

Technological Innovation in Increasing Sport Access and Participation for People with Disabilities and Inactivity-A Report on 1st Conference USCI (University Sport Consortium International)_November 5-6, 2024

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The conference's final report, including a short report of all articles, is downloadable. The conference was held at Universitas Negeri Padang in Indonesia with the executive participation of four universities from three countries (Indonesia, Malaysia, and the Philippines) under a formation named "University Sport Consortium International (USCI)."

This conference's scope was multidisciplinary in sports sciences and physical education, with a notable aspect of "Technological Innovation in Increasing Sport Access and Participation for People with Disabilities and Inactivity."

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"Technological Innovation in Increasing Sports Access and Participation for People with Disabilities and Inactive"



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Sports Participation Questionnaire for Senior High School Students

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ABSTRACT

Background. Understanding the factors that influence students' sports participation is crucial, and one effective way to collect this data is through questionnaires. **Methods.** This study consisted of four phases: the preparation stage and translation process, validation procedures, and field trials. Seven experts provided assessments based on three components: material, clarity, and feasibility. The trial was conducted using the test-retest method, involving 55 samples involved in 12 types of sports. The average age of the participants was 15 years 7 months, consisting of 19 women and 36 men. **Results.** The results showed that the expert assessment quantitatively produced a value of $r = 0.95$, included in the high category. All items had a calculated r value $> r$ table (0.266) for item validity, meaning all items were declared valid. The test-retest shows an intraclass correlation value of 0.957, which means this sports participation instrument is reliable. **Conclusion:** This study implies that this instrument can effectively measure student participation in sports in school environments and similar studies. This is important for policymakers, educators, and researchers in formulating appropriate interventions to increase student participation in sports activities, ultimately improving their health and well-being.

KEYWORDS: *Sport Participation, Instrument, Student, Validity, Reliability*

INTRODUCTION

Sports participation among high school students is vital for their physical, mental, and social development, providing health benefits, character building, discipline, cooperation, and leadership skills (1)(2)(3)(4). Understanding the factors influencing sports participation is essential, often achieved through questionnaires. These questionnaires measure students' involvement in sports, both in and out of school, with high validity and reliability to ensure accurate assessment. For instance, Yukhymenko-Lescroart's Academic and Athletic Identity Scale (AAIS) demonstrated robust factorial validity, proving reliable across genders and sports participation levels (5). At the same time, Barquero-Ruiz's Tactical Assessment Instrument validated players' tactical skills in football (6).

Validation and consistency are crucial; questions must be relevant and internally consistent to produce stable results (7). As Olayinka demonstrated, this process involves expert reviews and pilot testing (8), refining the instrument with feedback before finalization (9). This study aims to validate a sports participation questionnaire for high school students by testing content, construct, and empirical validity and ensuring

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consistency through statistical methods. Reliable validation of this tool will support future research in sports and physical education.

MATERIALS AND METHODS

The preparatory phase involves defining the questionnaire's main objective, identifying relevant variables, and determining measurement methods. In the development phase, questions are created to align with these variables, ensuring respondents' clarity, relevance, and appropriate length. Next, expert validation is conducted, where experts evaluate the material, clarity, and feasibility on a 1-5 scale. The pilot study performs content validation, construction, and reliability tests (Cronbach's Alpha, Test-Retest) with 55 students from State Senior High School No. 3 Bukittinggi, aged around 15 years). The UiTM Research Ethics Committee has approved all procedures related to Research Ethics to operate by ICH Good Clinical Practice Guidelines, Malaysian Good Clinical Practice Guidelines, and the Declaration of Helsinki with approval number REC/10/2024 (PG/MR/538). Figure 2. shows the participants' tendency to participate in sports activities with the following types of sports selected. Figure 1 shows the four stages of research: the preparation stage, development, validation, and testing.

RESULTS

Development Phase. Sub-variable items were determined (Individual Participation, Sports Infrastructure, Socio-cultural, Institutional), and question items were created. In addition, at this stage, the scale used is also determined, namely the Likert scale 1 to 7, where 1 = Strongly Disagree, 2 = Disagree, 3 = Somewhat Disagree, 4 = Neutral, 5 = Somewhat Agree, 6 = Agree, and 7 = Strongly Agree.

Expert Validation. The questionnaire was also translated from Indonesian to English to facilitate its validation by experts who were not professionals in Indonesian. The instruments were assessed by material experts, who consist of several experts with experience in the field. Expert validation is shown in Table 1.

Pilot Study. Table 2 shows that all data from the first test (test) and the second test (retest) have a calculated r value greater than the r table (0.266).

Next, the average of each instrument was sought from the first data (test) and the second data (retest). The data was then processed using IBM SPSS 27. The following data were obtained: The Sports Participation Instrument has a reliability value 0.957. According to Cohen, a reliability value greater than 0.85 is the highest value of an instrument's reliability (10).

DISCUSSION

The study's findings reveal high validity and reliability for the sports participation questionnaire, evidenced by an intraclass correlation of 0.957, exceeding the standard of 0.85 (10)(11). This reflects a robust instrument development process supported by theories of item validity and test-retest reliability. Item validity ensures each questionnaire item accurately measures the targeted constructs, with expert validation playing a key role, as demonstrated in Nor et al.'s work on nutritional knowledge for athletes (12) and Ozene et al. validation of the Sports Nutrition Knowledge Questionnaire (13). Test-retest reliability, tested by administering the questionnaire at different times, confirms consistent results, as seen in the Recreational Sport Well-Being Scale (14) and other validated tools like the Malaysian Sports Culture Index (15).

Statistical measures, such as Cronbach's alpha and the intraclass correlation coefficient (ICC), quantitatively validate these instruments' reliability and internal consistency. The study aligns with prior research, reinforcing that expert validation and statistical analyses are essential to developing reliable sports and health questionnaires. High validity ensures accurate construct measurement, while strong test-retest reliability affirms consistent results, which is critical for longitudinal studies.

The study's outcomes emphasize the practical value of reliable sports and health research instruments. Such tools allow for accurate data collection on participation, infrastructure perception, and socio-cultural factors, enabling participants to share experiences reliably. Future research could enhance the questionnaire's applicability to diverse populations, refine its design by integrating new trends in exercise science and technology, and conduct extended longitudinal studies to test its stability further. These advancements will deepen the instrument's relevance and adaptability in sports and health research, supporting precise and reliable data collection.

CONCLUSIONS

The conclusion of this study shows that the instruments developed have high validity and reliability. This indicates that the instrument development process has undergone reasonable procedures, resulting in a reliable measurement tool for research in sports and health. The findings imply that the instrument can be widely used in

research environments, significantly contributing to collecting accurate and consistent data for policymakers, educators, and researchers.

APPLICABLE REMARKS

- Valid and Reliable Instrument: With an expert assessment correlation value of $r = 0.95$ and an intraclass correlation of 0.957 in the test-retest, this instrument is valid and reliable for measuring student sports participation.
- Relevant for Policy Intervention: This instrument can be used by educators, policymakers, and researchers to understand the factors influencing student sports participation. This knowledge enables them to design targeted interventions that enhance student involvement in physical activities, ultimately benefiting their health and well-being.

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AUTHORS' CONTRIBUTIONS

Study concept and design: Endang Sepdanius. Acquisition of data: Nurul Diyana Binti Sanuddin. Analysis and interpretation of data: M. Adli Bin Mohd Sidi. Drafting the manuscript: Rini Afriani. Critical revision of the manuscript is needed for important intellectual matters. content: Bekir Erhan Orhan. Statistical analysis: Endang Sepdanius. Administrative, technical, and material support: Endang Sepdanius. Study supervision: Mohd Salleh Bin Aman.

CONFLICT OF INTEREST

The authors mention no "Conflict of Interest" in this study.

ETHICAL CONSIDERATION

The UiTM Research Ethics Committee has approved all Research Ethics procedures to operate according to the ICH Good Clinical Practice Guidelines, Malaysian Good Clinical Practice Guidelines, and the Declaration of Helsinki, with approval number REC/10/2024 (PG/MR/538).

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ARTIFICIAL INTELLIGENCE (AI) USE

There was NO use of artificial intelligence (AI) for preparation, writing, or editing this paper.

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Figure 1. Sports Participation Instrument Development Process

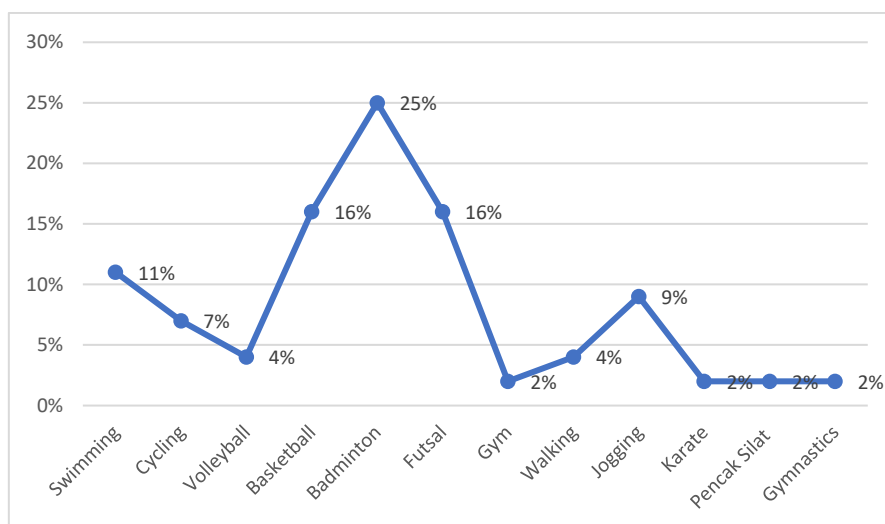


Figure 2. Percentage of students by preferred sport

Table 1. Expert assessment of sports participation instruments

Item	Expert 12	Expert 4	Expert 13	Expert 11	Expert 1	Expert 2	Expert 3
X1	5	5	5	5	5	5	4
X2	4	5	5	4	5	5	4
X3	5	5	5	5	5	5	4
X4	5	5	5	4	5	5	4
X5	5	5	5	4	5	5	4
X6	4	5	5	4	5	5	4
X7	5	5	5	5	5	5	4
X8	5	5	5	4	5	5	4
X9	5	5	5	4	5	5	4
Amount	43	45	45	39	45	45	36
r value	0.96	1.00	1.00	0.87	1.00	1.00	0.80

Overall Value $r = 0.95$

Table 2. Validity Items for the Sports Participation Instrument

Sub Variable	Item	Pearson Correlation (Test)	Pearson Correlation (reTest)	r table	Criteria
Individual Participation	I participate in sports activities at least three times a week.	0.782	0.785	0.266	Valid
	I spend at least 30 minutes every time	0.660	0.841	0.266	Valid
	I consistently do this sport every week	0.593	0.639	0.266	Valid
	I still exercise, whether in a group or individually	0.633	0.771	0.266	Valid
	With my exercise, I feel my physical fitness is improving.	0.616	0.796	0.266	Valid
Sports Infrastructure	The infrastructure related to sports in my area is very supportive.	0.695	0.760	0.266	Valid
	The open space surrounding me allows me to do sports.	0.580	0.748	0.266	Valid
	My place's infrastructure and open spaces related to sports are well managed.	0.733	0.775	0.266	Valid
	It is very easy for me to access infrastructure and open spaces for exercise.	0.584	0.697	0.266	Valid
Socio-cultural	In the community, exercising is an important part of maintaining health.	0.505	0.624	0.266	Valid
	In the neighborhood where I am now, providing particular time to exercise	0.653	0.647	0.266	Valid
	I (female/male) do not feel isolated when participating in sports in my environment.	0.620	0.687	0.266	Valid
Institutional	My school has a budget for a program to increase sports participation.	0.464	0.507	0.266	Valid
	Having a program coordinator makes sports participation run well at my school	0.334	0.352	0.266	Valid
	Various innovative programs are provided in schools to increase sports participation.	0.632	0.626	0.266	Valid
	There is cross-sector support to increase participation in sports at my school	0.600	0.631	0.266	Valid

Development of Integration of Physical Activity and Nationalism Learning Through The Experiential Nationalism Orientation Teaching (ENOT) Program

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ABSTRACT

Background: The fading sense of nationalism is a critical issue globally. Globalization's negative impact, identity crises, lack of educational innovation, and insufficient early nationalism instillation contribute to this decline among youth. This study aims to develop and validate the Experiential Nationalism Orientation Teaching (ENOT) program through games for children aged 5-9 to instill nationalist values and enhance motor skills. **Methods:** Involving 140 students, this study used the ADDIE model for development. Item validity was assessed with Aiken's V in Excel and reliability with SPSS 20. **Results:** The ENOT program includes 10 games focusing on cooperation, resilience, and national symbols. The small-scale test yielded an Aiken V score of 0.73, improved to 0.83 in a large-scale test, indicating high validity and reliability. **Conclusion:** The ENOT program effectively instills nationalism in children, blending engaging physical activities with nationalist values making learning active and impactful.

KEYWORDS: *Children, Instilling Nationalist Values*

INTRODUCTION

In globalization, fading nationalism has become a significant concern in various countries (1,2), including Indonesia. Globalization, with all its benefits, also brings negative impacts that can weaken the national identity of a nation (3). The penetration of foreign culture that is increasingly accessible to the younger generation can influence their perspective on national values. The younger generation tends to be more exposed to values that are more universal or foreign (4,5) (6,7), so the identity and love of the homeland are increasingly fading. This condition is exacerbated by the lack of innovation in nationalism education and limited efforts to instill national values from an early age.

The decline in nationalistic values, especially in children and teenagers, can impact national and state awareness in the future (8). Various studies show that instilling nationalistic values from an early age can help form a strong personality foundation (9,10), love of the homeland (11), and high social awareness (12,13). However, the traditional approach to nationalism education is often considered less interesting and ineffective for children. An approach that is too theoretical or based on memorization makes it difficult to motivate children to understand and deeply internalize nationalist values.

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This study aims to develop and validate the Experiential Nationalism Orientation Teaching (ENOT) learning program through physical activity games aimed at children aged 5-9. This program is expected to not only instill nationalism values but also encourage the development of children's motor skills in a fun and meaningful way. Using the ADDIE development approach, which includes five stages, this program was tested on groups of students with validity and reliability measurements through the Aiken V test and SPSS analysis.

MATERIALS AND METHODS

This type of research is research and development by adapting the ADDIE method, which consists of 5 stages: Analysis, Design, Implementation, Evaluation, assessment of the design, and test results carried out by nine experts. One hundred forty children in Indonesia took part in this research with age criteria of 5-9 years. The nine experts who validated the program consisted of 3 children's movement learning academics, three practitioners, and three character educators. The research procedure consists of testing the program's validity and reliability. Experts assess by filling out an evaluation form of 20 question items with four indicators.

RESULTS

The product developed in this study is the Experiential Nationalism Orientation Teaching (ENOT) learning program, designed as a series of physical games to instill nationalism values in children aged 5-9. It is written in a book. The ENOT program consists of 10 games, each designed to combine physical activity with educational elements of nationalism. Each game contains national values such as cooperation, an unyielding spirit, knowledge of the national anthem, and understanding of state symbols. This program also aims to improve children's basic motor skills through fun and interactive physical activities.

The games in the ENOT program have been designed to consider the physical and cognitive development of early childhood. These games are accompanied by instructions that are easy for teachers and students to understand and are equipped with supporting media to clarify children's understanding of nationalism. By involving basic motor activities such as running, jumping, and catching, this program is designed so that children can be active and enthusiastic in learning so that the values of nationalism are more easily embedded naturally in them.

Validity Analysis. Nine experts assessed the content validity of the ENOT program using Aiken V to measure the level of conformity between the evaluation items and the objectives of nationalism learning. The validity test was conducted in two stages: a small-scale test and a large-scale test, with each Aiken V value listed in Table 1.

Internal validity was conducted by involving 140 participants from kindergarten students, resulting in an average correlation value of 0.83. More complete details regarding Aiken's V Score Criteria and Categories can be seen in Table 2.

There were two product revisions before and after the program was tested in the field. Product improvements are based on expert validation advice. The reliability of the ENOT program was analyzed using SPSS version 20 software. The calculation results showed a Cronbach's Alpha score of 1,000, which means this instrument is reliable. In addition, this study also involved an assessment of students' responses to the ENOT program. This assessment aims to determine students' responses to program development. Seven questions are asked through interviews because students in kindergarten cannot read yet. The seven statements cover students' feelings and responses to the ENOT program. More complete details can be seen in Table 3.

DISCUSSION

The study results indicate that the Experiential Nationalism Orientation Teaching (ENOT) game-based program is valid for instilling nationalism values in children aged 5-9. The Aiken V test showed a value of 0.73 at the small-scale test stage, which increased to 0.83 after revision, indicating that this program is effective and can be implemented well.

The ENOT program supports a play-based approach to early childhood education, which effectively engages children and improves motor skills, such as running and jumping. The interactive activities in the program also teach values such as teamwork, courage, and pride in national identity (14,15).

This program has the potential to be integrated into the early childhood education curriculum, creating a fun and meaningful learning experience. This study suggests innovative developments in nationalism education through interactive methods, focusing on physical games that can improve children's social and motor skills. Further research is needed to explore the long-term effects of this program on children's nationalism attitudes and its application in various social contexts.

CONCLUSION

The Experiential Nationalism Orientation Teaching (ENOT) program has demonstrated strong validity and

reliability as an effective tool for instilling nationalism values in children aged 5-9 through interactive games. The high Aiken V values (0.73 in small-scale and 0.83 in large-scale tests) and Cronbach's Alpha score of 1.0 confirm the program's robustness and reliability. Designed with physical activities like running, jumping, and team-oriented tasks, ENOT fosters an engaging learning environment that combines motor skill development with essential values such as cooperation, perseverance, and national pride. The program's success suggests its potential for integration into early childhood education curricula, providing a meaningful, enjoyable approach to nationalism education. Future research should investigate the long-term impacts of the ENOT program on children's attitudes toward nationalism and its adaptability across diverse social contexts. Future studies should explore its long-term impact and adaptability across diverse educational settings.

APPLICABLE REMARKS

- The Experiential Nationalism Orientation Teaching (ENOT) program provides an innovative approach to instilling nationalism values in young children (ages 5-9) through physical activity-based games.
- The program's high validity (Aiken V = 0.83) and reliability (Cronbach's Alpha = 1.0) demonstrate its effectiveness in combining motor skill development with national values such as cooperation, perseverance, and national pride.
- This model offers a meaningful, engaging alternative to traditional nationalism education, making it suitable for integration into early childhood curricula.

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AUTHORS' CONTRIBUTIONS

Concept and design: Nuridin Widya Pranoto, Ahmad Chaeroni, Rayendra, Varhatun Fauziah, Joan Siswoyo. Acquisition of data: Alexandre Sibomana, Japhet Ndayisenga. Analysis and interpretation of data: Nuridin Widya Pranoto. Drafting the manuscript: Rayendra, Varhatun Fauziah. Critical revision of the manuscript for important intellectual content: Nuridin Widya Pranoto, Ahmad Chaeroni, Joan Siswoyo. Statistical analysis: Nuridin Widya Pranoto. Administrative, technical, and material support: Rayendra, Alexandre Sibomana Study supervision: Nuridin Widya Pranoto.

CONFLICT OF INTEREST

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ETHICAL CONSIDERATION

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Table 1. Aiken V Analysis

Expert (N)	Item	Σ Evaluation	$\bar{x}$ Assessment	Σs	$\bar{x} s$	V	Category	Scale
9	1-20	579	64.33	399	44.33	0.73	Currently	Small
9	1-20	630	70	450	50	0.83	Tall	Big

Table 2. Content Validity

Criteria	Score	Aiken's V Category
Security	0.83	Tall
Physical Ability Suitability	0.83	Tall
Cognitive Ability Match	0.81	Tall
Compliance with National Values	0.81	Tall

Table 3. Assessment of Student Response to the ENOT Program

No	Question	N	Number of Answers	Percentage (%)	SD
			Yes	No	Yes
1	Item 1	140	137	3	97.86%
2	Item 2	140	130	10	92.86%
3	Item 3	140	125	15	89.29%
4	Item 4	140	136	4	97.14%
5	Item 5	140	135	5	96.43%
6	Article 6	140	130	10	92.86%
7	Item 7	140	132	8	94.29%
$\bar{x}$		140	134.28	5.71	96%

Examining the Use of VR Media on Adolescent Motor Skills: A Literature Review

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ABSTRACT

Background. Adolescent motor skills are an important aspect of physical and mental development that affects various daily activities. **Objectives.** This study aims to review the existing literature on using VR media to improve adolescent motor skills. **Methods.** The method used in this study was a systematic literature review. Using academic databases such as PubMed, Google Scholar, and IEEE Xplore, as well as relevant keywords such as "Virtual Reality," "motor skills," and "adolescents," articles that met the inclusion criteria were selected. The study's population is a scientific article focusing on using VR for adolescent motor skills, with 10 articles selected as the primary sample based on their relevance and research methodology. **Results** of a literature review suggest that VR can significantly improve adolescent motor skills, with some studies showing improvements in hand-eye coordination, balance, and movement accuracy after intervention with VR. Although VR's potential in improving adolescent motor skills is enormous, challenges such as the high cost of devices, the need for adequate space, and potential health risks such as motion sickness need to be addressed. **Conclusion.** More research and investment in affordable VR devices are needed to maximize their benefits. With immersive and interactive environments, VR can motivate teens to become more physically active. However, further efforts are needed to optimize the implementation of this technology in the context of education and physical therapy. Thus, investment in further research on its long-term impact is strongly encouraged to ensure continued benefits for adolescent motor development.

KEYWORDS: *Motor, Media, VR, Adolescent*

INTRODUCTION

Motor skills are basic abilities that are very important for adolescents' physical and mental development (1–3). These skills include coordination, balance, and dexterity of motion abilities that affect various aspects of daily life, including sports activities, daily living skills, and social interaction. In adolescence, when there are many physical and psychological changes, the development of motor skills becomes increasingly crucial (4). However, many adolescents face challenges in developing their motor skills due to various factors, such as lack of physical activity, more sedentary lifestyle changes, and limited access to adequate sports facilities and play spaces.

Virtual Reality (VR) technology has grown rapidly in recent decades and is beginning to be adopted in various fields, including education, training, and health. VR offers an immersive experience that can simulate real and imaginative environments, giving users the sensation of being in a different world. In the context of motor skills, VR has great potential to provide the necessary stimulation for adolescent physical development through interactive and engaging games and exercises (5).

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Virtual Reality (VR) has shown effectiveness in improving motor skills in areas like physical therapy and athletic training, making it a promising tool for adolescent motor skill development. However, this application is still new, and further research is needed to understand its efficacy and potential challenges. Key obstacles, such as high device costs, space and equipment requirements, and health risks like motion sickness, need consideration. This study explores VR's potential to enhance adolescent motor skills and provides insights for developers, educators, and health practitioners on integrating VR as a supportive tool in motor development (6).

VR in adolescent motor skills holds substantial promise across education, health, and sports. VR has been effective in rehabilitation for those with motor impairments and shows potential for adolescents with special needs by offering a controlled environment tailored to improve coordination and engagement (7). While short-term benefits like improved balance and coordination are documented, more research is needed on long-term impacts. This study innovates by designing and evaluating VR programs specifically for adolescents, aiming to provide interactive and practical solutions for integrating VR into educational and therapeutic settings.

MATERIALS AND METHODS

This qualitative descriptive research is a literature study that analyzes various sources to strengthen insights on the application of blended learning in physical education and sports. It gathers, summarizes, and analyzes relevant literature using secondary data from scientific articles and journals with keywords like learning models, blended learning, and physical education. Selected articles are organized in a table by researcher, publication year, study design, objectives, samples, instruments, and findings.

RESULTS

Table 1 is a critical partial analysis of 5 journals.

DISCUSSION

From the results of a literature study of 10 articles reviewed and presented previously, several discussions are related to the continuous use of VR media in adolescent motor skills (13). The use of virtual reality (VR) to improve children's motor skills has shown promising and urgent results based on various studies. Analysis of the results showed that using VR significantly improved children's basic motor skills, including balance, hand-eye coordination, and agility, with children who practiced using VR showing faster improvement than traditional methods. VR provides an interactive and immersive environment that increases a child's motivation and active participation, making physical exercise more engaging and enjoyable. This is especially important for children less interested in traditional physical activities or those with special needs, as VR can provide a safe and controlled environment. However, some risks, such as motion sickness and eyestrain, must be considered and minimized by developing appropriate usage protocols (14).

Virtual Reality (VR) has shown promise in enhancing children's motor skills, offering an immersive environment that improves balance, hand-eye coordination, and agility while boosting motivation for physical activity. Short-term studies highlight rapid skill improvements compared to traditional methods, positioning VR as a potentially effective tool for motor development. However, challenges like high costs, the need for adequate space, and health risks such as motion sickness hinder its widespread adoption in educational and physical therapy settings (15). Further research is necessary to develop more affordable, portable devices and to create training protocols for educators and therapists, ensuring safe and effective long-term use to maximize VR's potential.

CONCLUSION

The conclusion of this study unequivocally confirms that the use of Virtual Reality (VR) in the development of children's motor skills is an innovative and important step to improve their health and physical development. By providing an interactive, immersive, and engaging exercise environment, VR can significantly increase a child's motivation and active physical activity participation and improve basic motor skills such as balance, hand-eye coordination, and agility. Although challenges such as device costs and health risks need to be addressed, the positive potential of using VR in a child's physical education and physical therapy is enormous. Therefore, a robust conclusion from this study is that VR is a valuable additional tool and a necessity in holistically improving children's well-being and motor development.

APPLICABLE REMARKS

- Using virtual reality (VR) to develop children's motor skills is an innovative and important step in improving their health and physical development.

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AUTHORS' CONTRIBUTIONS

Concept and design of the study: Novia Nazirun. Data acquisition: Bafirman. Data analysis and interpretation: Wilda Welis. Compiled the script: Novia Nazirun. Critical revision of the manuscript for important intellectual content: Novia Nazirun. Statistical analysis: Deswandi. Administrative, technical, and material support: Wilda Welis. Study supervisor: Bafirman, Wilda Welis.

CONFLICT OF INTEREST

The authors mention no "Conflict of Interest" in this study.

ETHICAL CONSIDERATION

This research has met the standards of research ethics and has received approval to be a sample of all respondents.

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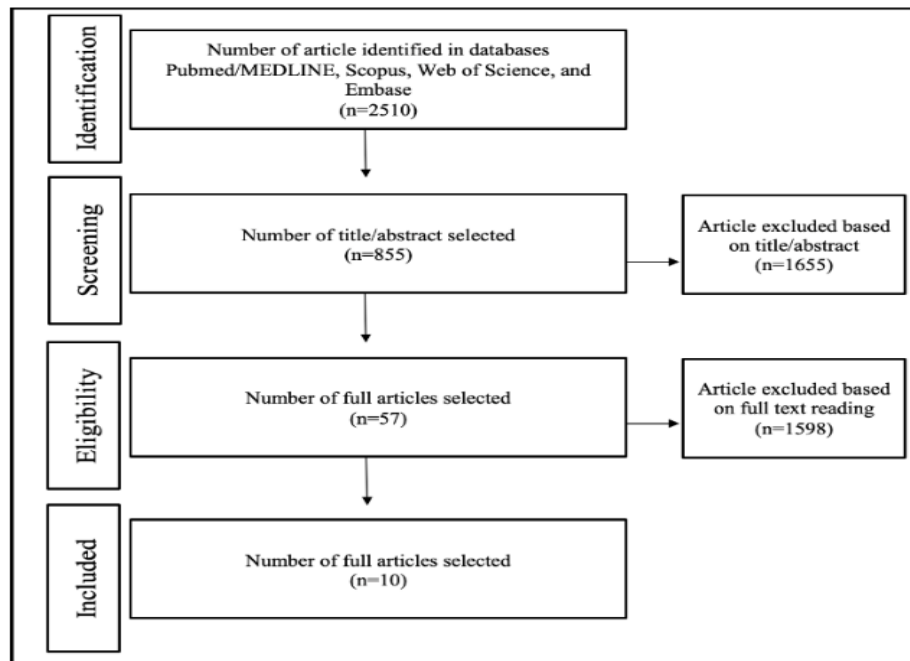


Figure 1. PRISMA flowchart of the article selection process

Table 1. Literature Review Summary of Results

Researcher	Article title	Research results
(8)	Effects of a multi-component virtual reality program on motor skills and functional postural control in children with hemiplegic cerebral palsy	This study provided early evidence of the effectiveness of the multi-component VR-based program in children with HCP. However, future studies with randomized controlled trial design must evaluate the long-term effects and compare them with conventional rehabilitation practice.
(9)	The effect of a virtual reality exergame on motor skills and physical activity levels of children with a developmental disability	Outcomes and results: Children in the experimental group significantly increased locomotor skills. Ball skills also increased but did not have significant differences. For PA levels, neither group showed a significant increase after the intervention. Conclusions and implications: A VR-based PA program effectively improved locomotor skills among children with DD. To significantly change the ball skills and PA levels of children with DD, a VR-based PA program mixed with a reality-based PA program is probably necessary.
(10)	Chapter 11: Fine motor skills and cognitive development using virtual reality-based games in children	The developed platform is cost-effective, remotely accessible, personalized, and physically less painful. The proposed virtual reality game and traditional rehabilitation methods can also be an auxiliary tool.
(11)	Individual differences in children's movement variability in a virtual reality playground task	The study found significant correlations in variability measures of upper and lower extremity movements, revealing four distinct movement variability profiles, highlighting the effectiveness of whole-body motion capture in assessing individual differences in children's gross motor competence.
(12)	Effects of virtual reality training intervention on predictive motor control of children with DCD – A randomized controlled trial	The VR intervention using Xbox 360 Kinect games over 8 weeks significantly improved motor imagery, motor planning, and control skills in children with DCD, suggesting its effectiveness in enhancing predictive motor control functions.

VR Media Is Key to Improving Fine Movement in Early Childhood: A Literature Review

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ABSTRACT

Background. This study reviewed the literature on using Virtual Reality (VR) to improve fine movement skills in early childhood. The problem identified was a challenge in developing fine movement skills, which are important for daily activities and early education. **Objectives.** This study aimed to evaluate the effectiveness of VR media in improving fine movement skills in early childhood. **Methods.** The method used involves searching and analyzing published empirical studies on the use of VR in early childhood education, focusing on the development of fine movement skills. Searches were conducted through academic databases such as PubMed, Google Scholar, and IEEE Xplore with the keywords "Virtual Reality," "fine motor skills," and "early childhood." The population and sample in the studies analyzed included early childhood children in formal education programs such as kindergartens and playgroups. The instruments used vary, including standardized tests of fine motor skills, direct observation, and VR software applications for motor skills practice. **Results.** It is shown that VR significantly improves fine movement skills in early childhood. The studies analyzed reported significant improvements in hand-eye coordination, manipulative skills, and movement precision after VR intervention. Some studies have also shown that VR can motivate children to practice motor skills more actively than traditional methods. **Conclusions.** VR is an effective and innovative tool to support the development of fine movement skills in early childhood. more research is needed to overcome limitations such as small sample sizes and diverse intervention durations. The implementation of VR in early childhood education curricula must be accompanied by clear guidelines and training for educators to maximize the benefits of this technology.

KEYWORDS: *Virtual Reality, Movement Skills, Early Childhood, Education*

INTRODUCTION

The advancement of technology, particularly Virtual Reality (VR), is transforming early childhood education by offering immersive, simulated environments that can enhance fine motor skills (1–3). Fine motor skills, involving precise hand-finger coordination are essential for daily tasks like writing and buttoning clothes. Their development in early childhood is crucial as it relates to readiness for formal education and the ability to perform everyday activities

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independently. However, many children face obstacles in developing these skills due to inadequate stimulation or developmental challenges, highlighting the need for innovative, supportive learning tools.

VR provides a potential solution by enabling children to practice fine motor tasks in a safe, engaging, and controlled environment. Through realistic simulations of daily activities, VR can be adapted to individual children's needs, providing them with tailored practice that fosters skill development in a fun and motivating way. VR applications allow children to engage in tasks like grasping and rotating objects, offering real-time feedback that refines their coordination and precision. This personalized approach supports children in overcoming challenges and mastering fine motor skills through repeated, adjustable exercises that reduce stress and enhance learning engagement (4,5).

Research supports the effectiveness of VR in improving fine motor skills and increasing motivation, showing that VR offers more practice opportunities than traditional methods. Studies reveal significant improvements in children's motor skills through VR-based educational games and exercises compared to conventional approaches. As VR grows in early childhood education, further research and development of practical guides for educators will help integrate this promising technology into curricula, maximizing its benefits for young learners.

MATERIALS AND METHODS

This qualitative descriptive research uses a literature study to analyze secondary data on blended learning in physical education. Data collection involves reviewing accredited scientific articles from sources like Mendeley, Google Scholar, and ScienceDirect with keywords such as Virtual Reality, fine motor skills, and early childhood education. Relevant articles are summarized by author, publication year, objectives, and findings and are analyzed to draw conclusions and provide recommendations.

RESULTS

This literature review was conducted to determine Diving into the Virtual World: How VR Media Is Key to Improving Fine Motion in Early Childhood. Compared to simple measurement results, the collected literature was analyzed with critical appraisal tables to answer the measurement objectives. As many as 10 literatures discuss Diving into the Virtual World: How VR Media Is Key to Improving Fine Motion in Early Childhood. All of these journals are journals that are international journals that are searched on the Google Scholar portal, Mendeley, science direct.com by typing the keywords "Virtual Reality, fine movement skills, early childhood, education, literature review," which is then analyzed using critical appraisal analysis to analyze from the core of the journal, as well as the results or findings of these journals. Table 1 is a critical partial analysis of 5 journals.

DISCUSSION

The literature review of ten studies reveals that using Virtual Reality (VR) significantly benefits the development of fine motor skills in early childhood. VR enhances children's hand-eye coordination, movement precision, and manipulative skills by offering an immersive, interactive environment that encourages active participation. VR applications with adjustable difficulty levels allow children to practice skills in a structured, enjoyable way, surpassing traditional methods. Moreover, VR increases children's engagement and motivation, as they practice more frequently and enthusiastically than conventional motor exercises, highlighting VR's psychological and physical advantages (11,12).

However, challenges such as device costs, educator training needs, and limited long-term research present obstacles to widespread VR implementation. Some studies report significant improvements, yet small sample sizes and varied intervention durations limit the generalizability of these findings. Additional large-scale research is recommended to validate these results and create practical guidelines for VR integration in early childhood education. Despite these challenges, the findings suggest that VR is a promising tool that, with appropriate support, can transform motor skills learning, making it more adaptive and engaging for young learners (13).

CONCLUSION

This study unequivocally concludes that Virtual Reality (VR) media is a very effective and innovative tool for improving fine movement skills in early childhood. An in-depth analysis of various empirical studies found that VR improves children's hand-eye coordination, movement precision, and manipulative skills and motivates them to practice more intensively and consistently compared to conventional methods. VR's excellence in creating interactive learning environments and adaptability to individual needs make it important in developing fine motor skills. Despite implementation challenges, such as the cost and need for educator training, the benefits generated by VR in this context are significant. Therefore, VR deserves to be considered an integral component in the early childhood education curriculum to optimize the development of fine motor skills.

APPLICABLE REMARKS

- Virtual Reality (VR) has proven effective in enhancing early childhood fine motor skills, particularly hand-eye coordination, manipulative abilities, and movement precision.
- VR can serve as a motivating tool, encouraging children to engage more actively in motor skill practice than traditional approaches.
- Successful integration of VR into early childhood curricula requires well-defined guidelines and educator training to optimize its benefits for young learners.

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AUTHORS' CONTRIBUTIONS

Study concept and design: Hafizah Delyana, Deswandi. Acquisition of data: Ramadoni. Analysis and interpretation of data: Sumarsih Anwar. Drafting the manuscript: Fiky Zarya. Critical manuscript revision for important intellectual content: Villia Anggraini, Happy Fitria, Elma. Statistical analysis: Damardjati Kun Marjanto. Administrative, technical, and material support: Melisa, Neneng Habibah, Nurmaines Adhyka. Study supervision: Haryani, Wakhid Kozin.

CONFLICT OF INTEREST

The authors mention no "Conflict of Interest" in this study.

ETHICAL CONSIDERATION

This review adheres to ethical standards by including only studies that were ethically approved and publicly accessible. All information from previously published research adhered to relevant ethical guidelines was synthesized.

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There was NO use of artificial intelligence (AI) for preparation, writing, or editing this manuscript.

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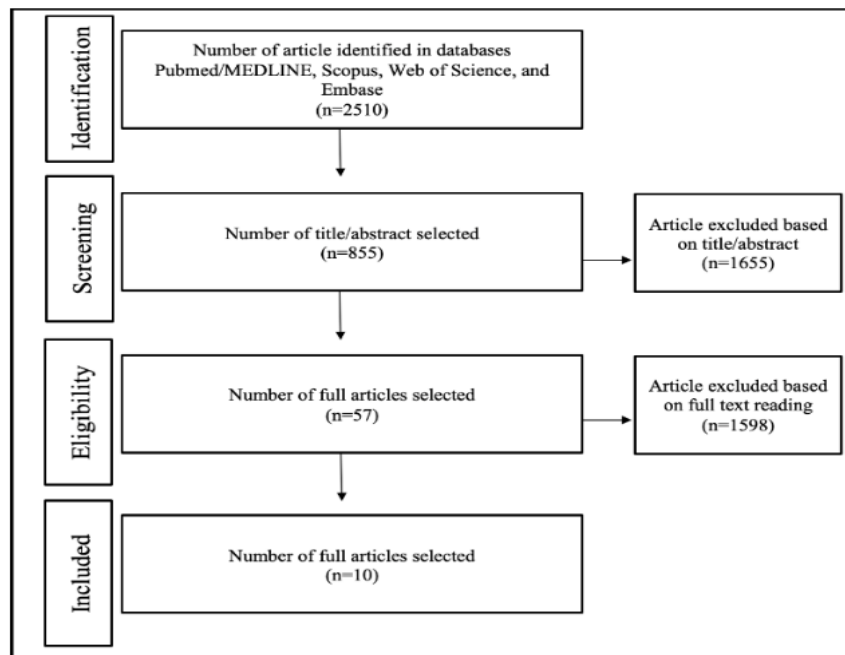


Figure 1. PRISMA flowchart of the article selection process

Table 1. Literature Review Summary of Results

Researcher	Article title	Research results
(6)	Performance of virtual reality game-based automated perimetry in patients with childhood glaucoma	VRF is comparable to the gold standard HVF in identifying and quantifying visual field deficits in pediatric glaucoma patients and may offer a valuable supplement or alternative to standard automated perimetry.
(7)	Virtual pets' cuteness matters: A shared reality paradigm for promoting internet helping behavior	The results show that virtual pet cuteness has a significant favorable influence on individual internet-helping behavior; parasocial interaction and generalized shared reality have a sequence mediation effect on the relationship between virtual pet cuteness and internet-helping behavior; and independent self-construal moderates the relationship between virtual pet cuteness and internet helping behavior. Accordingly, this study's results provide helpful implications for using virtual pets to enhance online mutual assistance.
(8)	Associations between psychological distress, early adverse experiences, and choice of avatars in an immersive virtual world	Avatar choice in virtual environments may reflect users' psychological distress and trauma history, suggesting the potential for these environments to treat past adverse experiences.
(9)	Exploring the relationship between attributional style measured in virtual reality and bullying among children at familial high risk of schizophrenia or bipolar disorder compared with controls	Children of parents with schizophrenia reported higher instances of bullying, a finding supported by caregivers and teachers and not explained by attributional style, suggesting the increased bullying is genuine.
(10)	Knowing versus doing: Children's Social Conceptions of and behaviors toward virtual reality agents	Children's varied emotional and social responses to VR agents suggest that agent type influences their perceptions and behaviors, informing future intervention designs.

Development of Beep Test Based on Sensor and Internet of Things

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ABSTRACT

Background. Many errors in calculations make it less accurate and effective in making measurements.

Objectives. This study aims to develop a beep test measuring instrument based on sensors and the Internet of Things, which is expected to provide more accurate beep test measurement effectiveness and practicality.

Methods. This research is in the form of research and development (R&D), which develops and produces products and tests the product's effectiveness. Electrical, physical condition, and measurement test experts validate the beep test product. After the validation and valid sampling test was carried out, it was continued with testing on a small sample of 10 people and a large group test of 20 people. **Results.** of the study showed that the validity of the electrical expert was 98% with the category "Feasible," followed by the physical condition expert, 94% with the category "Feasible," and finally, the measurement test expert, 92% with the category "Feasible." Furthermore, a reliability test was carried out on a small group of 0.985 or "Very Strong" while it was 0.987 or "Very Strong" in a large group. **Conclusion.** Research and development is a step in reducing errors in calculations that make the development of the beep test a feasible and effective digital measurement in measurements.

KEYWORDS: *Beep Test, Vo2max, Technology, Sports, Infrared Sensor*

INTRODUCTION

Today's technology cannot be separated from humans; technology continues to develop with the advancement of knowledge (1). Technological advances have penetrated the field of sports, which aims to progress in the field of sports (2). The application of technology in sports cannot be denied because sports have now seen much progress in technology, with technology having entered the field of sports, which aims to be a measuring tool for sports ability or achievement (3). To achieve achievement in sports, winning requires physical, technical, tactical, and mental conditions, but achievement can also be supported by pleasant technological advances (4).

For monitoring, of course, the data must first be compared. Usually caused by the lack of physical condition ability testing tools, especially those based on technology (5). In sports, there are now emerging advances in products to be used as analysis tools to see the progress of children's abilities in achieving achievements (6). These products include treadmill measuring tools, gymnastics, and others (7). Running is one of the many exercises for endurance (8). Manual tests are still used in the beep test, written on paper. This often causes errors in calculating the scores obtained by runners. Therefore, developing a beep test measuring tool combined with technology is necessary to produce more effective and relevant test results.

The solution that researchers can use to solve this problem is to combine sensor technology to assess

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physical activity in the general population (9). The sensors that can be used are Arduino and infrared (IR) sensors connected to the Internet of Things (10). To answer this question, we will conduct a study on developing Arduino-based beep test measuring instruments and IR sensors on the Internet of Things.

MATERIALS AND METHODS

Study design. This research has a development nature that uses the Research and Development (R&D) model—involving several experts who are competent in their respective fields, such as electrical experts, physical condition experts, and measurement test experts, with the aim of the validation test stage, which helps find out the advantages and disadvantages of existing materials. Valid tests were carried out after the product was produced, followed by field tests.

Participant. Ten participants took part in this test in the small group and 20 people in the large group. The study participants were men aged 18-25 years.

Product Design. Product name: Technology-based test measuring instrument (Beep Test). Materials used: Arduino, Infrared sensors, internet of things (Figures 1 and 2).

Statistical Analysis. After the data is obtained, continue with testing using the correlation coefficient.

RESULTS

From the research that has been conducted, the following results were obtained:

1. Based on the observations of the three experts, it can be said that this Beep test tool can be used in the very good category with a value of 94.67%.
2. Based on the reliability test results, the sensor and IoT-based beep test tool can be said to be feasible to use (reliable) and consistent in data collection with a value of 0.986.

DISCUSSION

Based on the research results, it can be said that the results of the validity test by experts, electrical experts, physical condition experts, and measurement test experts stated that the beep test tool meets the requirements with a very good category and can be used in carrying out data collection under the measurement principle. The validity of a tool shows the truth and validity of the tool and determines whether it can be accepted by the wider community (11).

By developing a beep test measuring tool product, data collection can provide more accurate and practical results in the implementation of data collection. Previous studies have shown that the number of tennis strokes can be measured with valid and reliable sensor technology, and IR sensors can analyze high-precision athlete movements in real-time, which is capable of accurately (12).

When a sensor technology-based test tool is developed, it provides an opportunity to collect more efficient data to determine cardiorespiratory fitness information. The findings in this study are that the manufacture of sensor technology-based test tools can often be applied in everyday life, especially in athlete training patterns, which do not require skilled workers, special equipment, and high costs. Thus, the future cardiorespiratory fitness level can be measured by creating a sensor-based test tool.

CONCLUSION

The development of the beep test tool is a step in reducing errors in calculations and can produce Arduino-based beep test measurements. IR sensors can be used as a feasible and effective digital measurement media that is valid and reliable in producing calculation results. In the future, researchers can test other sports that can be combined with IR and IoT sensors. Further research with larger sample sizes and long-term follow-up is suggested to strengthen the evidence on the sustained benefits of Kegel exercises on maternal health and recovery. Future applications could extend to various sports, allowing for more precise monitoring of athletic performance and enabling widespread use in fitness centers, schools, and sports organizations.

APPLICABLE REMARKS

- This study demonstrates that Kegel exercises are an effective non-pharmacological intervention for reducing pain in laboring women and accelerating postpartum recovery, particularly in those experiencing perineal wounds.
- Given the positive results, Kegel exercises can be recommended as part of routine care for pregnant women, especially in managing postpartum pain and enhancing the recovery process.
- Healthcare providers, including midwives and obstetricians, should consider incorporating Kegel exercises into prenatal and postnatal care programs to offer a safe, cost-effective alternative to pain management.

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AUTHORS' CONTRIBUTIONS

Study concept and design: Heri Haryanto, Anton Komaini. Acquisition of data: Bafirman. Analysis and interpretation of data: Ahmad Chaeroni. Drafting the manuscript: Heru Andika. Critical revision of the manuscript for important intellectual content: Heru Andika.

CONFLICT OF INTEREST

The authors mention no "Conflict of Interest" in this study.

ETHICAL CONSIDERATION

This study adhered to ethical standards in research involving human participants. Informed consent was obtained from all participants before participating in the study, ensuring they were fully aware of the study's purpose and procedures. Participants were assured that their involvement was voluntary and that they had the right to withdraw at any time without consequence. Additionally, all personal data collected during the study were kept confidential and used solely for research. The study was conducted under relevant ethical guidelines and regulations, ensuring the well-being and safety of all participants throughout the research process.

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FINANCIAL DISCLOSURE

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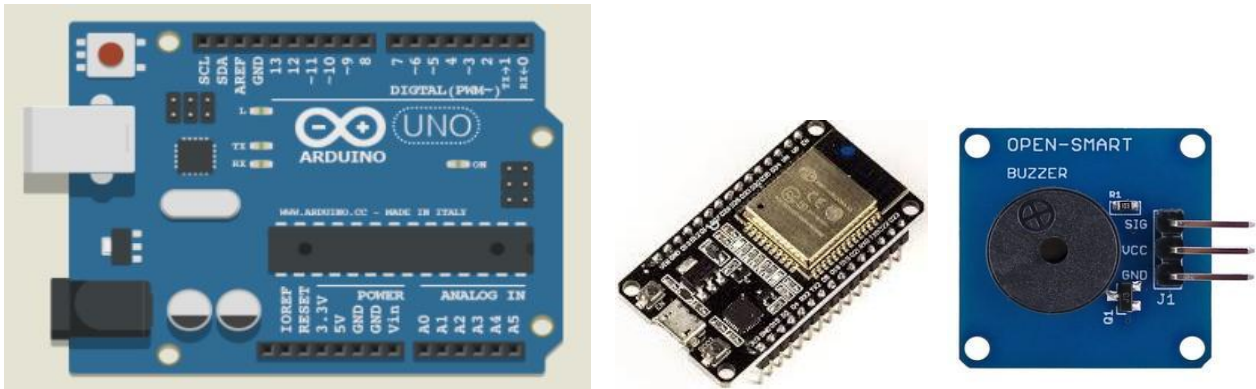


Figure 1. Beep test measuring equipment



Figure 2. Products Produce

Revolutionizing Anti-Doping Education: A Web-Based Model for Athlete Empowerment

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ABSTRACT

Background. The increasing use of doping among athletes is often attributed to a lack of knowledge regarding anti-doping regulations. Education is considered a key factor in promoting doping-free sports. While conventional education methods are effective, the rise of information and communication technology (ICT) presents an opportunity to reach a broader audience. In the Fourth Industrial Revolution context, ICT-based education offers a more accessible and scalable approach to anti-doping education. **Objectives.** This research aims to develop a web-based anti-doping education model to improve athletes' knowledge and awareness of anti-doping practices. **Methods.** This study follows the ADDIE development model (Analyze, Design, Develop, Implement, Evaluate) for designing and developing the anti-doping education model. The model was then subjected to validity and practicality testing. The validity was assessed using Aiken's V coefficient, while practicality was evaluated through surveys completed by educators and participants. **Results.** The web-based anti-doping education model demonstrated high validity with an Aiken V value of 0.84. The model also received positive feedback regarding its practicality, with educators rating it at 85% and participants at 87.9%. **Conclusion.** The Edu-ADBW model is a valid and practical web-based anti-doping education tool that can significantly enhance athletes' understanding of anti-doping principles. It is an effective solution for promoting doping-free sports, especially in Indonesia.

KEYWORDS: *Model, Education, Anti-doping, Athletes, Validity, Practicality*

INTRODUCTION

Doping is using prohibited substances or methods to improve sports performance (1). Doping is prohibited in sports because it harms athletes' health and career development. Doping can cause impaired function of vital organs such as the heart, liver, and kidneys and even death. However, the use of doping by athletes is continuously increasing every year. Education is a formal and non-formal learning process that aims to educate, provide knowledge, and develop individual potential, realizing an optimal learning process (2). Education is an essential form of education that significantly affects human life. With a sound system and quality, education ensures the achievement of its optimal goals, which is vital for individuals and dramatically impacts a nation's progress (3). Education aims to change the understanding of individuals, groups, and communities towards something so that they can do something independently and appropriately. There are three main goals in providing education, namely so that a person can: 1) Determine the problems and needs they want. 2) Understand what they can do about the problem and use existing resources. 3) Making the most appropriate decisions on the problem (4,5).

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So far, anti-doping education in Indonesia is still conventional through face-to-face, so not all athletes get anti-doping education, which causes low knowledge of athletes about doping. In Indonesia, although 73.75% of people have accessed the internet, the use of technology and information in the form of websites is still not widespread. This shows great potential for developing education through online platforms to reach more people. By increasing accessibility and relevant educational content, we can support learning and knowledge growth across the country, harnessing the great potential of this already high internet penetration to improve Indonesian people's quality of life and education. So this research and development aims to develop an anti-doping education model by utilizing technology as an educational website that can be done anywhere, and athletes who get anti-doping education can be more. Through this model, it is hoped that athletes' knowledge related to anti-doping can increase and that the use of doping in athletes can be prevented to realize the ideal of doping-free Indonesian sports.

MATERIAL AND METHODS

This research is a development research using the ADDIE development model. ADDIE is a development model applied to design learning by preparing a learning environment that can facilitate a complex learning environment by optimally engaging the learning environment by responding to many situations, interactions in context, and interactions between contexts (6). Validation instruments are also prepared to test the product in terms of content, language, and graphics. The website design can be seen in Figure 1.

The instrument in this study uses a web-based anti-doping education model assessment questionnaire. Before being used, the questionnaire was first validated by linguists, material experts, and evaluation experts. The model validation instrument has an Aiken's V value of 0.88.

Data Analysis. The validity test between assessors in this study was carried out using the V Aiken validity coefficient (7). Then, the product practicality test is analyzed by percentage (achievement score/maximum score*100). The classification for this assessment is presented in Table 1.

RESULTS

Design of Web-Based Anti-Doping Education Model (Edu-ADBW Model). Planning is carried out by identifying the needs of anti-doping education in athletes, determining educational materials, determining educational media and facilities, and determining educational methods. Implementing the web-based anti-doping model consists of syntax, social systems, reaction principles, and support systems. The syntax in the web-based anti-doping model is developed based on web-based learning syntax.

Model Validity. The validity test of the web-based anti-doping education model has assessment indicators, namely the structure and content of the model. The assessment results of the five validators can be presented in the table 2.

Model Practicality. One-to-one *testing* was conducted on four educational participants, each an athlete from weightlifting, powerlifting, athletics, and football. The one-to-one test was carried out by observing the participants one by one simultaneously using the web-based anti-doping model. The results of the one-to-one evaluation analysis can be seen in Table 3.

After conducting a one-to-one evaluation test, the researcher made revisions according to the comments given by the participants.

DISCUSSION

The use of doping is prohibited because, in addition to harming the career and future of an athlete, it also harms the athlete's own body (4,8). The research and development of the Edu-ADBW Model, although it contributes significantly to improving anti-doping knowledge in sports athletes, is inseparable from several limitations that need to be considered. First, the development of this model focuses on improving knowledge alone without involving aspects of anti-doping attitudes and behaviors in athletes, which is an important area to be developed in future research to achieve a more holistic impact. Second, as an educational model, Edu-ADBW requires infrastructure support from educators, participants, website media, laptop or smartphone devices, and a stable internet network. The reliance on all of these components limits model implementation's flexibility in situations with limited or no adequate access to technology (9). Third, the loss of respondents during the study became a standard limitation, where out of the 30 athletes who were initially registered, only 24 people managed to complete all stages of the study. Despite these limitations, the Edu-ADBW model still makes a valuable contribution to anti-doping education in athletes, but it needs to be considered for future research to expand its scope and minimize implementation barriers.

CONCLUSIONS

Based on the research conducted, it can be concluded that the web-based anti-doping education model (Edu-ADBW model) is an educational model carried out online using website media so that education can be carried out anywhere. The syntax in this education model consists of orientation, accessing the material, accessing and

doing exercises, and reflection. This education model is valid and practical based on the research conducted. From the results of this study, it can be recommended that national anti-doping organizations and sports organizations in Indonesia be able to provide anti-doping education to athletes online so that more athletes get the education and can reduce the number of athletes who use doping.

APPLICABLE REMARKS

- The web-based anti-doping education model (Edu-ADBW model) is an education model that is provided online through website media, allowing education to be carried out anywhere.
- In this educational model, orientation, material access, access, and reflection are syntax.

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AUTHORS CONTRIBUTIONS

Concept and design of the study: Rika Sepriani. Data acquisition: Pudia M. Indika. Data analysis and interpretation: Hansi Effendi. Compiled the script: Abdul Halim Mokhtar. Critical revision of the manuscript for important intellectual content: Nurul Ihsan and Hilmainur Syampurma. Statistical analysis: Hastria Effendi. Administrative, technical, and material support: Yovhandra Ockta. Study supervisor: Sepriadi.

CONFLICTS OF INTEREST

This research has no conflicts of interest.

ETHICAL CONSIDERATION

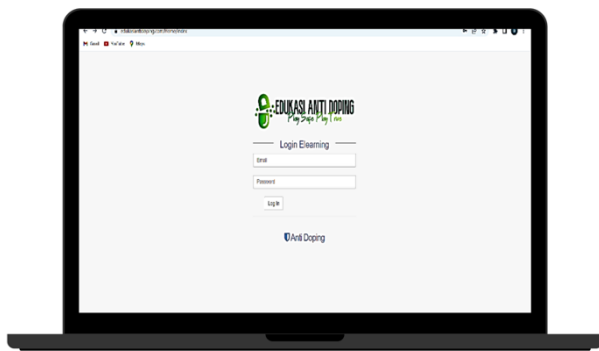
This research has met the standards of research ethics and has received approval to be a sample of all respondents.

ARTIFICIAL INTELLIGENCE (AI)

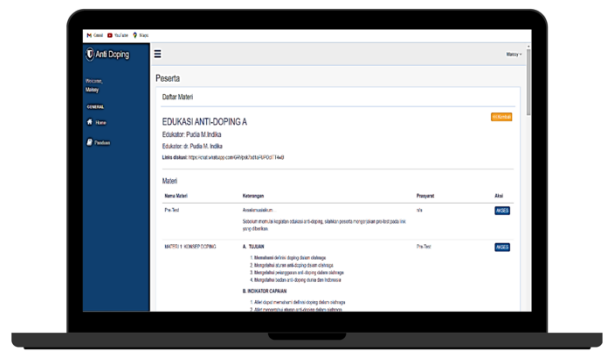
Use There was NO use of artificial intelligence (AI) for preparation, writing, or editing this manuscript.

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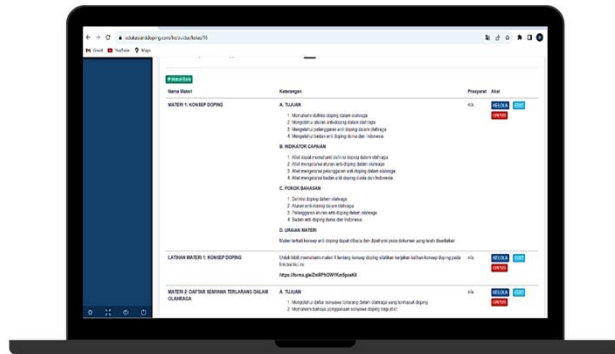
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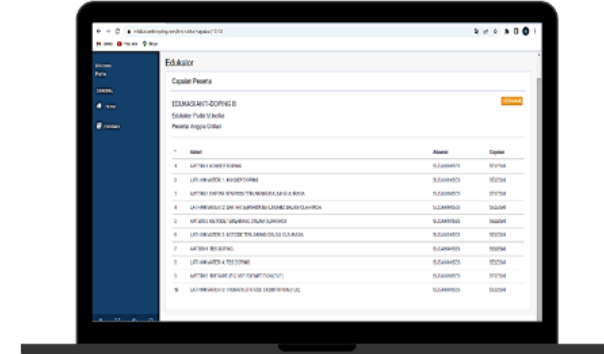
a) Cover Anti-Doping Education Educator Website Display



b) Anti-Doping Education Educator Website Display



c) Anti-Doping Education Educator Website Display



d) Achievements of Participants in Web-Based Anti-Doping Education

Figure 1. Anti-Doping Education Educator Website Design

Table 1. Classification for validation and practicality

Validity		Practicality	
Correlation	Description	Percentage (%)	Description
0,801-1,00	Very high validity	0 – 20	Not practicality
0,601 – 0,800	High validity	21 – 40	Less practicality
0,401 – 0,600	Moderate validity	41 – 60	Fairly practicality
0,201 – 0,400	Low validity	61 – 80	Practicality
0,001 – 0,200	Very low validity	81 -100	Very practicality
≤ 0,00	Not valid		

Table 2. Model Validity

Aspect	Mean	Aiken's V	Description
Model Content	4,52	0,85	Very high validity
Model Construct	4,3		
Mean	4,41		

Table 3. Practicality of One to One Evaluation test model

Aspect	Average	(%)	Description
Learning Objectives	4,5	90	Very practicality
Material	4,45	89	Very practicality
Method	4,55	91	Very practicality
Media	4,3	86	Very practicality
Time	4,5	90	Very practicality
Usefulness	4,58	92	Very practicality
Average	4,48	90	Very practicality

Grit and Character Building in Gymnastic: Mechanism of Psychology in Sport Activity

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ABSTRACT

Background. Floor gymnastics is an activity that enhances physical skills while serving as a tool for character development in students. Through this discipline, students have discipline, perseverance, teamwork, responsibility, and sportsmanship. Through this discipline, This study explores how floor gymnastics training can foster grit in students. **Objectives.** This research aims to understand how grit is developed through floor gymnastics and to provide a mechanism of psychology for sports activity. **Methods.** This qualitative study utilizes Grounded Theory, collecting data through semi-structured interviews, field observations, and document analysis with 20 teachers/coaches from extracurricular activities at the junior high school level in Padang City. Data was analyzed using NVivo 14 software. **Results.** The findings indicate that floor gymnastics improves physical skills and instills core values like discipline, teamwork, responsibility, and sportsmanship, contributing to students' overall character development. **Conclusion.** Floor gymnastics is an effective tool for integrating physical and moral education, supporting students' holistic development.

KEYWORDS: *Grit, Character, Floor Gymnastics, Psychology*

INTRODUCTION

Engaging in physical activity during physical education is essential for enhancing students' physical and psychological well-being. By implementing objective evaluations, we can better understand and support each student's growth and success in school (1). Extracurricular activities serve as a platform for enhancing student skills, which are integral to success in sports. Within athletics, grit—defined as passion and perseverance toward long-term objectives—is significantly related to fortitude and cognitive, affective, and behavioral variables (2). Students exhibiting high levels of grit tend to possess exceptional cognitive and emotional skills, setting them apart as resilient and successful learners.

Fostering student resilience through character development aims to enhance the caliber of individuals who possess both knowledge and strong ethical values (3). Character constitutes a fundamental element of every individual, reflecting a commitment to responsibility, discipline, diligence, and perseverance (4)(5). This research specifically examines the utilization of floor gymnastics exercises to develop grit among students. The objective of this study is to delineate the role of physical education in character development, with a particular emphasis on grit, and to analyze its implications for the comprehensive self-development of students.

MATERIALS AND METHOD

This study uses a qualitative method, which tends to reveal how the increase in grit in students' character is

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formed in floor gymnastics activities. There are several reasons why researchers use qualitative methods, including (1) adapting qualitative methods to be more accessible when dealing with various realities; (2) the qualitative method presents a direct relationship between the researcher and the respondent; (3) qualitative methods are more sensitive and more adaptive to various sharpening influences and value patterns encountered through the triangulation approach (6).

The selection of subjects in this study uses the purposive sampling method to determine the number of participants, which means that the sampling in this qualitative research is not purely random but deliberately chosen by individuals and tends to answer relevant questions in the research title (7). The researchers interviewed 20 extracurricular teachers and coaches to collect data. They analyzed the data using open, axial, and selective coding steps to find the main themes. The researchers also used NVivo 14, a program for analyzing qualitative data, to help with this process.

RESULTS

The research findings come from in-depth, semi-structured interviews. This method involves asking specific open-ended questions and recording detailed answers. The researcher aimed to provide example questions that prompted valuable insights for this study.

Question 1. How do coaches/teachers view floor gymnastics as a means to enhance student discipline?

"Floor gymnastics requires consistent practice and proper technique. Through repeated and consistent practice, students learn the importance of discipline in training and how this discipline impacts their ability to master correct movements. The complexity of floor gymnastics means that perseverance and discipline determine a student's skill level in executing these movements."

Question 2. What is the role of teachers in shaping students' character through floor gymnastics?

"Teachers and extracurricular coaches are role models and guides who demonstrate positive attitudes, such as hard work, patience, and sportsmanship. They also provide moral guidance and motivation, helping students understand the significance of these values in daily life."

Question 3. How do coaches/teachers believe floor gymnastics teaches teamwork?

"The cooperation among students is generally good, although they can sometimes lose interest when faced with particularly challenging movements."

Question 4. How do coaches/teachers think floor gymnastics can boost students' self-confidence?

"When students successfully master a floor gymnastics movement, they experience a sense of achievement and self-satisfaction. This helps enhance their self-confidence, especially when they can perform initially difficult movements"

Question 5. Why do coaches/teachers believe teaching sportsmanship through floor gymnastics is important?

"However, while students typically avoid negative behavior during evaluations, some may not complete the assigned movements as required by the teacher or coach."

Question 6. How do coaches/teachers view floor gymnastics as a means to develop perseverance and hard work in students?

"Interview results indicate that some students demonstrate hard work and persistence in learning gymnastics movements, while others may easily lose interest if the exercises do not progress effectively."

Question 7. How do coaches/teachers believe floor gymnastics can help instill a sense of responsibility in students?

"Research findings show that students generally exhibit a good level of responsibility towards their peers, indicating a commendable degree of care for their friends' safety."

In this study, the researcher combined observations with interviews. The researcher observed extracurricular activities and conducted interviews with teachers and coaches. The observations conducted during training sessions provided a comprehensive view of the research location to confirm the interview results.

DISCUSSION

Sports participation is hailed as one of the effective ways to nurture positive character among adolescents (8). This is under the results of research that show that in floor gymnastics, every student is responsible for the progress and safety of himself and his friends. Teachers can emphasize the importance of a sense of responsibility by giving individual and group tasks that must be completed with full awareness and commitment.

Creating a positive environment through floor gymnastics activities is one of the important points of the success of sports in fostering students' positive character (9,10). Social actions and behavioral patterns

influenced by the communication process in a team are one approach to improving teamwork (11). Sports activities strengthen friendships and cohesion between adolescents and students (12).

Gymnastics is one of the sports that plays an important role in improving students' overall well-being, including socialization and psychology (13), so the level of education of teachers or coaches is an important need in the field of gymnastics (14). The model of character values in sports activities consistently strengthens the behavior of young people/adolescents. Teaching what it means to treat opponents, officials, and teammates with respect is a fair and meaningful form of sportsmanship (15).

CONCLUSION

The implementation of character education in floor exercises teaches students physical skills and instills important values that support their character development. For instance, discipline and perseverance cultivated through regular practice enhance both technique and skills, helping students grasp the significance of diligence and hard work in achieving their goals. Additionally, teamwork is fostered through group activities, and the sense of responsibility developed through individual and group tasks strengthens students' social capabilities. The sportsmanship taught through competition and assessment in floor exercises also aids students in developing a character that can graciously accept both victories and defeats. Thus, floor exercise is an effective tool for integrating physical and moral learning, which is crucial for the holistic development of students.

APPLICABLE REMARKS

- This study emphasizes integrating character education with physical training, mainly through floor gymnastics.
- The findings reveal that floor gymnastics is an effective method for enhancing physical skills and a vital tool for cultivating essential character traits, including discipline, perseverance, teamwork, responsibility, and sportsmanship.

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AUTHORS' CONTRIBUTIONS

Yogi Setiawan conceptualized and designed the study, directed the research process, and coordinated the data collection and analysis. He held primary responsibility for drafting and revising the manuscript. Firunika Intan Cahyani contributed to the study design, assisted with data collection through interviews, and offered valuable insights during the data analysis phase. Additionally, she played an instrumental role in the writing and revision of the manuscript and assisted with data collection, mainly through observations and the facilitation of interviews. Both authors engaged collaboratively in data analysis and reviewed and approved the final manuscript.

CONFLICT OF INTEREST

The authors mention no "Conflict of Interest" in this study.

ETHICAL CONSIDERATION

This study ensured ethical integrity by obtaining informed consent from all participants, guaranteeing their right to withdraw at any time. Participants' confidentiality and anonymity were maintained, and data was securely stored. The study adhered to ethical guidelines, ensuring respectful interaction with participants and approval from the relevant institutional review board.

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ROLE OF THE SPONSOR

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FINANCIAL DISCLOSURE

The authors have no financial interests related to the material in the manuscript.

ARTIFICIAL INTELLIGENCE (AI) USE

There was NO use of artificial intelligence (AI) for preparation, writing, or editing this manuscript.

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The Balance Between Fasting And Exercise In Ramadhan: How Does It Affect The Basal Pulse?

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ABSTRACT

Background. Fasting, training, and competition are particularly interesting to athletes who fast during Ramadhan. Physiologically, can he/she adapt while fasting and exercising? **Objectives.** This study aims to prove physiological adaptation as seen from pulse rate indicators. **Methods.** This study used an experimental method where the sample was given treatment. The sampling technique uses voluntary sampling to obtain a sample of 13 students. Pulse measurements were taken before bed and waking up on training and non-training days. Data were analyzed with the help of SPSS version 26. **Results.** These findings suggest a decrease in pulse rate after waking up compared to before bedtime. In the second group, the overall significance value was $p > 0.05$, indicating no significant difference between the groups, whether the exercise was given or not. In the third group, the overall significance value was also $p > 0.05$, meaning that there was no significant difference between men and women in terms of pulse rate before sleep, pulse rate when waking up, and changes in pulse rate. **Conclusion.** Fasting does not hinder the ability to perform exercise.

KEYWORDS: *Weight Training, Circuit Training, Ramadan Fasting, Pulse, Recovery*

INTRODUCTION

Fasting is done based on religion and culture (1). Based on a religious point of view regarding doing good and the obligations of religious demands and demands, as a culture, fasting is a series of activities within social groups (2). However, what happens when athletes fast and train? Several studies explain that when fasting conditions occur, higher fatigue in the afternoon (1) can result in hypoglycemia (3). Other research states that fasting positively correlates with fatigue and mood but has a non-positive correlation with sleepiness, exercise, and calorie intake (4). The results of this study prove that there are physiological losses in the form of fatigue and hypoglycemic events. Both of these things are detrimental to appearance. This study shows that fasting has a decreasing effect on physiological performance. The cause of decreased performance is none other than lifestyle changes. Sleep deprivation occurs, and fluids are complex to access. Both of these are the leading causes of changes in performance. Other studies show that the fighting power of athletes cannot be appeased. A study also revealed that exercise can maintain fitness (16–19). During fasting, athletes still train as usual, both weight training to increase strength and running (2). However, it has not been proven that fasting can increase or decrease fitness (5). These studies support the argument for contributing research evidence concerning fasting and exercise.

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MATERIALS AND METHODS

Participants. The subjects in this study were students who actively participated in fitness activities at the fitness center majoring in Sports Science at the University of Tanjungpura. The sampling technique uses voluntary sampling, where the sample voluntarily participates in the research. So, 13 students comprised a sample of 6 boys and seven girls, aged 19-20 years.

Research Design. This study uses an experimental method where the sample is given treatment. The treatment was carried out by providing weight training circuit training every other day—a maximum of 10 meetings (20 days fasting). Exercise is done 1.5 hours before breaking the fast. The pretest and post-test measurement instruments in this study on the application of the exercise can be seen in Table 1.

Statistical Analysis. In this research, data analysis was carried out to determine the basal pulse results after treatment. The data were analyzed by conducting a paired-sample differential test with the help of IBM SPSS 26 software.

RESULTS

The study comprised a sample of 13 sports students who underwent a series of 10 training sessions during the fasting month. The study recorded pulse measurements before and after waking on both training and non-training days. Additionally, the research was structured into three distinct groups: the first group analyzed the differences in pulse rate before sleep and upon waking; the second group examined the disparities between exercise and non-exercise conditions; and the third group explored variations in pulse rate between men and women undergoing exercise treatment.

Based on the data results, the difference in pulse rate in both exercise treatment and without treatment obtained mean values that are not very different or reach significant values. The results can be seen in Table 2.

Based on the data results, the mean values are not very different and do not reach significant values for both men and women. The results can be seen in Table 3.

DISCUSSION

This study delves into the correlation between fasting and physical exercise during Ramadhan and their influence on basal pulse rate. It underscores the importance of comprehending how the interplay between fasting and physical activity can impact cardiovascular health and basal pulse rate. The findings from the initial group of the study indicate a significant difference in pulse rate before and after waking up on exercise days, depending on the treatment administered. Physiologically, the body adapts to recuperate during periods of rest. However, excess fluid loss occurs during fasting and rigorous exercise, although exercising on the eve of breaking the fast seems to have minimal impact. Previous research has demonstrated that consuming Pocari and mineral water affects pulse rate following physical activity (6), as the heart's performance escalates during exercise (7). Fasting increases carbohydrate savings and increases body fat burning (9). During fasting, there is an increase in oxidative processes in the cells (8) and a decrease in blood sugar levels (10). Fasting impacts how to provide nutrition to athletes, including exercises that are shifted towards breaking the fast (10). During fasting, sleeping is a problem; generally, sleeping less than 6 hours is considered insufficient, and 7-9 hours is perfect (11). During fasting, the need for sleep is reduced. Lack of sleep will affect physical activity (28), psychological disorders occur (12), susceptibility to high blood pressure (13), concentration, drowsiness (14), and depression anxiety (15). Training and recovery are crucial; this process balances the training load given and efforts to prevent injury. Recovery is also understood as the ability to return to normal to do sports again. This dehydrated condition tends to increase the pulse. Further fatigue will occur, decreased agility, and an increase in heart rate so that this pulse. Trained athletes will experience a decreased pulse when they wake up, So this pulse is also an indicator of the level of athlete training.

CONCLUSION

The strategic selection of exercise timing and the consideration of suitable exercise types can mitigate adverse effects on the basal pulse. These conclusions offer valuable insights for those intending to uphold their physical fitness during fasting, laying the groundwork for a well-balanced approach that harmonizes physical activity and fasting to preserve heart health throughout Ramadhan.

APPLICABLE REMARKS

- Fasting and physical exercise during Ramadhan and their influence on basal pulse rate.
- It underscores the importance of comprehending how the interplay between fasting and physical activity can impact cardiovascular health and basal pulse rate.

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AUTHORS' CONTRIBUTIONS

Concept and design of the study: Muhammad Fakhrrur Rozi, Y. Touvan Juni Samodra. Data acquisition: Uray Gustian. Data analysis and interpretation: Ardo Okilanda, Isti Dwi Puspita Wati. Compiled the script: Firunika Intan Cahyani, Muhammad Fakhrrur Rozi. Critical manuscript revision for important intellectual content: Muhammad Fakhrrur Rozi, Didi Suryadi. Statistical analysis: Mikkey Anggara Suganda, Ardo Okilanda. Administrative, technical, and material support: Firunika Intan Cahyani. Study supervisor: Muhammad Fakhrrur Rozi.

CONFLICT OF INTEREST

The authors mention no "Conflict of Interest" in this study.

ETHICAL CONSIDERATION

This research has met the standards of research ethics and has received approval to be a sample of all respondents.

FUNDING/SUPPORT

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FINANCIAL DISCLOSURE

The authors have no financial interests related to the material in the manuscript.

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Table 1. Plyometric Training Program

Length of Exercise		(every two days)
Intensity		75%
Time (duration)		1.5 hours
Exercise Program		weight training
Exercise Type	Exercise Measure	Description
Main Exercises: The circuit method of weight training consists of 12 tools, namely leg extension, tricep extension, calf raise, chest press, leg curl, butter, sit up, back up, standing rowing, pull down, leg press and leg curl.	Frequency: every two days: Exercise is done 1.5 hours before breaking the fast. Repetitions: 75% Sets: 3 sets Rhythm: Smooth Recovery: Revorery between tools 10-15 seconds and rest between sets for 4 minutes.	Increase reps and sets at a rate of 75% each week

Table 2. Descriptive Results of Pulse Rate Exercise Treatment and Without Treatment

Result	Group	N	Mean	Std. Deviation	Minimum	Maximum
Pulse Rate Before Sleep	Exercise Treatment	13	70.6546	8.25871	56.40	81.20
	Without Treatment	13	69.2569	6.14026	59.20	78.60
	Total	26	69.9558	7.16549	56.40	81.20
Pulse Rate Waking Up	Exercise Treatment	13	61.2215	7.50425	46.80	74.40
	Without Treatment	13	59.8200	5.47173	48.00	67.20
	Total	26	60.5208	6.47398	46.80	74.40
Pulse Difference	Exercise Treatment	13	9.4331	5.77378	3.00	19.63
	Without Treatment	13	9.4369	5.17462	2.80	19.20
	Total	26	9.4350	5.37163	2.80	19.63

Table 3. Descriptive Results of Male and Female Pulse Rate

Result	Group	N	Mean	Std. Deviation	Minimum	Maximum
Pulse Rate Before Sleep	Male	6	67.0167	7.22286	62.40	81.20
	Female	7	73.7729	8.26796	56.40	80.40
	Total	13	70.6546	8.25871	56.40	81.20
Pulse Rate Waking Up	Male	6	57.2167	5.87211	46.80	64.20
	Female	7	64.6543	7.35568	53.20	74.40
	Total	13	61.2215	7.50425	46.80	74.40
Pulse Difference	Male	6	9.8000	5.56129	5.40	17.00
	Female	7	9.1186	6.37572	3.00	19.63
	Total	13	9.4331	5.77378	3.00	19.63

Digi-Biosportex: A Digital Interface Learning Media for Enhancing Understanding of Movement Analysis and Injury Prevention in Sports

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ABSTRACT

Background. Integrating digital technology in education is essential to meet the evolving needs of students, especially in higher education. Traditional methods of teaching sports biomechanics often lack interactive elements crucial for understanding complex concepts. **Objective.** This study aims to develop and evaluate *digi-biosportex*, a digital interface-based learning media designed to improve university students' understanding of sports biomechanics, utilizing the project-based learning (PBL) model for an interactive learning experience. **Method.** The development followed the 4D model (define, design, development, dissemination), incorporating features such as movement simulations, injury analysis tools, and biomechanical instructional materials. **Result.** The findings show that *digi-biosportex* is valid and practical, enhancing students' theoretical and practical understanding of sports biomechanics. **Conclusion.** *Digi-biosportex* is an effective tool for teaching sports biomechanics, offering a model for integrating digital technology into complex subjects.

KEYWORDS: *Digital Learning Media, Sports Biomechanics, Project-Based Learning*

INTRODUCTION

Since the early 21st century, the shift towards digitalization has become a dominant phenomenon across various sectors of life, including education (1)(2). In higher education, digitalization has increasingly become critical as a response to the evolving demands of the times and the need for more effective learning methods (3)(4)(5). However, amidst the rapid development of digital technology, there still exists a disparity in its utilization, particularly concerning quality and accessibility (6)(7). Universitas Negeri Padang (UNP), one of Indonesia's prominent higher education institutions, faces challenges in leveraging digital technology, particularly in sports education.

This research is part of a series of studies conducted since 2020 regarding the development and model of Sports Biomechanics learning. Previously, from 2020-2021, the researcher developed a Sports Biomechanics Learning Module Based on Literacy Skills to Enhance Concept Understanding and Social-Emotional Perception through an E-Book. In the following year, 2022, the researcher tested the module's effectiveness on students. Subsequently, in 2023, digitalization was applied to Physical Education learning based on Construct 2 software for locomotor movement material. For 2024, the researcher aims to digitalize learning media for the Sports Biomechanics course by combining PBL with comprehensive features such as movement

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simulations, injury analysis, and biomechanical materials in a single, accessible platform. The detailed roadmap is illustrated in the diagram below.

MATERIALS AND METHODS

The digital learning media is constructed and subjected to a validity test during the Development phase. This involves expert validation to ensure that the media meets the required educational standards and effectively addresses the learning objectives. Experts provide feedback and recommendations for improvements, which are incorporated into the final product. Testing the validity between raters uses the validity coefficient V from Aike. Then, product practicality testing is analyzed by percentage (achievement score/maximum score*100%).

RESULTS

a. Define. Observations and interviews revealed several key issues affecting the effectiveness of learning. One notable problem is the lack of student motivation, which stems from the absence of engaging and effective media to support learning activities. Additionally, students face challenges that further impact their learning experience. For the product analysis phase, the focus includes a thorough review of the curriculum, lesson plans, and other supporting materials. This review is essential for identifying gaps and areas for improvement. The findings from this analysis will guide the subsequent steps in the research, ensuring that the development of digital learning media aligns with the identified needs and effectively enhances the educational experience.

b. Design. To enhance online learning of sports biomechanics for university students, researchers have designed comprehensive educational materials to thoroughly understand biomechanics principles, including human movement analysis, injury prevention, and the physical laws governing sports activities. The developed content includes an introductory section on the fundamentals of biomechanics, core instructional videos on key concepts such as movement analysis, injury mechanics, and the application of biomechanical principles in sports performance. This innovative approach is expected to enhance students' understanding and biomechanics skills, addressing the challenges faced in traditional learning environments.

c. Development. The practicability of the product was also rated very good, with an average score of 90.42, indicating that this product is efficient for users to use in the context of learning (Table 5). These results show that digital-based learning media is theoretically valid and practical in real applications, meeting the needs of PE students. For more details, please see the table below.

DISCUSSION

The development of interactive learning media in sports biomechanics for university students has become increasingly vital amid rapid technological advancements (8)(9)(10). This initiative reflects efforts to offer more engaging, practical, and student-centered learning experiences in the digital age. By integrating interactive media, as demonstrated in this study, learning can evolve beyond traditional methods to more dynamic approaches that align with university students' modern learning preferences and styles. This research is crucial as it addresses the challenges associated with contemporary educational environments in higher education.

Future studies should aim to measure the impact of interactive learning media on overall academic achievement and practical skills in sports biomechanics (11)(12). Expanding the development of such media across various subjects and educational levels could benefit a broader range of students and educators(13)(14)(15). This research was limited to the development phase, focusing on the validity and practicality of the learning media. Future research should continue to assess these tools' effectiveness in real-world applications to enhance the quality of education through technological integration.

CONCLUSIONS

The development of interactive learning media in sports biomechanics for university students is a critical response to the challenges posed by modern education in the digital era. This research aims to address the gap between traditional teaching methods and the evolving needs of higher education students by offering a dynamic and engaging learning experience. Through the implementation of interactive, video-based learning materials, students gain theoretical insights into sports biomechanics and have the opportunity to practice and refine their skills, even in a remote learning environment. This study highlights the significance of adaptive teaching strategies catering to university students' diverse learning preferences and styles. Integrating technology into the educational process, particularly in a complex subject like sports biomechanics, which requires both theoretical understanding and practical application, makes the learning experience more effective and engaging.

APPLICABLE REMARKS

- The development of digi-biosportex highlights the importance of integrating digital media in education, especially in fields like sports biomechanics that require both theoretical and practical understanding.
- This tool can enhance student engagement and motivation by utilizing movement simulations and interactive instructional materials, helping them grasp complex concepts.
- Applying the platform's Project-Based Learning (PBL) model allows students to apply their knowledge in real-world contexts, improving practical skills and problem-solving abilities.
- Additionally, the tool addresses accessibility challenges some institutions face, enabling flexible learning inside and outside the classroom.
- The findings from this study suggest that interactive digital tools can enhance the quality of education and can be expanded to other fields and educational levels to create more effective learning experiences.

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AUTHORS' CONTRIBUTIONS

Umar conceptualized and led the study, overseeing the development and project management. Yovhandra Ockta contributed to the design and creation of movement simulations and instructional content. Yovhandra Ockta assisted in developing the learning platform, instructional materials, and data analysis. Alimuddin provided expertise in integrating project-based learning and validated the educational content. Masrun contributed to developing, testing, and evaluating the tool's practicality and effectiveness. All authors contributed to data analysis and manuscript preparation.

CONFLICT OF INTEREST

The authors mention no "Conflict of Interest" in this study.

ETHICAL CONSIDERATION

This study was conducted under ethical guidelines for research involving human participants. Informed consent was obtained from all participants, including students and teachers, before their involvement in the field trials. Participants were assured of their anonymity and confidentiality, with all personal data being securely stored and used solely for research purposes. The study adhered to ethical standards, ensuring that no harm came to the participants and that they were free to withdraw from the study at any time without consequence. Additionally, the research was approved by the relevant educational and institutional ethics committees to ensure compliance with ethical norms and guidelines.

FUNDING/SUPPORT

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ARTIFICIAL INTELLIGENCE (AI) USE

There was NO use of artificial intelligence (AI) for preparation, writing, or editing this manuscript.

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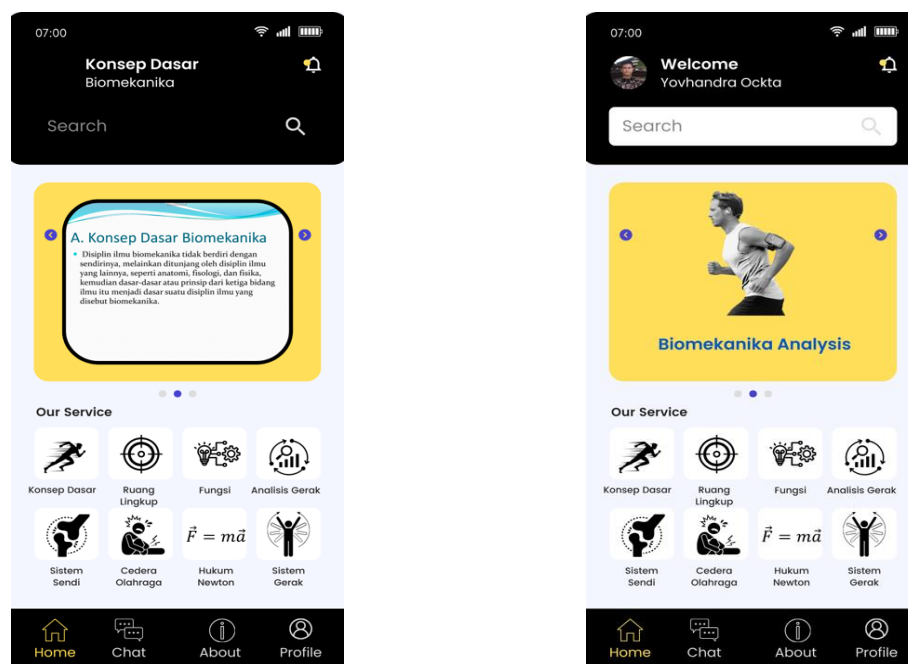


Figure 1. Learning Media Design

Table 1. Testing the validity

Items	Material Expert (n=3)			S1	S2	S3	Σ	n(c-1)	Aiken (V)	Classification
	1	2	3							
1	4	4	5	3	3	4	10	12	0,83	High
2	5	4	4	4	3	3	10	12	0,83	High
3	5	4	5	4	3	4	11	12	0,91	High
4	3	3	4	2	2	3	7	12	0,58	Enough
5	4	4	4	3	3	3	9	12	0,75	Enough
6	4	4	4	3	3	3	9	12	0,75	Enough
7	4	4	4	3	3	3	9	12	0,75	Enough
8	4	4	4	3	3	3	9	12	0,75	Enough
9	4	4	4	3	3	3	9	12	0,75	Enough
10	5	5	5	4	4	4	12	12	1	High
$\bar{x}$									0,75	Enough
Items	Language experts (n=3)			S1	S2	S3	Σs	n(c-1)	Aiken (V)	Classification
	1	2	3							
1	4	5	4	3	4	3	10	12	0,83	High
2	4	4	4	3	3	3	9	12	0,75	Enough
3	3	4	3	2	3	2	7	12	0,58	Enough
4	5	5	5	4	4	4	12	12	1	High
5	5	5	5	4	4	4	12	12	1	High
6	4	4	4	3	3	3	9	12	0,75	Enough
$\bar{x}$									0,79	Enough
Items	Media experts (n=3)			S1	S2	S3	Σs	n(c-1)	Aiken (V)	Classification
	1	2	3							
1	3	3	3	2	2	2	6	12	0,5	Enough
2	5	5	5	4	4	4	12	12	1	High
3	5	5	4	4	4	3	11	12	0,91	High
4	5	5	5	4	4	4	12	12	1	High
5	5	5	5	4	4	4	12	12	1	High
6	3	3	2	2	2	1	5	12	0,41	Enough
$\bar{x}$									0,95	High
$\bar{x}$ (Overall)									0,79	Enough

Table 2. Product practicality

Items	n	Percentage	Classification
1	3	86.70	Very practical
2	3	94.14	Very practical
3	3	95.87	Very practical
4	3	86.40	Very Practical
5	3	84.74	Very practical
6	3	94.14	Very practical
$\bar{x}$		90.42	Very practical

Physical Education Model Based on Teaching Personal and Social Responsibility: Improving Student Character 21st Century High School

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ABSTRACT

Background. Field trials for a TPSR-based Physical Education Learning Model were conducted in four West Sumatra, Indonesia senior high schools. Schools were selected using cluster random sampling based on 2022 National Examination scores. **Objectives.** The study aimed to develop and assess the effectiveness of a TPSR-based Physical Education model to improve student character in the 21st Century. **Methods.** The development process included preliminary research, prototyping, and assessment phases. This involved needs and context analyses, followed by creating model books and e-books, which educational experts validated. **Results.** Data collection focused on validity, practicality, and 21st Century Skills assessments. Validity was analyzed via a Likert scale, while practicality was gauged through teacher and student questionnaires. Data were analyzed using IBM SPSS, ensuring significance at $p < 0.05$. **Conclusion.** The TPSR-based model was validated as practical and effective in enhancing student character, demonstrating its potential for implementation in physical education curricula.

KEYWORDS: *Learning Models, Physical Education, TPSR, 21st Century Characters*

INTRODUCTION

Physical Education (PE) has the potential to become a 21st-century revival field (1)(2). Its comprehensive historical record illustrates that PE in the 1800s developed as a science-based profession in the health sector. PE focuses on physical activity and differs from general subjects. PE classes require special preparation and operation to communicate and practice the values and goals of physical education well (3)(4). Character education has become an essential part of educational development and a strategic policy agenda in the educational curriculum in various countries. Therefore, morality, character education, or moral development, however defined, has been a concern of public schools since the beginning. The essence of this context is the embodiment of the ideal Indonesian human being following the philosophy of Pancasila (5)(6).

In this regard, character is central to projecting 21st-century education from government policies and national education. It is developing crucial character values. In this case, physical education in schools is expected to develop physical fitness, students' knowledge, and character values. Previous research has been reviewed, including those related to character education models in physical education learning (7)(8). Most evidence shows that character and physical education can improve students' fitness and growth through physical activity, which plays a vital role in learning. One of the character-based physical education learning models is very much needed

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to integrate the two educational ideas related to health and character. To better structure and comprehensively understand the developed Physical Education model, quantitatively and qualitatively, we recommend the Physical Education learning model called TPSR. In this study, we chose a pedagogical approach in the cooperative model, automatically resulting in a positive learning experience for students.

The development of learners requires an activist, transformative, transdomain, and intercontextual pedagogical model in Physical Education, Sport, and Health. Its dual central theme (learning by serving) reveals a new perspective on teaching and learning in schools. TPSR follows the characteristics of Physical Education, Sports, and Health, a subject used as a reference to improve student fitness and character of students. Therefore, it is crucial to explain that the design of the PE model balances the scientific approach with practice as a learning model that combines elements of constructivism and connectivism (9). To solve this problem, we recommend a PE Learning Model Based on Teaching Personal and Social Responsibility to improve students' character in Valid and Practical.

MATERIALS AND METHODS

Field trials for a TPSR-based Physical Education Learning Model were conducted in four senior high schools in West Sumatra, Indonesia, selected via cluster random sampling based on 2022 National Examination scores. Tenth-grade students from Natural Sciences and Social Sciences participated, totaling 160 students. The development process included preliminary research, prototyping, and assessment phases. Initial analyses involved needs, context, and curriculum evaluations, leading to a conceptual framework. The prototyping phase produced model books and e-books for teachers and students, validated by educational experts for content and language. Data collection utilized validity, practicality, and 21st Century Skills assessments, with validity analyzed using a Likert scale and practicality assessed through questionnaires. The Kolmogorov-Smirnov Test was used to examine data distribution, and IBM SPSS software analyzed the results, ensuring significance at $p < 0.05$. Practicality was categorized based on specific score ranges, guiding the evaluation of the model's effectiveness in enhancing student character.

RESULTS

Validity of Physical Education Learning Based on Teaching Personal and Social Responsibility.

Validity assessment tests the validity of content, construction, and language. Product validation is carried out by seven experts in written form and discussed until they agree that the learning model of Physical Education based on TPSR developed is valid, as seen in Table 1.

Practicality of Physical Education Learning Based on Teaching Personal and Social Responsibility. The practicality of the product developed is seen from the ease of use. The consistency between expectations assessments shows the practicality of the TPSR-based Physical Education learning model. It means that the practicality of the learning model is determined by the assessment of experts, teachers, and students who use the model at school and who state that the product developed can be applied. In this case, it is known that the syntax, social system, and reaction principles of the TPSR-based Physical Education learning model, according to the validator at the validation stage, can be implemented with an average V value of 0.83, 0.75, and 0.83, respectively. Furthermore, the results are compared with the responses of teachers and students regarding this matter. This test was conducted in 4 schools.

The results of the practical analysis in Table 2 show that the learning model of physical education based on teaching personal and social responsibility, which is actualized with teacher and student e-books, is practical and makes it easier for teachers to deliver material on the dimensions of Physical Education, development activities and games and sports.

DISCUSSION

So far, we have presented the importance of understanding models by physical education teachers. At the risk of sounding repetitive, we would like to emphasize that many physical education teachers in Indonesia still do not know about learning models and are unable to use models (10)(11)(12). Research on pedagogical models used in physical education has grown in the last two decades. The growth has been so high that it is necessary to conduct a quick review to determine which models currently exist, which are developing, and which are suitable for use in physical education learners (13)(7)(14). Our findings can be used as a model of PE, which is suitable for obtaining physical education learning outcomes regarding botnets and character. This model has followed the systematic validity proof process adapted from the previous one.

CONCLUSIONS

The TPSR-based physical education learning model has good quality in terms of validity, practicality, and effectiveness. The results of the validity of the model book, electronic module book, and student electronic book have very high validity criteria in content, construct, and language. It means that the learning model meets the criteria of relevance and consistency. According to teachers and students, the TPSR-based physical

education learning model meets the ease of use criteria. In terms of effectiveness, the learning model can improve students' 21st Century Skills related to performance and moral character.

APPLICABLE REMARKS

- The TPSR-based Physical Education learning model demonstrates strong applicability for enhancing students' physical fitness and character development.
- Given its high validity and practicality, as evidenced by expert validation and positive feedback from teachers and students, this model can be effectively integrated into school curricula.
- The model's focus on teaching personal and social responsibility aligns with the goals of 21st-century education, promoting the development of critical skills and moral character in students.
- It is highly recommended for implementation in schools seeking to foster holistic student growth through physical education.

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Jaka Putra Utama contributed to the conceptualization, methodology, data analysis, and manuscript writing. Umar was responsible for project administration, supervision, and manuscript review. Gusril handled data collection, validation, and manuscript editing, while Rusdinal contributed to the literature review, framework development, and manuscript editing. Masrun assisted with data collection and statistical analysis. Yovhandra Ockta played a key role in writing the original draft, interpreting data, and finalizing the manuscript. All authors reviewed and approved the final version of the manuscript.

CONFLICT OF INTEREST

The authors mention no "Conflict of Interest" in this study.

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This study was conducted under ethical guidelines for research involving human participants. Informed consent was obtained from all participants, including students and teachers, before their involvement in the field trials. Participants were assured of their anonymity and confidentiality, with all personal data being securely stored and used solely for research purposes. The study adhered to ethical standards, ensuring that no harm came to the participants and that they were free to withdraw from the study at any time without consequence. Additionally, the research was approved by the relevant educational and institutional ethics committees to ensure compliance with ethical norms and guidelines.

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Table 1. Validity results based on Aiken's V coefficient values

Research Aspect (Product)	Component	Score (V. Aiken)	Interobserver reliability	Description
Model book	Construction	0.89	1 (ICC)	Very high
	Content	0.85	1	
	Language	0.88	1 (ICC)	
Teacher's book	Construction	0.82	0.87	
	Content	0.81	0.94	
	Language	0.89	1 (ICC)	
Student book	Construction	0.87	1 (ICC)	
	Content	0.84	1	
	Language	0.89	1 (ICC)	
21st-century character assessment	Construction	0.84	1	
	Content	0.89	1 (ICC)	
	Language	0.88	1 (ICC)	

Table 2. Results of practical product development

Assessment Aspect	SSHS 1 S	SSHS 2 S	SSHS 1L	SSHS 2L
Teacher e-book				
Ease of application of teacher's books in learning physical education	97.12	93.12	90.06	98.33
The use of teacher's books in Physical Education learning	94.03	97.15	97.23	95.45
All materials are presented in books on Physical Education learning.	98.13	98.16	98.19	97.56
Average (%)	96.43	96.14	95.16	97.11
Overall Average (%)	96.21			
Category	Very Practical			
Student e-book				
Ease of following student e-books in Physical Education learning	91.34	97.45	98.34	97.13
The use of student e-books in Physical Education learning	96.45	93.67	93.57	95.21
Ease of students in learning Physical Education learning materials	98.05	96.35	97.47	98.09
Allocation and application of students' e-book time in Physical Education learning	95.13	95.21	92.44	96.17
Average (%)	95.24	95.67	95.46	96.65
Overall Average (%)	95.75			
Category	Very Practical			

Optimizing Motor Skill Development in Elementary Students: A Comparative Study of Team Game Tournament (TGT) and Teaching Games for Understanding (TGfU) Models

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ABSTRACT

Background. Developing gross motor skills in elementary school students requires effective and engaging teaching methods. The Team Games Tournament (TGT) and Teaching Games for Understanding (TGfU) models are two commonly used approaches in physical education; however, a comparison of their effectiveness in improving motor skills has not been widely studied. **Objectives.** This study aims to compare the effectiveness of the TGT and TGfU teaching models in improving the gross motor skills of Grade IV students at SD Negeri 2 Bathin Solapan, Bengkalis. **Methods.** A quasi-experimental design was used with two randomly assigned groups: one using the TGT model and the other using TGfU. The intervention was conducted over 16 sessions, measuring motor skills through tests such as shuttle run, catch and throw balance and a 30-meter sprint. Data were analyzed using statistical tests to assess pretest and posttest score differences. **Results.** The TGT group showed a significant improvement, with an average pretest score of 20.3 and a posttest score of 20.1 ($p < 0.001$). In contrast, the TGfU group showed only a slight increase, with an average pretest score of 19.3 and a posttest score of 19.6, but the change was not statistically significant ($p = 0.203$). Despite lacking statistical significance, the TGfU model improved students' understanding of game concepts and cognitive skills. **Conclusion.** The TGT model is more effective than TGfU in improving gross motor skills, while TGfU provides long-term benefits in cognitive and social aspects. This study recommends integrating both teaching models into the physical education curriculum to create a more holistic learning experience for students.

KEYWORDS: *Team Games Tournament (TGT), Teaching Games for Understanding (TGfU), Motor Skills, Elementary Schools*

INTRODUCTION

Physical development of children in elementary school is a period of rapid physical growth, seen in the marked increase in motor skills and muscle coordination (1–3). The development of gross motor skills in children does not occur by itself but through intensive practice and learning (4–7). To ensure that children's growth and development, especially in gross motor skills, achieve the desired results, many factors play a role, including the creativity and ability of educators to choose appropriate learning methods in elementary schools (8–10). Physical development involves activities designed to train motor skills, including sports activities at school. One of the characteristics of early childhood is active movement, so the learning environment must provide facilities that support this condition. An interesting, meaningful, flexible, and friendly learning

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environment is needed, allowing children to explore movement creativity (11). Lack of teacher competence in teaching sports decreases children's motivation to try and like sports (12).

Students with poorly developed motor skills often have difficulty following the sports lessons taught by the teacher. This can lead to frustration, decreased motivation, and dissatisfaction with learning. Therefore, using the right learning model in PE (Physical Education) Learning is important to support the development of students' motor skills. By comparing the two above, it is hoped that a more effective way can be found to help students overcome difficulties in their motor skills so that the learning outcomes of PE learning can be improved overall. This research hoped to contribute to developing a better curriculum and learning practices in physical education.

MATERIALS AND METHOD

This study will be divided into two groups: TGT and TGfU model learning. Treatment was carried out for 16 meetings; the purpose was to compare the two training groups that were more efficient in improving gross motor skills at Elementary School 2 Bathin Solapan, Bengkalis Regency. Proportional Random Sampling is a method of taking samples from members of the population using a random method without considering the population's strata, so the sample obtained in this study was 30 male students in grade IV. Samples in grades IV.A. and IV.B. were taken, then paired (matched) with the A-B-B-A pattern in two groups with 15 students each. The data collection technique used is a quantitative measurement, with a data collection tool in the form of a test, primarily to assess the gross motor skills of elementary school students. Four tests are used: 4 x 10-meter shuttle run, throw catch, stand positional balance stroke, and 30-meter sprint, each with a specific goal and tool. The assessment is based on the norms set for each test (Table 1).

RESULTS

This study explores the pretest and post-test results of two learning approaches: TGT and TGfU. The pretest results showed that the TGT group had an average score of 20.3 and a median of 15.8, while the TGfU group recorded an average of 19.3 and a median of 15.0. After the intervention, the mean posttest score for TGT decreased slightly to 20.1 with a median of 14.3, while TGfU showed a slight improvement to 19.6 with a median of 14.6 (Table 2, Figure 1).

Before the hypothesis test, the analysis requirements test is carried out with a normality test (Shapiro-Wilk). Normality and homogeneity tests aim to determine whether the data obtained is normally distributed. The final test data is analyzed using the following decision-making basis (Table 3, Figure 2).

The analysis showed that the W value for the Pretest TGT-Posttest TGT group was 0.62 with a very significant p-value (< 0.001). This indicates a significant difference between pretest and posttest in the TGT group. Furthermore, for the TGfU-Posttest TGfU group, the W value obtained was 0.57, with a p-value less than 0.001. The data shows that it is normal and can be continued with hypothesis testing.

In the TGfU group, the mean difference between the pretest and posttest was -0.300, with a p-value of 0.203472. This shows that although the change is not significant, learners in this group show a deeper understanding of the game concepts learned. With a lower error standard (0.196) and a 95% confidence interval between -0.866 and 0.184, TGfU can potentially improve learners' engagement and understanding of the game.

DISCUSSION

The analysis showed that both methods showed significant differences in motor skill development, although TGT did not show a significant decrease post-intervention, while TGfU showed a slight improvement in game concept understanding, although not statistically significant. Based on the data, the TGT learning model appears superior in the direct improvement of gross motor skills, as shown by the decrease in the average score from the pretest to the posttest. The limitations of this study include a small sample size (30 students) and a relatively short duration of the intervention (16 meetings). In addition, the study only included students from a single school, so the results may not be generalized to the broader population. The recommendation for further research is to conduct studies with a larger sample size and involve various schools to increase external validity. In addition, future research could consider using more comprehensive evaluation instruments to measure students' motor, cognitive, and social skills more thoroughly.

CONCLUSION

This study compares the effectiveness of the TGT (Team Games Tournament) and TGfU (Teaching Games for Understanding) learning models in improving the gross motor skills of elementary school students. The analysis showed that the TGT model was superior in improving motor skills, with a very significant p-value (< 0.001), although there was a slight decrease in post-test scores. This suggests that TGT can increase student

motivation and engagement in physical learning, which is in line with previous research showing the positive impact of this model on social skills and cooperation between students. On the other hand, although the TGfU model did not show a statistically significant improvement, it was revealed to deepen students' understanding of game concepts and develop their cognitive skills. Previous research has also supported these findings, suggesting that TGfU contributes to better decision-making during games. Although both models have their strengths, TGT is more effective for directly improving physical skills, while TGfU provides long-term benefits in terms of cognitive and social aspects.

APPLICABLE REMARKS

- This study highlights the effectiveness of the Team Games Tournament (TGT) model in enhancing gross motor skills among elementary students, making it a valuable approach for improving physical education outcomes.
- However, the Teaching Games for Understanding (TGfU) model, while not significantly improving motor skills in this study, offers long-term cognitive and social benefits, particularly in game understanding and decision-making.
- Educators should consider integrating both models into their physical education programs to provide a well-rounded learning experience that fosters students' physical and cognitive development.

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AUTHORS' CONTRIBUTIONS

Anton Komaini contributed to the original draft's conceptualization, methodology, data analysis, and writing. Alfand Setiawan was responsible for the literature review, data collection, and analysis. Yovhandra Ockta conducted the data collection, statistical analysis, and interpretation of the results. Wilda Welis handled the writing, editing, and revising of the manuscript. Khairuddin provided supervision, reviewed the manuscript, and gave final approval.

CONFLICT OF INTEREST

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Table 1. Descriptive Data

Group	Mean	Median	SD	SE
Pretest TGT	20.03	15.8	9.60	1.24
Posttest TGT	20.01	14.3	11.80	1.52
Pretest TGfU	19.03	15.0	9.05	1.17
Posttest TGfU	19.06	14.6	10.83	1.40

Table 2. Shapiro-Wilk Normality Test

Group	W	P
Pretest TGT-Posttest TGT	0.62	< 0.001
Pretest TGfU-Posttest TGfU	0.57	< 0.001

Table 3. Paired T-Test

Group	statistic	df	p	Mean difference	SE difference	95% Confidence Interval	
						Lower	Upper
Pretest TGT-Posttest TGT	0,606	59.00.00	0,268056	0,199	0,227	-0.370	0,654
Pretest TGfU-Posttest TGfU	-1.060	59.00.00	0,203472	-0.300	0,196	-0.866	0,184

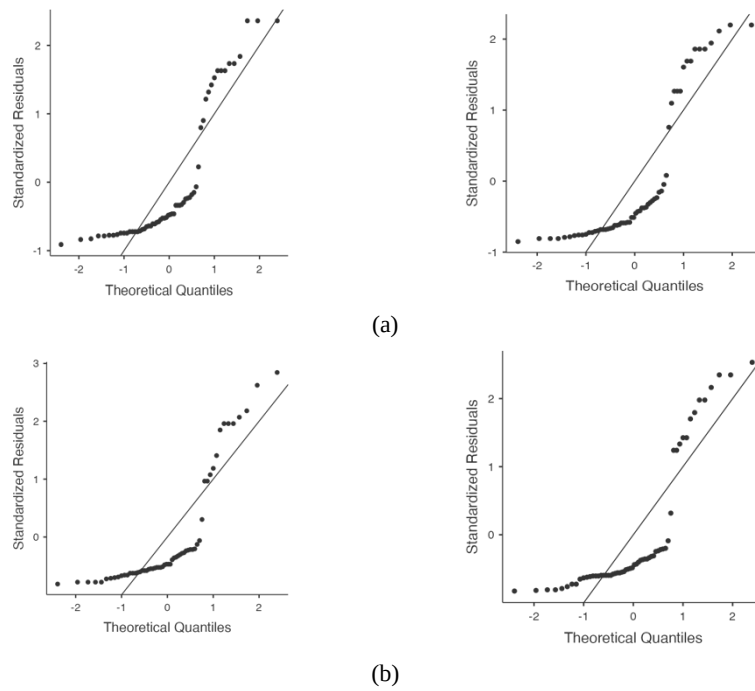


Figure 1. (a) TGT pretest-posttest, (b) TGfu pretest-posttest

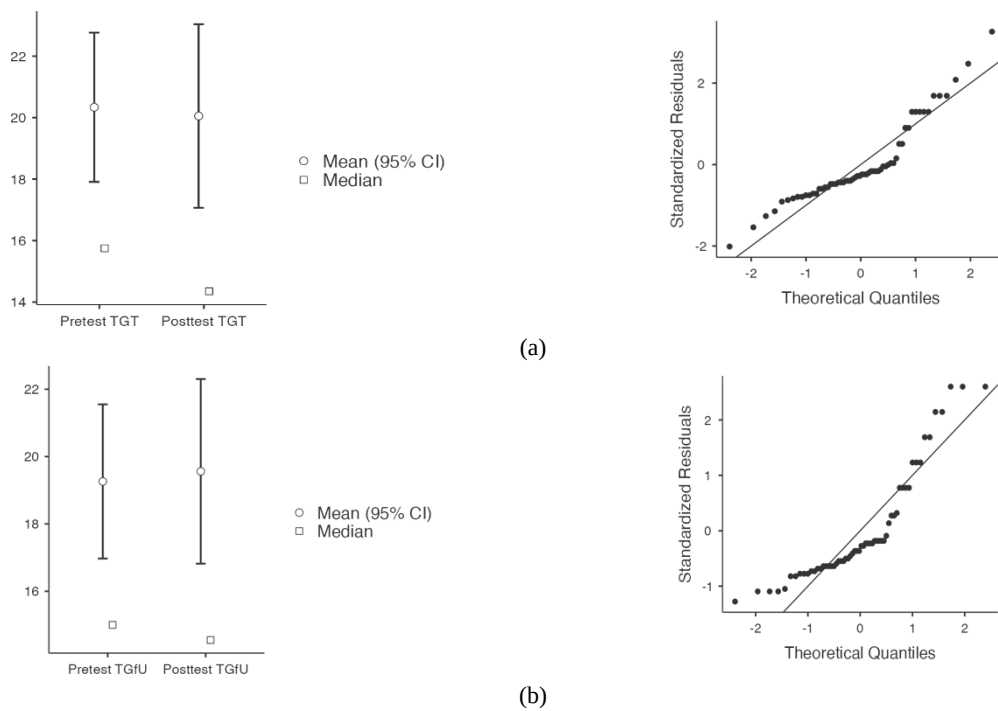


Figure 2. (a) Pretest-posttest of TGT, (b) Pretest-posttest of TGfU

Promoting “Bumi Sikerei” Strategy as A Core for Destinations’ Sustainability: The Connection of Local Wisdom with Sport Tourism

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ABSTRACT

Background. Sports tourism is a rapidly growing segment of the tourism industry, offering new perspectives and supporting a shift in tourist behavior toward a more active lifestyle. **Objectives.** This study aims to understand social and cultural villages and economic conditions comprehensively. **Methods.** This research is a qualitative explorative study conducted in Matotonan Village, Modabag Village, and Muntei Village in the Mentawai Islands. Data collection methods include participatory observation, semi-structured interviews, and document studies. Data analysis employs thematic techniques to identify, categorize, and interpret main themes. **Results.** The sustainable development of sports tourism villages is carried out by identifying village characteristics, natural and cultural potential, and suitable promotional strategies. **Conclusion.** Collaboration with various stakeholders, including the tourism department, is crucial in supporting this promotion, which, in turn, can enhance the local economy.

KEYWORDS: *Mentawai, Sikerei Tribe, Local Wisdom, Sport Tourism, Destinations Sustainability*

INTRODUCTION

Sustainable tourism destinations related to sports tourism are now at the forefront of efforts to preserve local communities' environment, culture, and welfare. Sports tourism is a rapidly growing segment of the tourism industry, offering new perspectives and supporting a shift in tourist behavior toward a more active lifestyle, which aligns with sustainable development goals (1–3). Sports tourism represents a new form within the global tourism industry with significant potential for developing tourism products. Sports tourism is a rapidly growing tourism with significant potential to promote sustainability. Through outdoor sports activities like trail running, trekking, and other fitness pursuits, tourists can connect with nature while gaining an understanding and appreciation of local values. Bumi Sikerei is a world-class surfing destination with substantial potential to develop into a sustainable center by integrating local wisdom and sports tourism. However, promoting Bumi Sikerei as a sustainable destination requires a well-planned and comprehensive strategy. Communities often practice local wisdom to manage their resources, yet they may lack sustainable measures; therefore, governments need to establish standards to evaluate the sustainability of such practices (4). This study aims to analyze the relationship between the local wisdom of Bumi Sikerei and the sustainable

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development of sports tourism and to develop a promotional strategy that supports Bumi Sikerei's position as a center for sustainable cultural and sports tourism. Through this approach, Bumi Sikerei is expected to become an exemplary tourist destination that showcases natural beauty and preserves its cultural identity, establishing itself as a model for tourism sustainability in Indonesia.

MATERIALS AND METHODS

This form of empirical research is based on qualitative studies conducted in Matotonan, Modabag, and Muntei villages in the Mentawai Islands. A qualitative approach is used in this study to explore social phenomena in depth and detail (5). The research follows a case study design to comprehensively understand specific conditions, particularly in Matotonan Village, Mentawai Islands. The data analysis process uses thematic analysis techniques, where the collected data is identified, categorized, and interpreted to uncover key emerging themes (6,7). Data validity is maintained through triangulation techniques by comparing findings from multiple data sources and collection methods.

Data Collection and Analysis. The interviewees included those who directly relate to and impact tourism development in Matotonan village, such as village heads, youth leaders, women leaders, and tour guides. The interview questions covered tourism characteristics (such as local lifestyle, community traits, and natural and socio-cultural conditions), potential, and possible links to sustainable tourism promotion strategies. The interview style is semi-structured but open, allowing for the introduction of new topics in an unstructured manner. Each interview lasts between one and two hours and is fully transcribed. Notes were taken during the community service meeting, which lasted an average of two to four hours. The analytical approach involves recursive data collection, analysis, and reference to existing literature (7).

RESULTS

Tourism and Community Characteristics. The hospitality of the Sikerei tribe can provide a valuable connection for tourists, allowing them to learn about the culture displayed in the daily lives of the Sikerei people in Matotonan village, Madobag village, and Muntei village (Figures 1 and 2).

Tourism Potential of Bumi Sikerei. The results of the documentation study indicate that UMA and Kulukubuk Waterfall can be attractive tourist attractions for both local and international visitors (Table 1 and Figure 3).

Strategi Promosi Sport Tourism Bumi Sikerei. Four Strategies are extracted from the study (Figur 4).

DISCUSSION

Tourism has become the primary economic source for many countries, providing economic and social benefits (8,9). The sustainable tourism model, which encompasses culture, clothing, food, lifestyle, and regional language, is key for fostering sustainable tourism in a region (10). This explanation relates to the findings of the researcher's study, which highlights Bumi Sikerei in the Mentawai Islands as a sports village tourist destination that maintains its authentic uniqueness. Villages such as Matotonan, Madobag, and Muntei exemplify sustainable natural and cultural tourism destinations. Additionally, incorporating sports events like running trails can be an alternative strategy for promoting tourism among nature sports enthusiasts. Community involvement can foster sustainable tourism development, enhance environmental sustainability, stimulate local economic growth, and improve community welfare. Practical strategies to leverage opportunities and address challenges include increasing public awareness, expanding ecotourism programs, promoting local wisdom and culture, strengthening partnerships with the government, and optimizing digital marketing. The selection of sports as a focal point in attracting tourists is a strategy for introducing culture and promoting physical activities. Promotion strategies that identify emerging and in-demand sports opportunities are key aspects of the emotional component in promotion management (11). Engaging compelling communication imagery as a promotional strategy fosters socio-cultural connections at individual and collective levels. Additionally, using experienced tour guides who can communicate with foreign tourists in English is crucial to support the development of sports tourism villages toward international tourism.

CONCLUSION

Connecting cultural tourism and sports requires a synergy between creating sports events and introducing local culture. In this case, natural sports events like trail running can be a sustainable promotion strategy. Developing sustainable sports tourism villages involves identifying the characteristics of the villages and communities, recognizing their natural and cultural potential, and determining appropriate promotion strategies. This effort aims to attract tourists, which can subsequently help improve the economic level of the community. Cooperation with various parties, such as the West Sumatra tourism office, is essential in

developing promotional strategies to attract local and international tourists.

APPLICABLE REMARKS

Increasing the potential of sports tourism is one way to improve the economy in rural areas. Advancing the tourism potential in the Mentawai Islands through the right promotion strategy can be a step in developing local tourism and sustainable sports.

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AUTHORS' CONTRIBUTIONS

Concept and design of the study: Anton Komaini, Firunika Intan Cahyani. Data acquisition: Yovhandra Ockta, Heru Andika, Ardi Arif. Data analysis and interpretation: Firunika Intan Cahyani, Retnaningtyas Susanti, Samuel Martin Pradana, Compiled the script: Andri Gemaini, Alimuddin. Critical revision of the manuscript for important intellectual content: Anton Komaini. Administrative, technical, and material support: Anton Komaini, Firunika Intan Cahyani. Study supervisor: Anton Komaini, Andri Gemaini.

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The authors mention no "Conflict of Interest" in this study.

ETHICAL CONSIDERATION

This research has met the standards of research ethics and has received approval to be a sample of all respondents.

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The authors have no financial interests related to the material in the manuscript.

ARTIFICIAL INTELLIGENCE (AI)

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Figure 1. UMA and jungle tracking tour at Kulukubuk Waterfall



Figure 2. Interaction with the Sikerei Tribe in Matotonan village

Table 1. Introduction of potential sustainable sports tourist attractions

Tour Packages	Description of Local Features
Natural Attraction Tourism	Eating sago caterpillars, searching for shrimp and fish, riding a boat called "pompong," picking kabib, hunting, archery, durian harvesting, pig farming, concocting medicine or poison
Nature Tourism	<i>Jungle Tracking</i>
Culinary	Types of local Matotonan food and its philosophy
Cultural Tourism	Turuk (the type of dance that exists in matotonan), traditional rituals (such as birth, death, and house-making rituals), UMA, tattoo making (TITIK), Traditional Musical Instruments (Gajeumak), ketongan (tuddukant)
Handmade Tour	Mat manufacturing (bolak), household furniture (baskets, chicken coops, pig coops), making accessories (Ngalou), traditional clothes of Matotonan village, making bows and arrows, Mentawai machetes (gagang)
Endemic Flora and Fauna Tourism	Flora: Monyet (mata besar, Joja, Bilou, simakobu, Obaketta), Faunans: Sago, taro, banana, taro



Figure 3. Open discussion and training on sustainable sports tourism promotion strategies

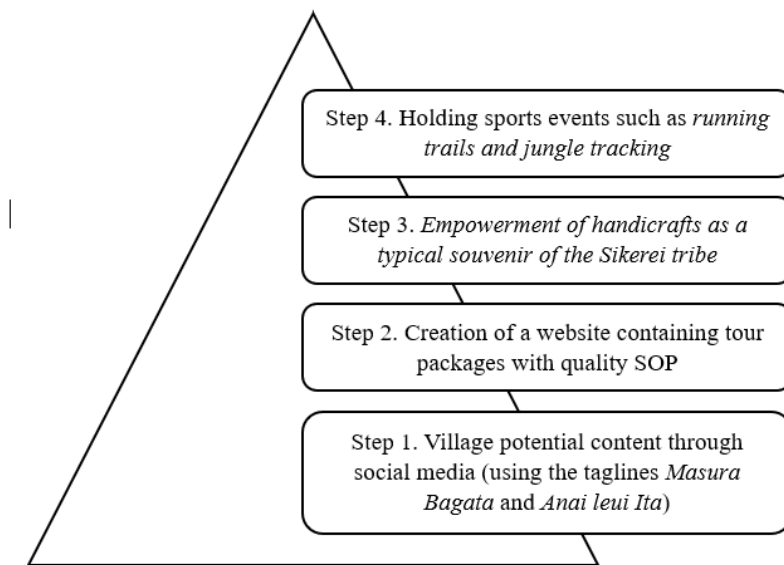


Figure 4. Four promotional strategy designs to increase sustainable sports tourism

Creative Gymnastics: An Innovative Approach to Blood Pressure Management in Hypertensive Patients

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ABSTRACT

Background. Hypertension is a prevalent chronic condition requiring innovative approaches beyond conventional medicine to achieve effective management. **Objectives.** Gymnastics Creation is an innovative intervention to lower hypertensive patients' blood pressure. **Methods.** This study used a quasi-experimental design with the pretest-posttest control group. A total of 40 outpatient hypertensive patients aged 20-40 years were selected through purposive sampling and divided into two groups: 20 subjects in the control group (CG) who participated in the PROLANIS exercise and 20 subjects in the intervention group (CGG) doing creative exercise. The creative gymnastics intervention was conducted four times a week for six weeks. Systolic blood pressure (SBP) and diastolic blood pressure (DBP) data were measured before and after the intervention using an Omron HEM 7156A digital sphygmomanometer. Data were analyzed using dependent t-test and independent t-test. **Results.** There was a significant decrease ($p < 0.05$) in SBP ($p = 0.000$), SBP pretest at 148.95 ± 6.863 ; SBP in posttest 134.00 ± 10.094 , and DBP ($p = 0.000$). DBP at pretest 94.75 ± 3.143 ; DBP at posttest 87.85 ± 2.560 , after the creation gymnastics intervention (CGG). While in (CG), there was no significant decrease in SBP and DBP ($p > 0.05$). **Conclusion.** Gymnastics Creation effectively reduces blood pressure in hypertensive patients. Therefore, creative gymnastics can be part of a rehabilitation program to manage blood pressure, in addition to medical interventions. Further research is needed to determine the optimal intensity and duration for patients with different severity of hypertension.

KEYWORDS: Hypertension, Creative Gymnastics, Blood Pressure, Physical Exercise, Cardiovascular Health

INTRODUCTION

Hypertension is a common global health problem and is a significant risk factor for cardiovascular diseases such as heart disease and stroke (1)(2). In Indonesia, the prevalence of hypertension is exceptionally high among the elderly, significantly affecting quality of life and public health costs (3). The management of hypertension usually involves pharmacologic therapy and lifestyle changes, including a low-salt diet and exercise. Exercise effectively lowers blood pressure, but challenges such as lack of motivation and monotony of conventional activities may deter patients from exercising regularly (4)(5). Gymnastics can improve metabolism and blood flow, thus helping to lower blood pressure(6).

Although many studies have explored exercises to lower blood pressure, there are no specific exercises for

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hypertensive patients under 40. Ergonomic exercises and low-impact aerobics effectively reduce blood pressure (7). Creative Gymnastics is emerging as an innovative alternative to managing hypertension, combining rhythmic free movement with music, which can increase patients' motivation to exercise (8)(9).

It combines low-impact aerobics, fitness exercises, Zumba, and regional dances to uplift the atmosphere. This study aims to explore the effectiveness of Creative Gymnastics in reducing blood pressure in hypertensive patients, hopefully providing new insights into non-pharmacological therapy and holistically supporting people's cardiovascular health.

MATERIAL AND METHODS

This study used a quasi-experimental design with 40 patients with level 1 hypertension selected through purposive sampling. Subjects were both male and female, 20-40 years old, with a systolic blood pressure of 140-159 mmHg and diastolic 90-99 mmHg. Subjects were divided into two groups: 20 subjects in the control group (CG) who followed the Chronic Disease Management Program (PROLANIS) exercise and 20 subjects in the intervention group (CGG) who followed the creation exercise.

Intervention. The creative gymnastics given to the intervention group consisted of warm-up movements (4 minutes), core movements (8 minutes), and cooling movements (3 minutes) with a total time of 15 minutes carried out 4 times in 1 week for 6 weeks. This creation gymnastics has a validity level with the construct method from 4 experts of 95%. The reliability score (Cronbach's Alpha) is 0.772, which means it has an excellent level of reliability.

The warm-up is done for ± 4 minutes with a movement change every 2x4 beats. The warm-up sequence includes relaxing the upper extremity, head and neck, and abdominal, waist, and leg muscles. Core movements last for ± 8 minutes with changes every 2x4 beats, which contain elements of low-impact aerobics, fitness exercises, Zumba, and regional dances. The cool down ± 3 minutes includes elements of regional gymnastics in the order of shoulder rolls, wave movements, head movements, arms, shoulders, waist, and relaxing legs.

Variable Measurement. Before and after the intervention, the subjects' blood pressure was measured using an Omron HEM 7156A digital sphygmomanometer that has been tested for validity according to international standards such as AAMI (Association for the Advancement of Medical Instrumentation) and ESH (European Society of Hypertension) (11).

Analysis Data. Data were analyzed using IBM SPSS software version 25 paired t-test and independent t-test with a significance level of $p < 0.05$.

Ethical Considerations. This research has received Ethics Committee Approval from the Research Ethics Commission of Padang State University (No. Ref:08.02/KEP-UNP/V/2024).

RESULTS

Data normality was analyzed using the Kolmogorov-Smirnov test, which showed that all data were normally distributed with $p > 0.05$ for all variables. Homogeneity of the data was assessed with the F test (Levene's Test for Equality of Variances), which showed non-significant results at the 5% significance level ($p > 0.05$), confirming that the variances between groups were homogeneous. The detailed results of this test are presented in Table 2.

Effect of Creation Gymnastics on SBP and DBP Blood Pressure. The analysis results comparing the difference in blood pressure between the treatment and control groups are presented in Table 4.

Table 4 shows no decrease in systolic blood pressure in the CG control group $p > 0.05$ (149.25 ± 5.637 mmHg to 152.90 ± 4.962 mmHg), while in the CGG intervention group, there was a significant decrease $p < 0.05$ (148.95 ± 6.863 mmHg to 134.00 ± 0.094 mmHg). Supported by Delta SBP comparison between CG and CGG $p < 0.000$. Diastolic blood pressure did not decrease in the CG control group $p > 0.05$ (94.90 ± 3.243 mmHg to 95.85 ± 2.581 mmHg), while in the CGG intervention group, there was a significant decrease $p < 0.05$ (94.75 ± 3.143 mmHg to 87.85 ± 2.560 mmHg). Supported by Delta DBP comparison between CG and CGG $p < 0.000$.

DISCUSSION

This study shows that physical activity in the form of creative gymnastics has a significant effect on reducing systolic and diastolic blood pressure in individuals with hypertension. This finding is consistent with previous research stating that aerobic exercise, including creative gymnastics, can improve cardiovascular function and reduce blood pressure (10)(11). The physiologic mechanism involves increased cardiac work efficiency (12)(13), improved blood circulation (7), and reduction in total peripheral resistance due to increased release of nitric oxide that functions as a natural vasodilator (14).

This study also found that the frequency and duration of exercise were positively correlated with the level of blood pressure reduction. However, there are limitations, such as limited sample size and homogeneous subject

characteristics, which may affect the generalizability of the results. Therefore, further studies with more extensive and diverse samples are needed to ensure the validity of the results. In addition, the positive effect of calisthenics on blood pressure is also influenced by other factors, such as diet, stress level, and lifestyle. Thus, although calisthenics is effective, holistic interventions that include diet and lifestyle management are highly recommended for optimal results.

CONCLUSIONS

From the results of this study, it can be concluded that creative gymnastics has the potential as an effective non-pharmacological intervention to reduce systolic and diastolic blood pressure in individuals with level 1 hypertension. Regular exercise can improve cardiovascular function and reduce peripheral resistance, lowering blood pressure. However, further studies with diverse participants and analysis of other variables, including the role of lifestyle and nutrition, need to be conducted to strengthen these findings.

APPLICABLE REMARKS

- It is recommended that people with level 1 hypertension use creation exercises to reduce blood pressure in connection with the Chronic Disease Management Program (PROLANIS) exercises from the Puskemas, which do not significantly impact lowering blood pressure.

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AUTHORS' CONTRIBUTIONS

Anggun Permata Sari, Pudia M Indika, and Muhammad Arnando contributed to the conceptualization, study design, and data collection. Wilda Welis, and Umar were involved in data analysis and interpretation. Ridho Bahtra and Randi Kurniawan provided critical revisions and manuscript drafting. Bekir Car, Ratko Pavlović, and Jose Vicente Garcia Jimenez contributed to the methodology and provided expertise in their respective fields. All authors reviewed and approved the final manuscript.

CONFLICT OF INTEREST

The authors mention no "Conflict of Interest" in this study.

ETHICAL CONSIDERATION

This study was conducted under ethical guidelines for research involving human participants. Informed consent was obtained from all participants, including students and teachers, before their involvement in the field trials. Participants were assured of their anonymity and confidentiality, with all personal data being securely stored and used solely for research purposes. The study adhered to ethical standards, ensuring that no harm came to the participants and that they were free to withdraw from the study at any time without consequence. Additionally, the research was approved by the relevant educational and institutional ethics committees to ensure compliance with ethical norms and guidelines.

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Tabel 1. Summary of Normality Test and Variance Homogeneity Results

Variable Data	Group	Normality Test		Variance Homogeneity		Conclusion
		Kolmogorov-Smirnov Z	p-Value	F	P (Sig.)	
Systolic Blood Pressure (SBP)						
Pretest	CG	1.106	0.174	2.962	0.093	N/H
	CGG	1.051	0.435	0.345	0.568	N/H
Posttest	CG	0.723	0.671	1.754	0.247	N/H
	CGG	1.179	0.223	3.248	0.098	N/H
Delta	CG	1.064	0.132	0.121	0.387	N/H
	CGG	1.263	0.188	0.728	0.522	N/H
Diastolic Blood Pressure (DBP)						
Pretest	CG	0.832	0.229	3.465	0.282	N/H
	CGG	0.879	0.556	2.769	0.731	N/H
Posttest	CG	1.387	0.410	1.487	0.089	N/H
	CGG	1.243	0.552	0.413	0.144	N/H
Delta	CG	0.941	0.092	2.223	0.534	N/H
	CGG	0.723	0.134	0.363	0.128	N/H

Note: N= Normal; H= Homogeneous

Table 2. SBP and DBP Difference Test between CG and TG

Group	Mean ± SD	t	Sig.(p-value)	Information
SBP (CG)				
● Pretest	149.25 ± 5.637	0.146	0.885	Non-significant
● Posttest	152.90 ± 4.962			
● SBP (CGG)				
● Pretest	148.95 ± 6.863	6.800	0.000*	Significant
● Posttest	134.00 ± 10.094			
● Delta SBP				
● CG	-3.65 ± 4.760	7.869	0.000*	Significant
● CGG	14.95 ± 9.439			
● DBP (CG)				
● Pretest	94.90 ± 3.243	1.235	0.875	Non-significant
● Posttest	95.85 ± 2.581			
● DBP (CGG)				
● Pretest	94.75 ± 3.143	7.984	0.000*	Significant
● Posttest	87.85 ± 2.560			
● Delta DBP				
● CG	0.95 ± 3.441	6.784	0.000*	Significant
● CGG	6.90 ± 3.865			

Note:*)=Significant at the 5% significance level. This study used a significance level of 5% or 0.05, corresponding to a confidence level of 95%

Implementing the Differentiated Learning Model and the Filanesia Curriculum in Football Learning in Elementary Schools

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ABSTRACT

Background. This research is based on the importance of fostering basic football skills, especially Low Ball Passing, for elementary school students. Good passing skills are a major foundation in soccer, which supports teamwork and understanding game tactics from an early age. However, based on initial observations, the passing ability of elementary school students is still low. **Objectives.** It aims to evaluate students' Low Ball Passing skills and analyze the extent to which existing learning models meet the needs of those basic skills. **Methods.** This study uses a quantitative descriptive method with a population of 19 students from several elementary schools. The low-passing test was conducted, with the results then categorized into three criteria: "Very Little," "Less," and "Moderate." Data analysis was conducted to determine the distribution of passing results based on class and the number of successful passing scores. **Results.** The study showed that most students were in the "Less" and "Moderate" categories, with seven or about 36.8% of the total participants filling each category. A total of 5 students (26.3%) were in the "Less Once." Grade 6 students have the highest number, with nine students and an average passing success score of 4.22, while students in the early grades (grades 1 and 2) have a lower average score. Overall, the average successful passing score for the 19 students was 3.95, which indicates that low passing skills still need to be improved. **Conclusion.** This study shows that elementary school students' low passing skills are generally still at the lower middle level. More intensive and continuous coaching is needed to achieve optimal development, especially for students with scores in the "Less Once" and "Less" categories. Implementing appropriate learning models, such as differentiated learning, can help meet the basic skills needs of football at the primary school level.

KEYWORDS: *Basic Skills, Physical Education, Student Evaluation, Football Learning*

INTRODUCTION

The development of basic soccer skills, especially Low Ball Passing, is significant for elementary school students as part of the physical development and motor skills (1). Football is a popular sport that can improve children's coordination, teamwork, and discipline (2). In Indonesia, physical education at the primary school level often focuses on the essential learning of various sports, including football. However, basic technical skills, such as passing, are often poorly mastered by students at this age. Low passing skills are indispensable because they are the foundation for mastering the game of football. A solid understanding of these basic techniques also helps students build confidence and improve their performance in the game.

Football learning at the primary school level includes an approach that focuses on developing students' technical, tactical, and physical skills (3). Previous research has shown that learning methods that integrate

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differentiation techniques can improve students' basic skills, including in passing the ball. Several studies emphasize the importance of active and collaborative learning, where students are involved in technical practice and the decision-making process during games (4). In addition, technology in training, such as video analytics and performance tracking applications, is increasingly being applied to provide more precise feedback and help students understand their engineering mistakes (5,6). However, despite the many initiatives to improve the quality of football learning, there are still challenges in implementing this approach consistently in school settings, especially regarding teacher resources and training. Therefore, this study seeks to assess students' basic passing abilities and explore how differentiated learning models can be implemented to improve their learning outcomes.

The application of the differentiated learning model in the context of developing basic football skills, especially in the low passing test at the elementary school level. Although many studies have been conducted in physical education, this study combines qualitative and quantitative analysis to assess students' basic skills and the impact of differentiation approaches on their learning outcomes (7,8). Additionally, the study assesses the end result of passing skills and provides insight into students' specific needs based on their ability level. Thus, this research is expected to make a new contribution to the practice of football learning in primary schools by offering more appropriate strategies to meet student's individual needs and improve the quality of teaching in sports.

MATERIALS AND METHODS

The approach and method used in this study is the Borg and Gall model. The subjects or samples in this study are elementary school students. The data collection technique for validating the developed model was used using a questionnaire measurement tool. To obtain the feasibility level of the learning model from the respondents, the researcher used quantitative data analysis techniques using a questionnaire instrument and a Likert scale.

RESULTS

Tables 1 and 2 are a descriptive analysis of elementary school students' Low Ball Passing test data.

Based on Low Ball Passing test data, most students were in the criteria of "Less" and "Medium," with each category filled by seven students or about 36.8% of the total participants. Meanwhile, the "Less Once" category includes five students, representing 26.3% of all students who took the test. This data shows that most students still need to improve their basic passing skills, with the highest percentage being in the "Poor" and "Medium" categories."

Average Number of Successful Passes. Overall, the average number of successful passes from the 19 students who took the Low Ball Passing test was 3.95. This shows that students' passing ability is generally still at the lower middle level. With an average below 5, these results indicate that most students have not yet reached an optimal level of passing skills, so additional practice is needed to help them improve these basic abilities (Table 3).

6th-grade students are the largest group in this low-passing test, with 9 participants having an average successful passing score of 4.22. This shows that 6th graders tend to have better passing skills than students in lower grades. In contrast, students in early grades 1 and 2 have lower grade averages, reflecting the need for more intensive basic training in younger age groups to improve their basic passing skills.

DISCUSSION

This study's discussion shows that elementary school students' low passing skills are still worrying, with results that place most students in the "Less" and "Medium" categories. An average successful passing score of 3.95 indicates that many students have not fully mastered this basic technique. This can be caused by several factors, such as a lack of attention to the development of basic skills in physical education programs and limited resources and teacher training (9,10). As a sport that involves many basic techniques, football requires a structured and systematic learning approach so that students can understand and master these skills effectively (11).

Applying the differentiated learning model is relevant to improving student learning outcomes (12,13). By adapting teaching methods according to each student's skill level, teachers can pay more attention to students experiencing difficulties and provide appropriate challenges for those with more abilities. This research underscores the importance of creating an inclusive and responsive learning environment that fits students' individual needs so that each student can develop and improve their basic skills. In addition, training and professional development for physical education teachers also need to be improved so that they can apply more effective teaching methods in learning football in primary schools.

CONCLUSION

The study's conclusion suggests that elementary school students' low passing skills still need to be improved, with the majority of students in the "Less" and "Medium" categories. The average successful passing score of 3.95 reflects the need for more effective and directed learning approaches, such as differentiated learning models, to meet students' individual needs. This research emphasizes the importance of coaching basic techniques in football from an early age so that students not only understand technical skills but also can apply them well in the game. Therefore, it is recommended that physical education teachers implement more diverse and adaptive strategies to improve students' passing skills and build their interest in football as a whole.

APPLICABLE REMARKS

- Physical education teachers can adopt more diverse and adaptive teaching strategies to enhance students' passing skills and foster a greater interest in football.
- Given that many elementary students are performing in the "Less" and "Medium" skill categories, targeted instructional approaches, such as differentiated learning, should be prioritized to address individual learning needs.
- Additionally, early coaching on football fundamentals should be emphasized, ensuring that students understand passing techniques and develop the ability to apply these skills in gameplay.

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Study concept and design: Aldo Naza Putra. Acquisition of data: Ridho Bahtra. Analysis and interpretation of data: Fiky Zarya. Drafting the manuscript: Fiky Zarya. Critical revision of the manuscript for important intellectual content: Fiky Zarya. Statistical analysis: Ridho Bahtra

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Table 1. Summary of Overall Data Results of Low Ball Passing Test Results in Elementary School Students

Criterion	Total Values (Successful Passing)	Number of Students
Less	1 – 2	5
Less	3 – 4	7
Keep	5 – 6	7

Table 2. Distribution of Assessment Criteria

Criterion	Number of Students	Percentage
Less	5	26.3%
Less	7	36.8%
Keep	7	36.8%

Table 3. Class-Based Analysis

Class	Number of Students	Grade Point Average
1	1	1
2	1	2
3	1	3
4	3	4
5	4	4
6	9	4.22

The Impact of Distributed Practice, Massed Practice, and Concentration on Free Throw Performance

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ABSTRACT

Background. Objectives. This study aims to determine the influence of training methods and concentration on *free throw* ability in volleyball athletes. **Methods.** This study uses a 2 x 2 factorial design to determine the influence of two training methods (distributed practice and massed practice) and concentration (high and low) with a sample of 40 basketball players. The study was divided into five groups (AB, A₁B₁, A₂B₂, A₁B₂, and A₂B₁). Each group consisted of 20 people in distributed practice and 20 in massed practice. Each group was given treatment for 16 meetings. The research data analysis used the two-way ANOVA technique followed by *the Tukey* test. **Results.** The results showed that (1) There was a significant difference between the two methods ($F_{hitung} = 17,23 > F_{tabel} = 4,41$). (2) Metode massed practice ($\bar{x} = 54$) significantly better than distributed practice ($\bar{x} = 46$), dengan $Q_{hitung} = 6,642 > Q_{tabel} = 2,95$. (3) Massed practice is more effective in athletes with high concentration ($\bar{x} = 64$ vs 47), $Q_{hitung} = 8,868 > Q_{tabel} = 3,85$. (4) There was no significant difference between the two methods in athletes with low concentration ($\bar{x} = 45$), $Q_{hitung} = 0$. (5) There is a difference between distributed practice in high-concentration athletes and massed practice in low-concentration athletes ($Q_{hitung} = 1,043$). (6) Massed practice is better at high concentrations than distributed practice at low concentrations ($Q_{hitung} = 9,911 > Q_{tabel} = 3,85$). (7) There is an interaction between training methods and concentration ($F_{hitung} = 18,94 > F_{tabel} = 4,41$). **Conclusion.** The study's conclusion showed an influence between the type of training method and the level of concentration in improving free throw ability.

KEYWORDS: *Training Method, Massed Training, Distributed Training, Free Throw Ability, Basketball*

INTRODUCTION

Free throws are an important skill in basketball that requires high accuracy, given after an opposing player violates the rules (1,2). Concentration is an important aspect of the success of free throws because environmental disturbances such as noise, team pressure, and mental status affect the athlete's ability to shoot into the basketball hoop (3). This explanation proves that involving psychological elements in sports coaching is an effort by coaches to facilitate the performance of athletes' motor skills (4), Especially when making free throws. Many factors affect the success of *free throws*, such as a good mentality and always being careful about the opponent's strength and ability. Therefore, a targeted training method is critical in performing free throw movements because a movement's effectiveness and efficiency can be an important factor in improving athletes' performance (5–7). The right training program contributes positively to the success of athletes'

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techniques and strategies which is under the research results (8), which state that a combination of appropriate training programs, between visualization and concentration, can improve the performance of basketball athletes when making free throws. The application of *massed practice* and *distributed practice* methods certainly depends on the characteristics of each athlete because not all methods have the same impact on each individual. In addition, this study also compared the effectiveness of the two training methods on athletes with different concentration levels (high and low). This research is expected to be a solution in determining effective training methods or approaches to improve *free throw ability* in basketball athletes.

MATERIALS AND METHODS

Participants and Procedure. This study uses a 2 x 2 factorial design to determine the influence of two training methods (distributed practice and massed practice) and concentration (high and low) with a sample of 40 OGC basketball club boys in Padang City. The research was divided into five groups (AB, A₁B₁, A₂B₂, A₁B₂, and A₂B₁). Each group consisted of 20 people in distributed practice and 20 in massed practice. Each group was given treatment for 16 meetings. The research population is all athletes who are members of the OGC Padang club, totaling 80 people, with details of 50 boys and 30 girls.

Data Collection Tools. Data were collected using a *grid concentration test* questionnaire and free throw skills. The questionnaire used has been expanded according to the needs of the research. The test was carried out 2 times, namely during the pre-test and post-test.

Instrument. In this study, the instruments used are concentration test techniques using *grid concentration tests* and free throw skills.

Statistical Analysis. The research data analysis used the two-way ANOVA technique followed by the *Tukey* test using SPSS. The treatment of the research was by providing exercises through the *distributed exercise method* and the *massed exercise method* for 16 meetings.

RESULT

The testing of the research hypothesis was carried out using the two-track ANAVA technique. The two-path ANAVA technique aims to determine the individual contribution of independent variables to the experimental results (main effect) and the influence of interaction (interaction effect).

The results of the two-path ANAVA calculation through the SPSS application above can be stated that: (1) The value of $F_{cal} 17.23 > F_{table} 4.41$ was obtained, so it can be concluded that there is a difference in the influence of *free-throw ability* based on the *distributed practice* and *massed practice* methods. (2) Obtained a value of $F_{cal} 18.94 > F_{table} 4.41$, it can be concluded that there is an interaction *between distributed practice* and *massed practice* methods with high concentration and low concentration levels in determining *free throw ability*. With the proof of the research hypothesis that there is an interaction between training methods and concentration on the *free throw ability* of men's basketball athletes of the OGC Padang City Club, then a further test is carried out with the *Tukey* Test, which aims to see which group has a significant difference or determine which group has better results on *free throw ability* men's basketball athletes of the OGC club in Padang city. The results showed that (1) There was a significant difference between the two methods ($F_{hitung} = 17,23 > F_{tabel} = 4,41$). (2) Metode massed practice ($\bar{x} 54$) significantly better than distributed practice ($\bar{x} = 46$), dengan $Q_{hitung} = 6,642 > Q_{tabel} = 2,95$. (3) Massed practice is more effective in athletes with high concentration ($\bar{x} = 64$ vs 47), $Q_{hitung} = 8,868 > Q_{tabel} = 3,85$. (4) There was no significant difference between the two methods in athletes with low concentration ($\bar{x} = 45$), $Q_{hitung} = 0$. (5) There is a difference between distributed practice in high-concentration athletes and massed practice in low-concentration athletes ($Q_{hitung} = 1,043$). (6) Massed practice is better at high concentrations than distributed practice at low concentrations ($Q_{hitung} = 9,911 > Q_{tabel} = 3,85$). (7) There is an interaction between training methods and concentration ($F_{hitung} = 18,94 > F_{tabel} = 4,41$).

DISCUSSION

The distributed practice method is an exercise that is carried out repeatedly, where there is sufficient rest time between movements (9). The weakness in the distributed practice training method is that athletes only make one free throw attempt, after which the athlete will wait for his turn to make the subsequent free throw opportunity. Therefore, the coach's role is vital as an evaluator regarding the mistakes of implementing the player's movements after the training experiment (10). Meanwhile, in the massed practice method, the form of exercise uses more repetitions than the distributed practice method (9). Athletes can improve their free throw ability, as seen from technical factors and accuracy. Repetition of movements helps athletes repeat movements in case of a mistake in technique or accuracy of free throws (11–13). Concentration is an important factor needed by athletes to be able to perform free throw techniques successfully. Repetition is essential so that the results, both technique and free throw accuracy, can be maximized. Thus, athletes will quickly achieve high

achievements (14). The capabilities of coaches and knowledge in sports science have resulted in different criteria for organizing training programs, often dominated by trends as a step in designing training methods based on specific adaptations and results achieved during the training process (15). The massed practice method is one of the practical training methods for improving free throw ability, both in athletes with high and low concentration levels.

CONCLUSION

Based on the results of the study on the influence of training methods on the free throw ability of men's basketball athletes of the OGC Kota Padang club, there is a difference in the results between two training methods, namely distributed practice (interrupted practice) and massed practice (continuous practice), in improving free throw ability. The massed practice method showed significantly better results than the distributed practice.

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AUTHORS' CONTRIBUTIONS

Study concept and design: Sari Mariati, Yogi Arnaldo Putra, Data Acquisition: Suci Nanda Sari, Desi Purnama Sari. Analysis and interpretation of data: Firunika Intan Cahyani, Rezki Mukhlis Ardiansyah. Drafting the manuscript: Firunika Intan Cahyani, Sari Mariati. Critical revision of the manuscript for important intellectual content: Sari Mariati. Statistical analysis: Hilmanur Syampurma, Kristian Burhan.

CONFLICT OF INTEREST

The authors mention no "Conflict of Interest" in this study.

ETHICAL CONSIDERATION

This research has met the standards of research ethics and has received approval to be a sample of all respondents.

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Table 1. Tests of Between-Subjects Effects for Free Throw

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	2459.075 ^a	3	819.692	20.753	.000	.634
Intercept	99900.025	1	99900.025	2.529E3	.000	.986
Metod	680.625	1	680.625	17.232	.000	.324
Concentration	1030.225	1	1030.225	26.083	.000	.420
Metod * concentration	748.225	1	748.225	18.944	.000	.345
Error	1421.900	36	39.497			
Total	103781.000	40				
Corrected Total	3880.975	39				

a. R Squared = .634 (Adjusted R Squared = .603)

Table 2. Summary of Analysis Of Variance (ANOVA) Advanced Test Results with Tukey Test

No	Groups compared	DK	Q _h	Q _t	Information
1	A dan B	1,355	6,642	2,95	Significant
2	A ₁ dan B ₁	1,917	8,868	3,85	Significant
3	A ₂ dan B ₂	1,917	0	3,85	Insignificant
4	A ₁ dan B ₂	1,917	1,043	3,85	Insignificant
5	A ₂ dan B ₁	1,917	9,911	3,85	Insignificant

Effectiveness of Zumba Combined with *Citrus sinensis* 'Moro' on Weight Loss: A Systematic Review

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ABSTRACT

Background. Maintaining weight requires special attention nowadays; someone with abnormal weight can lose weight by exercising and consuming low-calorie foods such as fruits and vegetables. **Objectives.** This study aimed to determine the effectiveness of Zumba exercise combined with *Citrus sinensis* 'Moro' on weight loss. **Methods.** Systematic review search based on Scopus-indexed international journals published in the last 5 years, including Zumba exercises, *Citrus sinensis* 'Moro,' and weight loss searched with the PRIMA scoring system obtained five articles that can be reviewed. **Results.** Zumba can play a role in burning calories, while *Citrus sinensis* 'Moro,' which contains flavonoids, can help inhibit hunger. **Conclusion.** Zumba exercise combined with *Citrus sinensis* 'Moro' effectively supports weight loss.

KEYWORDS: *Zumba Exercise, Citrus Sinensis 'Moro,' Weight Loss*

INTRODUCTION

Obesity is a condition in which excessive body fat is accumulated (1,2). Food or binge eating disorders contribute significantly to the increased uptake of obesity. People with normal fat and no history of being overweight should avoid weight gain to reduce health risks, as it will lead to cardiovascular disease and heart failure (3). The sophisticated era has made people do activities with the help of technology, so people have become ignorant of health, especially in maintaining weight. Some diet and exercise programs are recommended to help one lose weight and improve fitness (4). Zumba is one of the sports that can help control obesity (5). A high-protein diet mainly derived from animal sources impacts kidney health, as it causes metabolic acidosis; consuming foods with natural alkalization, such as fruits and vegetables, is better (6). Citrus fruits have bioactive components such as flavonoids, alkaloids, and terpenes with antioxidant, antidiabetic, cardioprotective, anticancer, and anti-inflammatory properties (7). Therefore, this study aims to analyze the effectiveness of Zumba exercise combined with *Citrus sinensis* 'Moro' on weight loss.

Several other studies have shown how Zumba exercises and *Citrus sinensis* 'Moro' can help lose weight. Zumba can be viewed as a preventive activity against lifestyle diseases, including lowering body mass index, improving blood sugar and cholesterol levels, and positively affecting the cardiovascular system (8). This workout is based on aerobic, interval, and strength training to promote faster calorie burning, improve

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cardiovascular function, and strengthen the whole body (9). In addition to physical exercise, which has a synergistic effect on weight control, it can be done by combining fruit and vegetable consumption to control weight (10). The flavonoids in oranges lead to weight loss, decreased adiposity, and increased metabolism, which is associated with mild hunger due to increased energy expenditure (11).

MATERIALS AND METHODS

This study used a systematic review of Scopus-indexed international journals published in the last 5 years covering Zumba exercise, *Citrus sinensis* 'Moro,' and weight loss. This systematic review uses the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRIMA) assessment. This study involved three stages, namely identification, screening, and inclusion. After going through these stages, five articles met the inclusion criteria of this systematic review.

RESULTS

Main information. Based on Figure 1, several articles were found in the Scopus database. The criteria in this study were articles published in the last 5 years that discussed zumba exercise, *Citrus sinensis* 'Moro,' and weight loss. A total of 465 articles were identified, and those that met the criteria for systematic review were five articles.

DISCUSSION

This systematic review aims to see the effectiveness of Zumba exercises combined with *Citrus sinensis* 'Moro' in losing weight. Based on the results of the systematic review in Table 1, it was found that Zumba exercise and consumption of *Citrus sinensis* 'Moro' were effective for weight loss. Zumba is one way to help the body burn excess fat and positively affect weight loss. Zumba is a dance that quickly burns calories and body fat because zumba movements use cardio exercises such as jumping, spinning, and moving fast. Zumba can be used to increase stamina and lose body fat and weight. Combining Zumba exercise with citrus fruit consumption (*Citrus sinensis* 'Moro') is a new finding that can help someone who is overweight. The content of flavonoids in citrus fruits can inhibit hunger. That way, *Citrus sinensis* 'Moro' can keep calorie intake low.

CONCLUSIONS

Zumba exercise combined with *Citrus sinensis* 'Moro' effectively supports weight loss. Zumba exercise can help burn calories significantly and boost metabolism. The combination with *Citrus sinensis* 'Moro' helps maintain body hydration during Zumba exercise; the content of *Citrus sinensis* 'Moro' reduces the desire to consume foods or drinks that are high in calories. So, this combination can keep the body in balance.

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Anggun Permata Sari, Anggi Yusriana, and Desi Purnama Sari contributed to the conceptualization, study design, and data collection process. Tika Gustina, Rara Putri Maliza, and Abdirrohim Muhammad Qori participated in data analysis and interpretation. Bekir Car, Ratko Pavlović, and Jose Vicente Garcia Jimenez provided methodological expertise and support. Randi Kurniawan contributed to the manuscript drafting and revisions. All authors reviewed, edited, and approved the final manuscript.

CONFLICT OF INTEREST

The authors mention no "Conflict of Interest" in this study.

ETHICAL CONSIDERATION

This systematic review adhered to ethical guidelines by ensuring all included studies were published in reputable, peer-reviewed journals with appropriate ethical approvals. No direct participant involvement was required for this review, as it focused solely on secondary data from existing studies. The reviewed studies followed ethical standards regarding participant consent, privacy, and safety in the context of clinical trials and interventions. The findings presented here are based on publicly available data and aim to contribute to evidence-based practices in health and wellness.

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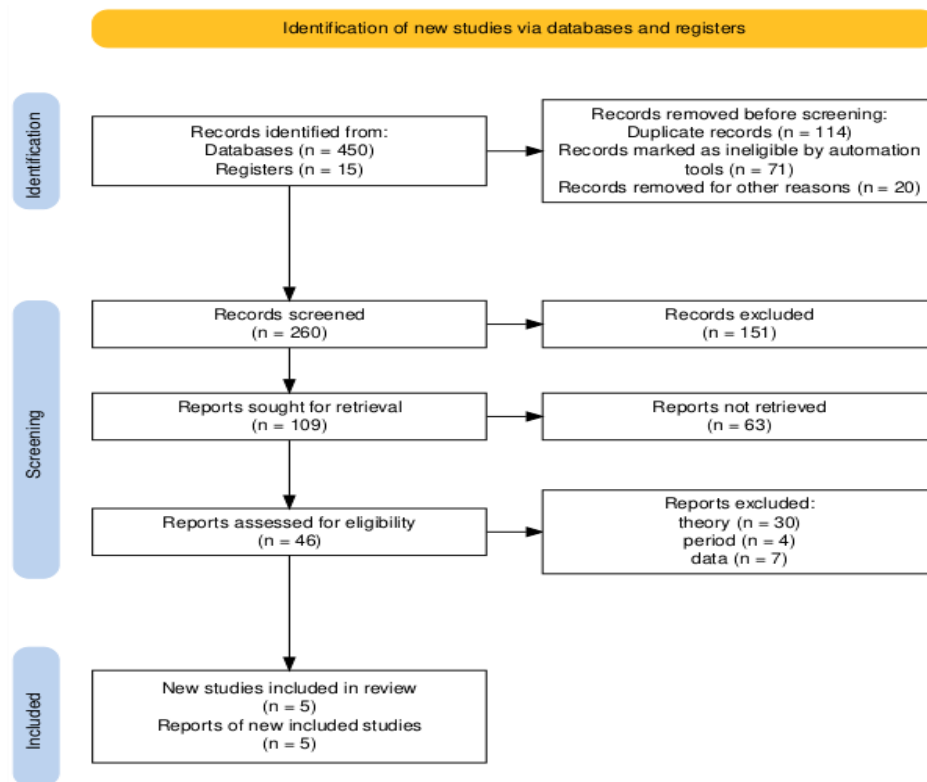


Figure 1. Diagram Alir PRISMA

Table 1. Results of a study on the effect of Zumba combined with *Citrus sinensis* 'Moro' on weight loss

Author	Title	Objective	Results
Rizki Oktaviana, et al., 2020 (12)	Effect Of Low-Impact Aerobic Dance and Zumba Exercise On Body Fat Percentage In Obese Women	To evaluate light aerobic exercise and Zumba in reducing body fat percentage in obese women based on body mass index (BMI).	Low-impact aerobic exercise is more effective in reducing women's body fat percentage at a heavy level, while Zumba is more effective in reducing body fat percentage at a mild level. Therefore, both have an effect in reducing body fat percentage.
Zala Nidhiba Mahendrasinh, et al., (13)	The Effects Of Zumba Dance and Low-Impact Aerobic Exercise On Body Fat Percentage In Patients With Obesity – A Comparative Study	To determine the effect of light aerobic exercise on body fat pesetas and Zumba exercise's effect on body fat percentage in obese patients.	Light aerobic exercise and Zumba dance improved BMI in obese patients.
Maisa Lmounier Magalhaes, et al., (14)	Effect Of Moro Orange Juice (<i>Citrus sinensis</i> (L.) Osbeck) On Some Metabolic and Morphological Parameters In Obese and Diabetic Rats	To chemically characterize 'Moro' orange juice. The effect of juice intake on metabolic parameters of obese, diabetic, or both mice through body mass management after anthocyanin activation during refrigerated storage was also assessed.	Orange juice consumption can reverse most metabolic changes in obese mice, including weight loss and improved biochemical profiles.
David Briskey, et al., (14)	Effectiveness of "Moro" Blood Orange <i>Citrus sinensis</i> Osbeck (Rutaceae) Standardized Extract on Weight Loss in Overweight but Otherwise Healthy Men and Women - A Randomized Double-Blind Placebo-Controlled Study	To determine the efficacy of <i>Citrus sinensis</i> 'Moro' red orange extract in weight loss in overweight but healthy individuals.	Standardized 'Moro' red orange extract can be a safe and effective alternative to aid weight loss when combined with diet and exercise.
Emerson Millay dan Ivo I. Kerppers (15)	Effectiveness Of Standardized Red Orange Extract (<i>Citrus Sinensis</i>) for Weight Reduction In Canine Obesity	Comparing the effectiveness of standardized red orange extract in reducing overweight in dogs compared to chromium picolinate and placebo	Adding red-orange extract to the diet of overweight and obese dogs can lead to weight loss and an increase in BCS.

Decrease in Leukocyte Levels Due to Oxygen Administration in Closed Aerobic Exercise: Case Study In Mice

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ABSTRACT

Background. Aerobic exercise in an enclosed space requires much oxygen for energy metabolism. If oxygen needs are not met, the production of free radicals will increase, causing oxidative stress and can trigger an increase in leukocyte levels. **Objectives.** This study aims to determine the effect of oxygen administration on closed aerobic exercise at various levels in honey-induced male mice. **Methods.** This study used an in vivo laboratory experimental method using a randomized complete block design (CRD). The study sample amounted to 30 mice, which were divided into six groups. Group (K-) is the group that was not given anything. The positive control group (K+1) was given 0.5 ml honey and open aerobic exercise but no oxygen. The positive control group (K+2) was given 0.5 ml honey and closed aerobic exercise, but no oxygen, and the treatment group (P1) was given 0.3 ml oxygen, 0.5 ml honey, and closed aerobic exercise. The treatment group (P2) was given 0.4 ml oxygen, 0.5 ml honey, and closed aerobic exercise. The treatment group (P3) was given 0.5 ml oxygen, 0.5 ml honey, and closed aerobic exercise. The maximum physical activity treatment was swimming and providing honey and oxygen in a closed aquarium for 7 days, which had previously been acclimatized for 7 days. Data were analyzed by one-way ANOVA at 0.05 level. **Results.** The results showed that oxygen administration had an effect ($p < 0.05$) on reducing the number of leukocyte levels. The most effective oxygen administration is in P3, with an oxygen concentration of 0.5 ml and 0.5 ml honey. **Conclusion.** Based on the results of the study, it can be concluded that aerobic exercise in the form of swimming in a closed aquarium that is given oxygen significantly reduces male mice leukocyte levels.

KEYWORDS: *Oxygen, Aerobic Exercise, Leukocytes*

INTRODUCTION

Physical exercise is necessary to maintain or improve fitness and prevent physical and mental illness. Aerobic exercise is one of the physical exercises that can improve nutritional status and physical function (1). Aerobic exercise is performed at a moderate or slow intensity, making the amount of oxygen available in the body sufficient to perform the exercise. However, aerobic exercise negatively impacts when not done correctly, regularly, and measuredly. Vigorous aerobic exercise can increase the production of free radicals in the body. The production of free radicals, such as reactive oxygen species (ROS), is inevitable during metabolism (2).

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Oxygen consumption increased with the addition of exercise types (3). During aerobic exercise, oxygen consumption in the body increases 20 times, while oxygen consumption by muscle fibers is estimated to increase up to 100 times. Increased oxygen consumption increases free radicals that cause cell damage. Oxidative stress is an imbalance between pro-oxidant and antioxidant forms, causing structural and oxidative changes in key biomolecules. Organic peroxides, misused proteins, and other oxidized biomolecules are sources of oxidative stress, which triggers oxidative disorders (4). Physical exercise is also a factor in the body's imbalance of free radical and antioxidant production, called oxidative stress. Oxidative stress from reactive oxygen species (ROS) increases due to muscle contraction (5,6). Continuous intense exercise stimulates a temporary increase in white blood cells known as "exercise-induced leukocytosis" (6). Therefore, this study aims to see the effect of oxygen administration in aerobic exercise on the leukocyte levels of male mice induced by honey.

Intermittent aerobic, resistance, high-intensity exercise, and other alternative modalities, such as swimming, provide an intense physical training force (7). Aerobic exercise can suppress the formation of reactive oxygen species (ROS) and increase the formation of adenosine triphosphate (ATP) (8). Oxidative stress is a change in the balance between producing reactive oxygen and nitrogen species (RONS, free radicals) (9). Oxidative stress causes cell damage due to an imbalance in the amount of free radicals with the amount of antioxidants in the body. Aerobic activity can increase leukocyte levels in the body. Honey is a natural food product with valuable nutritional value and therapeutic properties due to bioactive ingredients (10). Honey contains the minerals selenium and zinc, which act as antioxidants.

MATERIALS AND METHODS

Study Design. This study is an in vivo laboratory experimental study with a complete randomized design (RAL) using experimental animals. This research was conducted at the Animal Physiology Laboratory of the Department of Science FMIPA UNP and the Padang City Sejawat Laboratory. The tools used in this study are mice cages, scales, mice swimming pools, measuring cups, micropipettes, microtubes, honey storage bottles, hand scoops, and animal surgical tools (scalpels). The materials used were mice, EDTA tubes, honey, distilled water, rice husks, pellets, and drinking water. The study was conducted for 15 days, namely 7 days of acclimatization, 7 days of treatment, and 1 day of leukocyte test examination. On the last day of treatment, all samples were bled through the tail to be tested for leukocyte levels at the Sejawat Laboratory in Padang City.

Study Animal. The samples used in this study were male mice aged 2-3 months with a body weight of 20-30 g, as many as 30 mice divided into six groups.

Data Analysis. Data were analyzed by one-way analysis of variance (ANOVA) and followed by a Post Hoc Test using the Slightest Noteworthiness difference (LSD) with a significance value of $p < 0.05$.

RESULTS

The results of the study of oxygen administration in aerobic exercise on lymphocyte levels of male mice induced by honey obtained the following results. Normality and homogeneity test of data on the number of leukocyte levels obtained normal and homogeneous data distribution in all groups with significance values ($P > 0.05$).

Then, the ANOVA test (Post hoc test) was carried out using the LSD test at the 5% significance level to determine whether there were differences in each treatment. Based on the results of the LSD (Least Significance Different) test, it is known that there are significant differences in each oxygen treatment on the leukocyte levels of male mice induced by honey. However, some differences are not significant in several groups, and this is due to several factors, one of which is that mice experience stress when doing aerobic swimming exercises.

DISCUSSION

This study aims to determine the effect of oxygen administration on aerobic exercise on the leukocyte levels of male mice induced by honey—an increase in hematologic values such as leukocytes after aerobic or anaerobic exercise (11, 12). The body's oxygen needs are met when performing aerobic exercise in an enclosed space accompanied by oxygen delivery. So, it is necessary to utilize oxygen that contributes to maintaining the body's metabolism because adequate oxygen in an enclosed space can reduce the consequences of hypoxia, and the role of honey that is beneficial to the body can reduce oxidative stress during exercise (13–15). By doing so, the antioxidants in the body are out of balance and cause leukocytes to decrease. Honey is an endogenous antioxidant that acts as a free radical scavenger and modulates oxidative stress (16).

CONCLUSIONS

Providing oxygen to aerobic exercise in a closed room affects reducing leukocyte levels. A significant decrease in leukocyte levels occurred in P3, with an oxygen concentration of 0.5 ml and honey of 0.5 ml. Further studies are needed to explore this approach's long-term effects and potential clinical applications in

human populations.

APPLICABLE REMARKS

- This study highlights the potential benefits of combining oxygen administration with aerobic exercise in a controlled environment to mitigate the increased leukocyte levels caused by oxidative stress.
- The findings suggest that providing oxygen, particularly at a concentration of 0.5 ml, and honey supplementation can effectively support immune function during aerobic exercise.
- These results can be applied in health and fitness settings, particularly for individuals engaging in high-intensity or enclosed-space exercises, to enhance recovery and reduce exercise-induced oxidative stress.

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AUTHORS' CONTRIBUTIONS

Anggun Permata Sari, Rara Putri Maliza, Desi Purnama Sari, Anggi Yusriana, Tika Gustina, and Abdirrohim Muhammad Qori contributed to the study design, data collection, and analysis, with Anggun Permata Sari and Desi Purnama Sari taking the lead in drafting the manuscript. Bekir Car, Ratko Pavlović, and Jose Vicente Garcia Jimenez provided critical revisions and expert input on the methodology and results. Randi Kurniawan supervised the overall research process and coordinated the collaborative efforts. All authors contributed to the review and approval of the final manuscript.

CONFLICT OF INTEREST

The authors mention no "Conflict of Interest" in this study.

ETHICAL CONSIDERATION

This study was conducted under ethical guidelines for research involving human participants. Informed consent was obtained from all participants, including students and teachers, before their involvement in the field trials. Participants were assured of their anonymity and confidentiality, with all personal data being securely stored and used solely for research purposes. The study adhered to ethical standards, ensuring that no harm came to the participants and that they were free to withdraw from the study at any time without consequence. Additionally, the research was approved by the relevant educational and institutional ethics committees to ensure compliance with ethical norms and guidelines.

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Table.1 Research Group

No	Group	Exercise Type	Honey Dosage	Oxygen
1	K-	Not given anything	-	-
2	K+1	Open aerobic exercise	0,5 ml	-
3	K+2	Closed aerobic exercise	0,5 ml	-
4	P1	Closed aerobic exercise	0,5 ml	0,3 ml
5	P2	Closed aerobic exercise	0,5 ml	0,4 ml
6	P3	Closed aerobic exercise	0,5 ml	0,5 ml

Table.2 Anova test

ANOVA			
	df	F	Sig.
Between Groups	4	3.407	.028
Within Groups	20		

Swimming as A Cardiovascular Exercise Supports Heart Function: A Literature Review

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ABSTRACT

Backgrounds. Swimming as a cardiovascular exercise engages the entire muscle of the body and improves blood circulation, so it is effective in supporting heart health and function. **Objectives.** This article aims to review the literature on the benefits of swimming as a cardiovascular exercise in improving heart function and health. By reviewing previous research, this article is expected to provide a deeper understanding of the contribution of swimming to cardiovascular health. **Methods.** Used is a literature study that collects and analyzes research results related to swimming and cardiac function from scientific journals, health articles, and clinical research results. The data collected were analyzed descriptively to see the relationship pattern between swimming activity and improvement of cardiovascular function. **Results.** of the literature study show that swimming has a significant impact on improving heart function. Swimming exercises have been shown to increase heart volume, reduce the risk of hypertension, improve blood flow, and increase oxygen levels. Swimming as an aerobic exercise can also lower bad cholesterol (LDL) levels and increase good cholesterol (HDL), positively impacting blood vessel health and lowering the risk of heart disease. **Conclusion.** Based on a literature review, swimming is one exercise that effectively supports heart health. Swimming provides excellent benefits, such as cardiovascular exercise, with long-term effects on improving heart function and decreasing the risk of cardiovascular disease. Therefore, swimming is recommended as part of an active lifestyle to prevent heart disease and improve quality of life.

KEYWORDS: *Heart, Swimming, Health*

INTRODUCTION

Heart disease is one of the global health problems that causes a high mortality rate every year (1). A sedentary lifestyle and an unhealthy diet often contribute to the risk of heart disorders. As a form of cardiovascular exercise, swimming is considered effective in supporting heart health, as this sport engages almost all body muscles and improves blood circulation. By swimming regularly, heart capacity and blood flow efficiency can be improved, which ultimately helps to lower the risk of heart disease (2). Therefore, understanding the role of swimming in improving heart function is important to promote a healthy lifestyle and the prevention of cardiovascular disease.

Research on the effects of cardiovascular exercise on heart health has grown rapidly, with swimming being one of the main topics due to its unique characteristics as a low-intensity aerobic exercise suitable for a wide range of ages and fitness levels (3). In previous studies, swimming has been shown to improve cardiovascular capacity, lower blood pressure, and reduce the risk of coronary artery disease through improved blood circulation efficiency and heart function (4). Unlike land-based exercise, swimming lowers the load on the

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joints and allows for a steady intensity, making it an ideal alternative for individuals with physical limitations or risk of injury. Recent literature reviews also show that swimming has the potential to improve blood lipid profiles and lower bad cholesterol (LDL) levels, which are key factors in the prevention of heart disease. However, more research is still needed to understand the optimization of swimming programs in improving cardiovascular health in a more specific and measurable way (5).

MATERIALS AND METHODS

The method used in this study is a systematic literature study that collects and analyzes various scientific sources regarding the influence of swimming as a cardiovascular exercise on heart function. The data collection process is done by searching for articles from leading academic databases such as PubMed, Google Scholar, ScienceDirect, and Scopus WoS, including research published in the last five years. Inclusion criteria include studies evaluating the effects of swimming on cardiovascular health, measuring cardiac function, and analyzing relevant data. After collection, articles that met those criteria were analyzed descriptively to identify consistent patterns and findings regarding the benefits of swimming in improving heart health. With this approach, it is hoped that a comprehensive picture of the role of swimming in supporting cardiovascular function can be obtained.

RESULTS

Table 1 is a critical appraisal analysis from 5 journals.

DISCUSSION

Swimming as a cardiovascular exercise shows that this sport has significant heart health benefits (11). As a form of physical activity involving the entire body muscle, swimming increases heart rate and breathing, improving blood circulation and oxygenation of body tissues (12). Studies show that individuals who regularly swim experience increased heart capacity, measured through increased heart volume and blood pumping efficiency. In addition, swimming is also effective in lowering blood pressure and bad cholesterol (LDL) levels, as well as increasing good cholesterol (HDL), which is an important factor in preventing coronary heart disease. Thus, swimming can be considered as one of the effective prevention strategies in maintaining cardiovascular health (13).

Furthermore, the advantage of swimming as a cardiovascular sport is its low impact on the risk of injury (14). Unlike land sports, which can put excessive pressure on the joints, swimming is done in the water, thereby reducing the load received by the body. This makes swimming a safe option for individuals with certain physical conditions or those in rehabilitation. In addition, these activities can also be done by people of different age groups, making them an inclusive option for increasing physical activity. Therefore, a structured and regular swimming program can be integrated into a healthy lifestyle to improve heart health and overall quality of life.

CONCLUSION

This study shows that swimming as a cardiovascular exercise significantly improves heart function and health. A literature review has proven that swimming improves cardiovascular capacity and helps lower blood pressure, reduce harmful cholesterol levels, and increase good cholesterol, all of which contribute to the prevention of heart disease. With its wide range of benefits and low risk of injury, swimming is an ideal alternative for increasing physical activity for healthy individuals and those with certain medical conditions. Therefore, encouraging regular swimming practice can effectively support heart health and improve overall quality of life.

APPLICABLE REMARKS

- Swimming provides excellent benefits, such as cardiovascular exercise, with long-term effects on improving heart function and decreasing the risk of cardiovascular disease.
- Therefore, swimming is recommended as part of an active lifestyle to prevent heart disease and improve quality of life.

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Study concept and design: Syahrastani, Dally Rahman. Acquisition of data: Fiky Zarya, Dally Rahman, Zulbahri, Yaslindo. Analysis and interpretation of data: Fiky Zarya, Zulbahri. Drafting the manuscript: Fiky Zarya, Dally

Rahman, Zulbahri. Critical revision of the manuscript for important intellectual content: Fiky Zarya. Statistical analysis: Fiky Zarya. Administrative, technical, and material support: Dally Rahman, Zulbahri. Study supervision: Syahrastani.

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The Guidelines for Research Ethics and Scientific Publication of Universitas Negeri Padang were unanimously decided by the members participating in the meeting to provide this document as the "Ethics Committee Approval Document" for the research.

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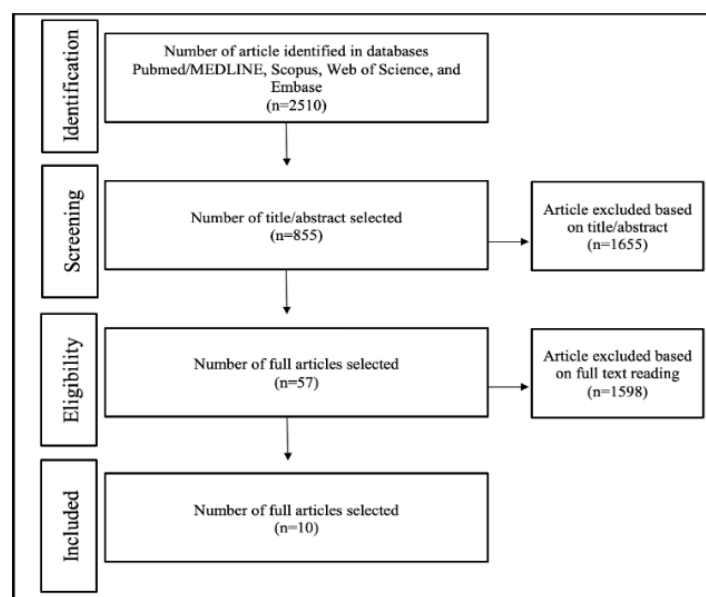


Figure 1. PRISMA flowchart of the article selection process

Table 1. Literature Review Summary of Results

Researchers	Article Title	Research Results
(6)	Using heart rate and acceleration biologgers to estimate winter activity costs in free-swimming largemouth bass	Heart rate recordings were high-quality during holding but dropped during experimentation, potentially due to interference from aerobic muscles during swimming. The models informed by acceleration or swimming speed appear best suited for field applications.
(7)	Heat stress affects swimming performance and induces biochemical, structural, and transcriptional changes in the heart of <i>Gymnocypris eckloni</i>	Our study offers a systematic exploration of the effects of heat stress on <i>G. eckloni</i> , providing valuable insights for cultivating high-altitude fish.
(8)	A High-intensity Interval training (running and swimming) and resistance training intervention on heart rate variability and the selected biochemical factors in boys with type 1 diabetes	The present study suggests the importance of early screening for CVD risk factors in adolescent males with T1D. Also, it was revealed that HIITR training, compared to other training patterns, improves cardiovascular health via the enhancement of autonomic modulation, VO2peak, plasma lipids, and catecholamine levels.
(9)	Secondary data analysis using Evidence-Based Bayesian Networks with an application to investigate the determinants of childhood stunting	Results from the experiment indicate that heart rate and swimming activity can be used as proxies for fish stress, thus opening the possibility for online stress monitoring in full-scale production.
(10)	Determining VO2max in competitive swimmers: Comparing the validity and reliability of cycling, arm cranking, ergometer swimming, and tethered swimming	Bicycle and tethered swimming tests demonstrated high validity with comparable VO2max estimates, explaining many differences in endurance performance. Choosing between these two methods involves a trade-off between the higher practical applicability and reliability of the bicycle test and the more sport-specific nature of the tethered swimming test.

Effectiveness of Kegel Exercise as an Intervention to Reduce Pain in Parturients

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ABSTRACT

Background. Pregnancy and childbirth are often followed by various complaints, one of which is pain, which can interfere with maternal comfort and postpartum recovery. One approach that can be used to reduce pain in laboring women (parturient) is Kegel exercises. **Objectives.** This study tests the effectiveness of Kegel gymnastics on pain levels during labor by providing different exercises in walking and Kegel gymnastics groups. **Methods.** The research method in this study was quasi-experimental with a Two Group Pre-Post Test Design research design. Experimental research is a study that conducts experimental activities (experiments) that aim to determine changes that arise due to specific treatments or experiments. After that, the subjects were divided into the walking group (K) and the Kegel exercise group (KD). Sixty-seven pregnant women in the second trimester who met the inclusion criteria were divided into different groups for treatment according to their respective groups. They continued to be monitored after delivery, with samples taken from Nagari Mahat. **Results.** The test results obtained a Sig.2-tailed value of 0.004 <0.05; it can be concluded that there is a significant difference in the average healing time of perineal wounds between the Kegel exercise group and the walking group. **Conclusion.** Kegel exercises can be a safe and effective alternative non-pharmacological intervention to reduce pain in laboring women while accelerating and facilitating the postpartum recovery process.

KEYWORDS: *Kegel Exercises, Pain, Parturient*

INTRODUCTION

Frequent pain during pregnancy, such as back or pelvic pain, is common and can cause discomfort enough to interfere with daily activities, even affecting the quality of life of pregnant women. The increased weight of the uterus and hormone-induced loosening of the pelvic joints cause back and pelvic pain, with pain increasing in the second trimester (1).

Identifying pain symptoms that occur during pregnancy, such as back or pelvic pain, is very important to determine appropriate treatment to reduce discomfort and improve the quality of care for pregnant women (2). The pain felt during labor when kinesio taping elastic bandages on the spine after being evaluated did not show results and did not provide changes in the mother giving birth. Currently, treatment is as difficult as drugs pose

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a risk to the fetus. However, there is evidence of low to moderate effectiveness with recommended non-pharmacological treatments for pain (3). Postpartum pain has a perineal wound with pain and discomfort during activities, so methods to manage pain by providing non-pharmacological methods tend to have no effect (4).

Kegel exercises are a type of exercise that everyone can do with Kegel muscles or pubococcygeal muscles (5). These muscles help keep the limbs in their original position to keep the spine fit (6). Kegel exercises can be achieved by stretching and relaxing the spinal muscles postpartum (7). This can reduce pressure on the spine and strengthen it in and around the vaginal muscles, improving blood circulation.

Various exercises can help with spinal weakness and loosen the muscles, and they range from physical therapy to surgery. One of the most popular exercises is the Kegel exercise because many people find it easy daily. Kegel exercises are performed with specific movements to provide optimal benefits. The degree of contraction, retention time, and fixation varies between participants. Currently, there is no established protocol for Kegel exercises, but the basic rules include: first, finding the right muscle to stop or slow down urination; second, formally contracting the muscle as previously described; and third, repeating the cycle (8).

Kegel exercises can be combined with biofeedback and electrotherapy to strengthen recovery outcomes and provide more significant benefits. Devices such as perineometers, kegel masters, and vaginal cones can be used in conjunction with Kegel exercises to strengthen the pelvic floor muscles, thus helping to improve their strength and function (9). Many people can contract the hip adductor, abdominal, and gluteal muscles during exercise, but not the pelvic floor muscles. In addition, alternating fast and slow muscle contractions are an important feature of this process.

Regarding the effectiveness of Kegel exercises as a recommendation to strengthen pelvic muscles after childbirth, research shows consistent results in strengthening pelvic muscles. Kegel exercise method recommended by the International Association of Urinary Incontinence with 6-8 exercises to contract the pelvic muscles for a few seconds with 1 day 8-10 repetitions with a duration of a week (10). In addition, Kegel exercises can traditionally be performed one-on-one or in a group under the supervision of a trained nurse or physical therapist, or patients can learn them on their own by looking at the training booklet (11).

Some studies show different results depending on whether the patient accurately recognizes and exercises the pelvic floor muscles, how much the therapist and patient trust and seriously practice the exercises to tighten the muscles postpartum, and how long the exercises are performed.

MATERIALS AND METHODS

The research design in this study was quasi-experimental with a Two Group Pre-Post Test Design research design. Experimental research is a study that conducts experimental activities (experiments) that aim to determine changes that arise due to specific treatments or experiments. The research time was conducted in May 2024—the place of research in Mahat. The sample in this study were postpartum women with 1st and 2nd-degree birth canal lacerations. The number of samples in this study was 67 respondents divided into 37 control groups and 30 Kegel exercise groups. Bivariate analysis was conducted to see the effect before and after the provision of Kegel exercises on the healing time of perineal wounds using the Mann-Whitney test.

RESULTS

Based on Table 1, it can be seen that there is an average difference in the group given exercise in the form of Kegel exercises, namely 4 days, while the average time to relieve pain in the control group is 5 days. Based on the results of the Mann-Whitney test, the Sig.2-tailed value is 0.004 <0.05; it can be concluded that there is a significant difference in the average pain healing time between the Kegel exercise group and the control group so that providing care in the form of Kegel exercises for mothers who experience postpartum pain and effective in accelerating healing time.

Table 2 shows that Kegel exercises are effective in treating pain during childbirth because there is a significant difference in mean values between the intervention and control groups, in other words, the effect of Kegel exercises on handling pain after childbirth. The statistical test results provide a p-value of 0.028 (p-value < α = 0.05), namely, there is an effect of Kegel exercises on handling the pain level in childbirth. Kegel exercises compared to walking have a difference of 1.13 points, which means that Kegel exercises can be said to help relieve the pain experienced.

DISCUSSION

Low back pain and pelvic pain are common in pregnancy and increase with gestational age. The pain sometimes spreads to the hips, legs, and feet (12). Exercise during pregnancy has many benefits, including alleviating back pain (13). Exercise during pregnancy has many benefits, such as reducing pain in the back,

lower abdomen, and buttocks (14). Current guidelines recommend that healthy pregnant women perform a minimum of 15 minutes of moderate-intensity exercise at the target intensity for 3 days 8 - 10; however, some pregnant women are limited by their physical condition and cannot perform exercise activities.

Therefore, less intense training may be more appropriate. However, although few systematic reviews have been conducted on strategies to reduce pain with exercise, they are very effective.

CONCLUSIONS

Kegel exercise effectively reduced pain in parturient, with the results of the Mann-Whitney test showing a p-value of $0.004 < 0.05$, which means a significant difference. Further research with larger sample sizes and long-term follow-up is suggested to strengthen the evidence on the sustained benefits of Kegel exercises on maternal health and recovery.

APPLICABLE REMARKS

- This study demonstrates that Kegel exercises are an effective non-pharmacological intervention for reducing pain in laboring women and accelerating postpartum recovery, particularly in those experiencing perineal wounds.
- Given the positive results, Kegel exercises can be recommended as part of routine care for pregnant women, especially in managing postpartum pain and enhancing the recovery process.
- Healthcare providers, including midwives and obstetricians, should consider incorporating Kegel exercises into prenatal and postnatal care programs to offer a safe, cost-effective alternative to pain management.

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AUTHORS' CONTRIBUTIONS

Iit Selviani conceptualized and designed the study, performed data analysis, and wrote the initial draft. Anggun Permata Sari contributed to data collection, analysis, and interpretation of the results. Tika Gustina and Rara Putri Maliza assisted with data collection and contributed to the manuscript revision. Anggi Yusriana analyzed the data and conducted the literature review. Abdirrohim Muhammad Qori reviewed the literature and helped edit the manuscript. Bekir Car supervised the research, analyzed the data, and reviewed the manuscript. Ratko Pavlović conducted statistical analysis and interpreted the findings. Jose Vicente Garcia Jimenez contributed to the methodology and manuscript writing, while Randi Kurniawan managed the project, provided methodology input, and edited the manuscript. All authors read and approved the final version of the manuscript.

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The authors mention no "Conflict of Interest" in this study.

ETHICAL CONSIDERATION

This study was conducted under ethical guidelines for research involving human participants. Informed consent was obtained from all participants, including students and teachers, before their involvement in the field trials. Participants were assured of their anonymity and confidentiality, with all personal data being securely stored and used solely for research purposes. The study adhered to ethical standards, ensuring that no harm came to the participants and that they were free to withdraw from the study at any time without consequence. Additionally, the research was approved by the relevant educational and institutional ethics committees to ensure compliance with ethical norms and guidelines.

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Table 1. Average Between Control Group and Kegel Gymnastics Group (n=67)

Kelompok	Mean	N	Std. Deviation	Std. Error Mean
Kontrol	5.43	37	1.14	,188
Senam Kegel	4.60	30	1.07	,195

Table 2. Effectiveness of Kegel exercises on pain levels during childbirth (n=67)

	Mean Rank	Z	N	Lower	Upper	Sig.
Kontrol	40.03	-2.90	37	0.27	1.37	67 .004
Senam kegel	26.57		30			

The Effect of High-Impact Aerobic Exercise on Body Fat Percentage of Nutritional Status

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ABSTRACT

Background. Obesity has become a global health problem due to high-calorie lifestyles and diets, resulting in increased body fat accumulation and health risks. The most optimal high-impact aerobic exercise to reduce body fat may vary based on an individual's fitness level and nutritional status. **Objectives.** This study aims to determine (1) the difference in the effect of high-impact aerobic exercise training on reducing the percentage of body fat, (2) the difference in reducing the percentage of body fat between members of the gymnastics studio La Diva with adequate and obese nutritional status, (3) the interaction effect between gymnastics training and nutritional status on reducing the percentage of body fat. **Methods.** This study used an experimental method with a 2 x 2 factorial design. The population of this study were all members of the La Diva gymnastics studio. The sampling technique used purposive random sampling, and the sample size was 40 La Diva Gymnastics Studio members. **Results.** Based on the results of the analysis, the following conclusions were drawn: (1) The effect of high-impact aerobic exercise is more influential in reducing the percentage of body fat (2) There is a difference in reducing the percentage of body fat between members of the gymnastics studio who have acceptable nutritional status with obese nutritional status. (3) There is an interaction effect between aerobic exercise and nutritional status on reducing the percentage of body fat. **Conclusions.** The results of this study conclude that La Diva gymnastics studio members with good nutritional status are suitable if they follow high-impact aerobic exercise.

KEYWORDS: *High Impact Aerobics, Body Fat Percentage, Nutritional Status*

INTRODUCTION

Everyone can make efforts to improve health through activities to regulate fat in the body correctly (1)(2). In addition to dietary regulation, exercise is a simple and inexpensive effort to improve health, as long as it is accompanied by knowledge and understanding of the correct health of exercise (3). Anthropometry and body composition are data in descriptive statistics used in human performance (4). These measurements are important assessments in research. Height, weight, and body composition are important descriptors and contribute to assessing health and fitness.

The result of accumulating fat due to an irregular diet will cause obesity, which has an impact on narrowing blood vessels due to being squeezed by fat (5). The presence of fat in the body is significant, among others, to protect against cold weather, as an energy reserve when using carbohydrates, as a source of essential fatty acids, as a means of transporting fat-soluble vitamins, and as a protector of internal organs (6). However, if the body's fat exceeds normal, it will be a big problem. In addition to the body looking less attractive, it is susceptible to some diseases (7). The standard ratio of body fat to body weight is about 25-30% in women and 18-23% in men. In contrast, the ratio of the amount of body fat is generally stored as follows: 50% in the tissue under the skin (subcutaneous), 45% around the organs in the abdominal cavity, and 5% in the intramuscular tissue (8).

If the hoarding increases, anatomical changes will occur; namely, in women, there is a buildup of fatty tissue around

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the hips, thighs, arms, waist, and abdomen. Meanwhile, in men, fat tissue accumulation generally occurs in the abdomen. Fat thickness under the skin is one of the anthropometric indices used to measure nutritional status, depending on body weight, gender, age, and activity (9). Measuring the thickness of fat under the skin can estimate the body's fat amount, especially in adults (6). The measurement is done by summing the body parts using a Skinfold Caliper. Skinfold measurement is a popular assessment of body composition. The principle of skinfold measurement is that subcutaneous fat is proportional to total body fat. The percentage of body fat can be calculated through the regression equation (10) by measuring the skinfold thickness at various places on the body.

Aerobic exercise is divided into two parts: low impact, Suitable for seniors according to their excitatory threshold, and high impact. Suitable for trained people. There is also another form of aerobic exercise from the two forms of aerobic exercise, namely mixed impact aerobic exercise. It has a mixed impact because the movements combined have high and low impact (11). This form of aerobic exercise is considered suitable for the community in general, significantly reducing the resting pulse rate, overcoming the lack of movement, and avoiding obesity to maintain physical fitness (12).

The selection and application of methods in aerobic exercise training for members of La Diva Gymnastics Studio so that aerobic exercise can reduce the percentage of body fat in this study will be tried aerobic exercise applied in the process of reducing the percentage of body fat, namely high impact aerobic exercise training to reduce the percentage of body fat. Aerobic exercise with high intensity will have more of an effect on increasing physical fitness. High-intensity aerobic exercise is commonly called high-impact exercise (4).

The reduction in body fat percentage is also determined by excess body weight. Human body weight comprises several components, namely fatty and lean tissues (13)(14). During childhood, there is little difference in body fat percentage between males and females, but from preadolescence to adolescence, girls will have more body fat than boys (10)(11).

Fat thickness under the skin is one of the anthropometric indices used to measure nutritional status, depending on body weight, gender, age, and activity. Measuring the thickness of fat under the skin can estimate the body's fat amount, especially in adults (15). The measurement is done by summing the body parts using the Skinfold Caliper. Being overweight (obese) is one of the criteria for nutritional status, with excessive fat accumulation in the body. Advances in science, technology, and economics have created an environment with a sedentary or sedentary lifestyle and a diet that is high in calories and fat and lacks exercise, so obesity is a plague that is rampant throughout the world.

It is necessary to conduct experimental research to reduce body fat percentage. The object is the La Diva gymnastics studio members, namely "The Effect of High Impact Aerobic Gymnastics Training on Decreasing Body Fat Percentage Judging from Nutritional Status (Experimental Study on Members of La Diva Gymnastics Studio."

MATERIALS AND METHODS

This study used an experimental method with a 2 x 2 factorial design. The population of this study were all members of the La Diva gymnastics studio. The sampling technique used purposive random sampling, and the sample size was 40 La Diva Gymnastics Studio members. Data analysis using ANOVA, data analysis prerequisite test using sample normality test (Lilliefors test with $\alpha = 0.05\%$), and variance homogeneity test (Bartlett test with $\alpha = 0.05\%$).

RESULTS

Data Description is presented in Table 1. Hypothesis Testing is presented in Table 2.

DISCUSSION

High-impact aerobic exercise training is increasingly recognized in sports as effectively reducing body fat percentage(4). However, further research is needed to understand how these exercises impact individuals with different nutritional statuses. This study aimed to explore the effects of high-impact aerobic exercise in the context of body fat loss in subjects with various nutritional statuses. This study concluded that gymnastics studio members with acceptable nutritional status are more suitable if given high-impact aerobic exercise.

CONCLUSIONS

Based on the research results and the data analysis, the following conclusions can be obtained: 1) The effect of high-impact aerobic exercise is more influential in reducing the percentage of body fat. 2) There is a difference in reducing body fat percentage between members of the gymnastics studio who have acceptable nutritional status and obese nutritional status. The decrease in body fat percentage in gymnastics studio members who have acceptable nutritional status is more significant than members of the gymnastics studio who have obese nutritional status. 3) There

is an interaction effect between aerobic exercise and nutritional status on reducing the percentage of body fat h. So, it can be concluded that gymnastics studio members with acceptable nutritional status are more suitable if given high-impact aerobic exercise.

APPLICABLE REMARKS

- This study highlights that high-impact aerobic exercise is particularly effective in reducing body fat percentage for individuals with acceptable nutritional status.
- For those with obesity, while benefits are still evident, combining high-impact exercises with other moderate activities may offer better results.
- Fitness professionals should tailor exercise programs based on an individual's nutritional status to optimize body fat reduction and ensure safety.
- This approach is crucial for gyms and fitness centers in designing personalized, effective fitness plans for their members.

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AUTHORS' CONTRIBUTIONS

Hilmainur Syampurma, Sri Gusti Handayani, conceptualized the study, with Hilmainur Syampurma taking the lead in data collection and analysis. Sri Gusti Handayani contributed to the study design and supervised the research process. Hilmainur Syampurma assisted with the statistical analysis and interpretation of the results. Edwarsyah and Rika Sepriani provided critical insights during the data analysis phase. Maifina Sri Ningsih contributed to the literature review and manuscript writing. All authors reviewed and approved the final manuscript.

CONFLICT OF INTEREST

The authors mention no "Conflict of Interest" in this study.

ETHICAL CONSIDERATION

This study was conducted under ethical guidelines for research involving human participants. Informed consent was obtained from all participants, including students and teachers, before their involvement in the field trials. Participants were assured of their anonymity and confidentiality, with all personal data being securely stored and used solely for research purposes. The study adhered to ethical standards, ensuring that no harm came to the participants and that they were free to withdraw from the study at any time without consequence. Additionally, the research was approved by the relevant educational and institutional ethics committees to ensure compliance with ethical norms and guidelines.

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Table 1. Data Description of Test Results of Body Fat

Treatment	Nutrition Status Level	Statistics	Test Results Initial	Test Results End	Decline
High impact aerobic exercise	Acceptable	Total	299.600	273.100	26.500
		Average	29.960	27.310	2.650
		SD	1.138	1.399	0.571
	Obese	Total	360.200	313.900	46.300
		Average	36.020	31.390	4.630
		SD	2.374	2.621	1.277

Table 2. Summary of Two-Factor Analysis of Variance Results

Source Variations	dk	JK	RJK	F _o	F _t
Average Treatment	1	421.85	421.85		
A	1	6.17	6.17	5.810	*
B	1	8.58	8.58	7.938	*
AB	1	11.14	11.14	10.314	*
Fallacy	36	38.85	1.08		
Total	40	486.59			

The Effects of Physical Endurance, Nutritional Status, and Motivation on Fitness in Primary School Children: A Cross-Sectional Study

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ABSTRACT

Background. Many factors affect the physical fitness of female students, including endurance, nutritional status, and motivation. **Objectives.** This study aims to determine the influence of endurance, nutritional status, and motivation on the physical fitness of female students. **Methods.** It employs a correlational quantitative approach using a path analysis model. The study population consists of primary school students in Padang City, and the sample was selected using purposive sampling, totaling 30 students aged 9–12 years old. Research instruments included a 20-meter *multistage shuttle run*, BMI measurements, a motivation questionnaire, and TKSI, with IBM SPSS 25.0 used for data analysis. **Results.** The findings were as follows: (1) endurance had a direct effect on physical fitness, contributing 11.02%; (2) nutritional status had a direct effect on physical fitness, contributing 54.2%; (3) learning motivation had a direct effect on physical fitness, contributing 4.24%; (4) there was an indirect effect of endurance on physical fitness through learning motivation, accounting for 16.48%; (5) there was an indirect effect of nutritional status on physical fitness through learning motivation, accounting for 57.91%; and (6) there was a combined effect of endurance, nutritional status, and motivation on physical fitness, totaling 29.16%. **Conclusion.** Nutritional status is the most dominant factor influencing the physical fitness of primary school students, both directly and indirectly, through learning motivation.

KEYWORDS: *Endurance, Nutritional Status, Motivation, Physical Fitness*

INTRODUCTION

Physical fitness is a correlation between physical condition based on physical requirements of an anatomical and physiological nature, where endurance plays a role in influencing physical freshness (1). Cardiorespiratory health is an essential indicator of fitness and a crucial health indicator in physical education (2,3). Additionally, a balanced nutritional strategy is important in enhancing physical fitness for daily activities, as nutritional status is influenced by one's dietary intake and energy expenditure (4,5). Proper nutrient consumption in students supports growth and development, not only physically but also in brain cell growth, intelligence development, and more. Motivation is also vital in enhancing student performance, as students need intrinsic and extrinsic motivation. When motivation decreases, students may become less interested in the learning process. Therefore, self-motivation, including desires, willingness, seriousness, perseverance, curiosity, and external motivation, such as support from parents, teachers, and friends, are necessary to foster students' academic achievement and inform effective educational strategies (6). Based on observations while teaching at a primary school in Padang, students' physical fitness has yet to reach an optimal level. This is evident in physical education classes, where many female students struggle to perform

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physical education movements. Moreover, according to the Minimum Competency Criteria with a threshold of 75, the average Mid-Semester Exam scores do not meet this minimum standard. This applies to both practical and theoretical assessments, with many students scoring below the school's Minimum Competency Criteria and struggling to explain theoretical aspects of the physical movements tested in practical exams. These data indicate that physical fitness levels at primary school in Padang remain relatively low, contributing to frequent fatigue among female students. This study aims to determine the influence of endurance, nutritional status, and motivation on the physical fitness of female students.

MATERIALS AND METHODS

This research employs a quantitative associative method with a path analysis approach. The exogenous variables in this study are endurance (X1), nutritional status (X2), and learning motivation (X3), which influence the endogenous variable of physical fitness (Y). Additionally, motivation (X3) serves as an intervening or mediating variable.

In this study, the population consists of 143 students. Purposive sampling is a sampling technique based on specific considerations. The sample for this study includes only female students from upper grades, totaling 30 students: 10 fourth-grade, nine fifth-grade, and 11 sixth-grade students. The dependent variable in this study is physical fitness, measured using the TKSI Phase instrument. Nutritional status is measured using the Body Mass Index (BMI) test while learning motivation is assessed through a questionnaire. The data analysis technique used for hypothesis testing is Path Analysis. Data analysis includes 1) data description, 2) analysis prerequisites, which consist of data normality and linearity tests, and 3) path analysis, which involves model testing and hypothesis testing.

RESULTS

Normality Test. The normality test aims to determine whether the residual values are normally distributed. The results of the normality test based on residual values using the help of the SPSS Program version 25.0 can be seen in Table 1. Based on the normality test calculation results using the *Komogrov-Smirnov* test, the price of the probability value > 0.05 . Thus, it can be concluded that all data groups in the study are normally distributed

Linearity Test. The Linearity Test aims to see if each data test criteria if the Sig value $> \alpha$ value = 0.05, then the data is said to be linear. If it is the other way around, the data is not linear. The following is a description of the results of the Linearity test in Table 2. The summary results of the research hypothesis test can be seen in Table 3. Based on the research conducted, it can be known that the research hypothesis of the sig $> \alpha$ 0.05, then the data is significant— H_a Accepted, which means that the efficiency of path analysis positively influences physical fitness.

DISCUSSION

Research findings indicate that endurance directly and positively influences the physical fitness of female students. Endurance emphasizes a state of continuous work capacity. Cardiorespiratory endurance is a key factor in physical fitness (7). Inadequate food intake can reduce endurance, as a healthy and fit body helps prevent illness, enabling students to continue their daily activities. Proper nutrition is crucial for optimal endurance performance (8,9). Despite differences in body composition, mechanical output, and absolute energy expenditure, the contribution of energy systems appears to have similar metabolic effects between males and females (10). In this regard, the role of physical education teachers is crucial for the successful implementation of effective physical education programs related to endurance, nutritional status, and student motivation. Teachers must be motivated to help students achieve an ideal level of fitness. They are tasked with teaching academic subjects and educating in the broader sense, which involves nurturing maturity of mind and behavior (11,12). Proper motivation in the learning process leads to better outcomes. Student motivation is necessary and even sufficient for success in distance learning (13). Another benefit of physical fitness is its support for individuals' capacity and productivity, making it especially beneficial for school-age children to develop strength, capability, creativity, and endurance, thus enhancing their stamina (14). Combining physical education and exercise motivation is also vital in ensuring successful learning outcomes in schools.

CONCLUSION

Based on the results of this study, several factors have direct and indirect effects on the physical fitness of female students at primary schools in Padang City. These findings indicate that endurance, nutritional status, and motivation are complementary factors that contribute to improving the students' physical fitness.

APPLICABLE REMARKS

- Evaluation of endurance ability, nutritional status, and motivation on the physical fitness of elementary school students, which can be used as an analysis of learning outcomes of elementary school students, especially in sports practice.

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AUTHORS' CONTRIBUTIONS

Concept and design of the study: Tjung Hauw Sin. Data acquisition: Riska Ramadani Lasri. Data analysis and interpretation: Firunika Intan Cahyani. Compiled the script: Tjung Hauw Sin. Critical revision of the manuscript for important intellectual content: Tjung Hauw Sin. Statistical analysis: Suci Nanda Sari. Administrative, technical, and material support: Padli. Study supervisor: Tjung Hauw Sin.

CONFLICT OF INTEREST

The authors mention no "Conflict of Interest" in this study.

ETHICAL CONSIDERATION

This research has met the standards of research ethics and has received approval to be a sample of all respondents.

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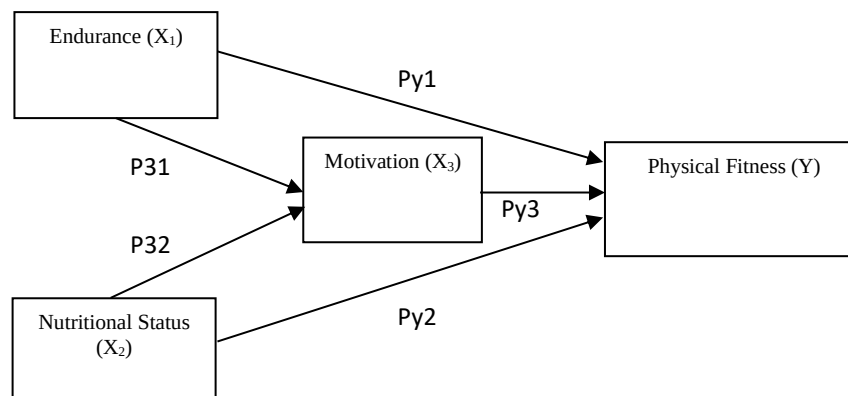


Figure 1. Research Design

Table 1. Normality Test

	Kolmogorov-Smirnov ^a		
	Statistic	df	Sig.
Endurance	.283	30	.901
Nutritional Status	.205	30	.220
Motivation	.124	30	.200
Physical Fitness	.123	30	.210

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Table 2. Linearity Test

Linearity	F _{count}	P _{value}	α	Conclusion
Physical Fitness (Y) over Endurance (X ₁)	1,57	0,885	0,05	Linear
Physical Fitness (Y) on Nutritional Status (X ₂)	0,830	0,634	0,05	Linear
Physical Fitness (Y) over Motivation (X ₃)	2,088	0,101	0,05	Linear
Endurance (X ₁) over Motivation (X ₃)	0,273	0,763	0,05	Linear
Nutritional Status (X ₂) on Motivation (X ₃)	0,938	0,574	0,05	Linear

Table 3. Hypothesis testing

Direct influence between variables	Path Coefficient	α	Conclusion
X ₁ to Y(P _{y1})	0,332	0,05	Significant
X ₂ to Y(P _{y2})	0,736		Significant
X ₃ to Y(P _{y3})	0,296		Significant
X ₁ to X ₂ (P ₂₁)	0,756		Significant
X ₁ to X ₃ (P ₃₁)	0,251		Significant
X ₂ to X ₃ (P ₃₂)	0,083		Significant

The Effectiveness of a Tennis Training Model with a Holistic Approach on Junior Athletes' Backhand Drive

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ABSTRACT

Background. Using the Hewitt Tennis Achievement Test, this study evaluates the effectiveness of a holistic tennis training model on junior athletes' backhand drive ability, considering physical, technical, mental, and emotional aspects. **Objectives.** To compare the effectiveness of a holistic approach versus traditional training in improving the backhand drive of junior athletes. **Methods.** An experimental design with pre-test and post-test was used. Twenty-two junior athletes were randomly divided into the experimental (holistic approach) and the control (traditional training) groups. Training was conducted 3 times a week for 8 weeks. Data were collected through backhand drive skill tests before and after the intervention. **Results.** In the experimental group, the average score increased from 11.36 to 16.73, with a standard deviation reduction (4.61 to 3.13). The t-value (6.04) was more significant than the t-table value (2.23), indicating that the holistic approach was practical. In the control group, the average score increased from 12.55 to 15.45, with a standard deviation reduction (4.083 to 1.440). The t-value (2.451) exceeded the t-table value, showing the traditional method's effectiveness. **Conclusion.** The holistic approach was found to be more effective in improving the backhand driveability of junior athletes compared to conventional methods, as evidenced by the higher post-test scores and greater t-values.

KEYWORDS: *Tennis, Holistic Approach, Backhand Drive, Junior Athletes*

INTRODUCTION

Tennis has become one of the most popular sports worldwide, enjoyed by professionals and young players. In this context, mastering basic skills, such as the backhand drive technique, is crucial for every player. An effective backhand drive influences match outcomes and plays a key role in an athlete's higher-level success (1). Despite many coaches and players recognizing the importance of this technique, challenges remain in consistently developing this ability. One of the main challenges in mastering the backhand drive technique is that tennis requires high technical skills. The backhand drive is a critical shot that often determines the outcome of a match (2). Therefore, a holistic approach that includes physical, mental, and emotional aspects must be considered. As noted, integrating mental relaxation techniques with physical training, such as in Virtual Mind and Body Relaxation (VMBR) training, can significantly improve performance (3–9). Although the holistic approach has proven effective in several contexts, research assessing its impact on backhand driveability in tennis is minimal. Most existing research focuses more on technical or physical aspects without considering the mental and emotional elements that can contribute to athlete performance. This creates a gap in the literature, especially in junior tennis, where developing basic skills is crucial. This aligns with the findings, which noted that incorporating psychological dimensions such as anxiety reduction and mental toughness can

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significantly improve performance in table tennis players, suggesting similar benefits could be observed in tennis training.

MATERIALS AND METHODS

This study aims to evaluate the impact of a holistic approach-based tennis training model on the backhand drive performance of junior athletes. An experimental design with control and experimental groups allows for systematically investigating cause-and-effect relationships between training methods and performance outcomes. The selection criteria included age 14-18 years, a minimum of 2 years of tennis playing experience, no significant injuries in the past 6 months, and not participating in other training programs during the study period. Random assignment and rigorous selection criteria are crucial in ensuring the validity and reliability of experimental studies. Data collected from the pretest and posttest were analyzed using paired sample t-tests to determine performance changes within each group and independent sample t-tests to compare differences between the experimental and control groups (10). Additionally, questionnaires were used to gather participant feedback on their experiences with the holistic training model and their satisfaction with the training program (11).

RESULTS

The normality test analysis indicated that the data distribution for the pretest and posttest was normal. The following are the results of the normality test obtained.

The normality test results for pretest and posttest backhand performance in both the experimental and traditional groups showed that the data distribution was normal. Based on the tables, the L_{α} value for the pretest backhand in the experimental group was 0.0905 with an L_{table} of 0.249.

In this study, the effectiveness of the holistic tennis training model was compared to traditional training in improving junior athletes' groundstroke backhand ability. Experimental Group (Holistic Approach): The pre-test results showed a mean score of 11.36 with a standard deviation (SD) of 4.61. After 8 weeks of training, the post-test mean score increased to 16.73, with SD reducing to 3.13. The t-value of 6.04 was significantly higher than the t-table value 2.23, indicating a significant improvement. Control Group (Traditional Training): The pre-test mean score was 12.55 with an SD of 4.083. The post-test mean score increased to 15.45, and SD decreased to 1.44. The t-value of 2.4521 was also more remarkable than the t-table value of 2.23, showing significant improvement in the traditional training group. Comparative Test: The post-test results showed that the experimental group had a higher mean score (16.73) and a greater t-value (2.437) compared to the control group (15.45), indicating that the holistic training model was more effective in improving backhand driveability. In conclusion, the holistic tennis training model demonstrated superior effectiveness in enhancing backhand driveability compared to traditional training methods.

DISCUSSION

The research results indicate that the application of a holistic approach-based tennis training model has a significant impact on improving the backhand drive skills of junior athletes. It can be concluded that the experimental group using the holistic training model showed better improvement than the control group using the conventional training model. The holistic approach in training involves integrating physical, technical, mental, and emotional aspects that can affect athlete performance. These findings confirm that the holistic approach-based tennis training model is more effective than the traditional training model in enhancing the backhand drive skills of junior tennis players. The holistic model improves technical performance and enhances mental resilience and consistency. This suggests that adopting a comprehensive training approach can significantly benefit the development of junior tennis players, particularly in Indonesia. Future research should explore this training model's long-term benefits and broader applicability to other sports.

CONCLUSION

The study demonstrates that the holistic tennis training model is more effective than traditional training in improving junior athletes' backhand driveability. Using the holistic approach, the experimental group showed significant improvements in both technique and consistency, as evidenced by higher post-test scores and a greater t-value than the control group. This suggests that training can enhance overall performance by integrating physical, technical, mental, and emotional aspects. These findings highlight the potential benefits of adopting a holistic approach in developing junior tennis players, particularly for improving key skills like the backhand drive.

APPLICABLE REMARKS

- The holistic tennis training model effectively improves junior athletes' backhand driveability.

- This suggests that training can improve overall performance by integrating physical, technical, mental, and emotional aspects.

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AUTHORS' CONTRIBUTIONS

Concept and design of the study: Rices Jatra. Data acquisition: Kamal Firdaus. Data analysis and interpretation: Yendrizal. Compiled the script: Syahrial Bakhtiar. Critical revision of the manuscript for important intellectual content: Damrah. Statistical analysis: Kamal Firdaus. Administrative, technical, and material support: Rices Jatra. Study supervisor: Kamal Firdaus.

CONFLICT OF INTEREST

The authors mention no "Conflict of Interest" in this study.

ETHICAL CONSIDERATION

This research has met the standards of research ethics and has received approval to be a sample of all respondents.

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Table 1. Frequency Distribution of Pre-Test and Post-Test Groundstroke

Backhand Drive	Pre-Test Experiment		Post-Test Experiment		Category
	Fi	(%)	Fi	(%)	
21 >	0	0,00	1	9,09	Excellent
18-20	2	18,18	3	27,27	Good
15-17	1	9,09	6	54,55	Satisfactory
12'-14	2	18,18	1	9,09	Fair
> 11	6	54,55	0	0,00	Poor
Total	11	100%	11	100%	

Table 2. Frequency Distribution of Pre-Test and Post-Test Groundstroke Backhand

Backhand Drive	Pre-Test Experiment		Post-Test Experiment		Category
	Fi	(%)	Fi	(%)	
21 >	0	0,00	0	0,00	Excellent
18-20	1	9,09	1	9,09	Good
15-17	4	36,36	7	63,64	Satisfactory
12'-14	1	9,09	3	27,27	Fair
> 11	5	45,45	0	0,00	Poor
Total	11	100%	11	100%	

Table 3. Summary of Normality Test Results

Data	N	L o	Ltable	Cat
Pretest Backhand Experiment	11	0,62847 222	0,17291 667	Normal
Posttest Backhand Experiment	11	1,09930 556	0,17291 667	Normal
Pretest Backhand Traditional	11	0,71180 556	0,17291 667	Normal
Posttest Backhand Traditional	11	0,71180 556	0,17291 667	Normal

Table 4. Summary of Test Results for Experimental and Control Group

Test	Group	Mean	SD	t-value	t-table	Result
Pre-Test (Groundstroke Backhand)	Experimental	11.36	0,20902778	06.04	02.23	Significant
Post-Test (Groundstroke Backhand)	Experimental	0,71736111	03.13			
Pre-Test (Groundstroke Backhand)	Control	12.55	4.083	24.521	02.23	Significant
Post-Test (Groundstroke Backhand)	Control	15.45	01.44			
Comparative Effectiveness (Post-Test)	Experimental	0,71736111	03.13	2.437	02.23	Significant
Comparative Effectiveness (Post-Test)	Control	15.45	01.44			

Android-Based Training Media for Practicing Passing Skills in Futsal

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ABSTRACT

Background. Passing in futsal requires fast and precise movements in a limited space, crucial for creating scoring opportunities. Despite its importance, the use of Android-based media for improving passing skills in futsal has been insufficiently explored. **Objectives.** This study aimed to develop and evaluate Android-based training media to improve futsal passing skills. **Methods.** Twenty male futsal athletes aged 16-19 participated in the field trial. Before implementation, material and media experts (n=4 each) assessed the feasibility of the training media, which was designed using Android Studio. The media included loading screens, menus, materials, and instructional videos. Data were analyzed using Aiken's V index, Intraclass Correlation Coefficient (ICC), and percentage. **Results.** The expert assessment showed a high feasibility rating ($V=0.947$, with $V1=0.956$ and $V2=0.938$). The ICC results indicated no significant differences between expert assessments ($ICC=0.588$), and Cronbach's alpha coefficient was 0.849 ($\alpha1=0.813$, $\alpha2=0.884$). The effectiveness score after implementation was 92.80%. **Conclusion.** The Android-based training media is feasible and effective in improving futsal passing skills. It provides a valuable tool for athletes, coaches, and futsal practitioners.

KEYWORDS: *Futsal, Passing, Technology, Android, Training*

INTRODUCTION

Futsal is a type of indoor football played by five players in one team and is officially regulated by the Federation Internationale de Football Association (FIFA) [1]. The game lasts two times twenty minutes and has alternating action with high intensity, so players must be quick and precise in every action [2]–[4]. Various aspects of futsal performance have been investigated, for example, passing decision-making [1], [5], [6], information constraints on decision-making in passing, dribbling and shooting changes [7], playing position [8], application of imagery exercises [9], development of shooting test [10], modified training method with NAZ APP [11], reliability of intermittent fitness tests [12], [13], and platforms with e-learning [14].

Passing is an important skill players must have when playing with teammates to create goal opportunities [15]–[17]. Instead, the success of a passing performance depends on the player's ability to change their perceptions and behavior during the game [5]. Passing in futsal occurs in smaller spaces, which requires quicker decision-making and makes this technique very difficult to predict [5], [18]. This study aims to develop

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Android-based training media for passing skills in futsal so that athletes, coaches, and futsal practitioners can use it to improve passing skills.

MATERIALS AND METHODS

Twenty futsal athletes (male, senior high school students aged 16-19) participated in testing the effectiveness of passing training media. Four material and four media experts assessed the media's feasibility before implementation. Material experts evaluated the content relevance, while media experts assessed the quality of the app's appearance and features. The experts were lecturers with at least five years of experience and AFC level one futsal coach licenses. Product testing was conducted in three stages: expert assessment, feasibility agreement, and implementation with athletes. Data was analyzed using Aiken's V index for expert assessments and ICC for agreement levels, with effectiveness measured by percentage scores.

RESULTS

Validity. Table 2 shows the overall average V index of the experts' assessments is 0.947.

Reliability. The average alpha coefficient is 0.849 (Table 3). The ANOVA results show that there is no difference in the assessment given between experts ($p>0.05$) (Table 4). Then, the ICC coefficient is 0.588 (Table 5).

Implementation. The results of product implementation obtained 92.80 (Table 6). Thus, the developed product is effective for training passing skills in futsal.

RESULTS

This Android-based training media has met the eligibility requirements of experts before being implemented.

The Android-based training media we developed is feasible and very effective for passing skills in futsal. However, we realize that some limitations need to be reported. This application can be downloaded with at least Android type 9 (pie). This application only contains training materials about passing in futsal, so future research improvements are needed regarding features, including other essential techniques and experimental trials for product implementation.

CONCLUSIONS

The conclusion of the results of this study is the presence. The initial display of the loading application is designed as well as possible. The main menu contains futsal, passing, training, more apps, share, and rate us. The material menu contains futsal history, techniques, international tournaments, futsal federations, and passing techniques in futsal. Furthermore, the video menu contains passing techniques in futsal, including the inside of the foot, the outside of the foot, the instep, and the heel. This training media is expected to be used by athletes, coaches, and practitioners to train and improve passing skills in futsal. Improvements in future research are needed in terms of features, including other essential techniques and experimental trials for product implementation.

APPLICABLE REMARKS

- Athletes, coaches, and practitioners can use this training medium to practice and improve passing skills in futsal.

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AUTHORS' CONTRIBUTIONS

Concept and design of the study: Nurul Ihsan. Data acquisition: Muhammad Andika Marlis Ramadhan. Data analysis and interpretation: Muhammad Andika Marlis Ramadhan. Compiled the script: Aldo Naza Putra. Critical revision of the manuscript for important intellectual content: Deby Tri Mario. Statistical analysis: Novadri Ayubi and Zsolt Németh. Administrative, technical, and material support: Rully Efendi. Study supervisor: Aydin Karacam.

CONFLICT OF INTEREST

The authors mention no "Conflict of Interest" in this study.

ETHICAL CONSIDERATION

This research has met the standards of research ethics and has received approval to be a sample of all respondents.

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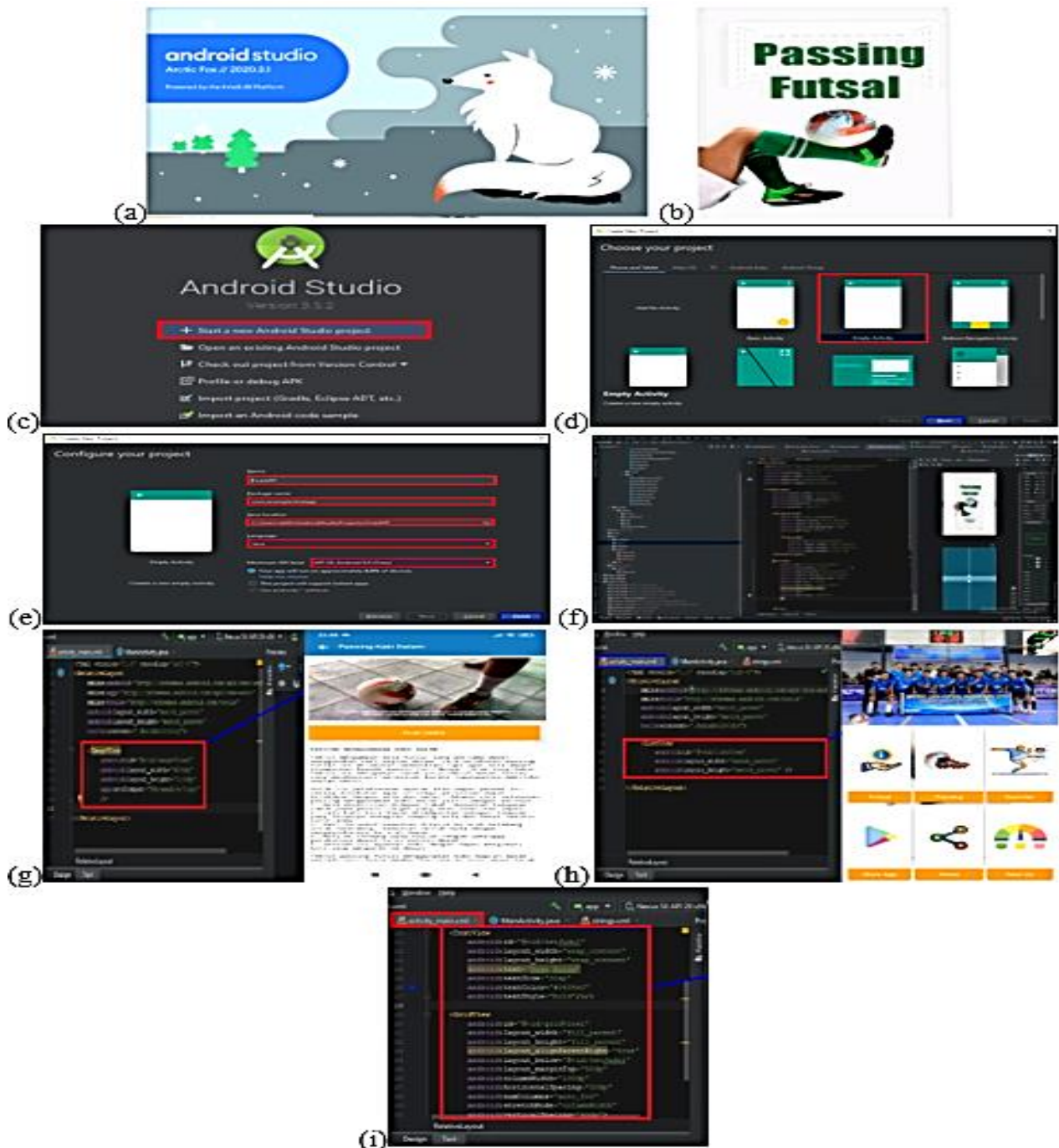


Figure 1. (a) Android Studio, (b) After becoming an application, (c) Start menu of Android Studio, (d) Project types in Android Studio, (e) Configuration in Android Studio, (f) Text view, (g) Image view, (h) List view, and (i) Grid view.

Table 1. Cronbach's Alpha Coefficient

Cronbach's Alpha	N of Items
0.813*	4
0.884**	4
$\bar{x} = 0.849^{***}$	

*Alpha coefficient for material experts, **Alpha coefficient for media experts, ***Average of both ratings

Table 2. Expert validation

Items	Material experts				S_1	S_2	S_3	S_4	$\sum S$	$n(c-1)$	V	Conclusion
	1	2	3	4								
1	5	5	5	5	4	4	4	4	16	16	1.000	High
2	5	5	4	5	4	4	3	4	15	16	0.938	High
3	5	5	5	5	4	4	4	4	16	16	1.000	High
4	5	4	4	4	4	3	3	3	13	16	0.813	High
5	5	5	5	5	4	4	4	4	16	16	1.000	High
6	5	5	5	5	4	4	4	4	16	16	1.000	High
7	4	5	4	4	3	4	3	3	13	16	0.813	High
8	5	5	5	5	4	4	4	4	16	16	1.000	High
9	5	5	5	5	4	4	4	4	16	16	1.000	High
10	5	5	5	5	4	4	4	4	16	16	1.000	High
$\bar{x}$											0.956	High
Items	Media experts				S_1	S_2	S_3	S_4	$\sum S$	$n(c-1)$	V	Conclusion
	1	2	3	4								
1	5	5	5	5	4	4	4	4	16	16	1.000	High
2	5	4	3	4	4	3	2	3	12	16	0.750	Enough
3	5	5	5	5	4	4	4	4	16	16	1.000	High
4	5	5	5	5	4	4	4	4	16	16	1.000	High
5	5	5	4	5	4	4	3	4	15	16	0.938	High
6	5	4	5	5	4	3	4	4	15	16	0.938	High
7	4	3	3	4	3	2	2	3	10	16	0.625	Enough
8	5	5	5	5	4	4	4	4	16	16	1.000	High
9	5	5	5	5	4	4	4	4	16	16	1.000	High
10	5	5	5	5	4	4	4	4	16	16	1.000	High
11	5	5	5	5	4	4	4	4	16	16	1.000	High
12	5	5	5	5	4	4	4	4	16	16	1.000	High
$\bar{x}$											0.938	High
Overall ($\bar{x}$)											0.947	High

Table 3. ANOVA

Source		Sum of Squares	Df	Mean Square	F	P
Between People		3.525	9	0.392		
Within People	Between Items	0.275	3	0.092	1.253*	0.310*
	Residual	1.975	27	0.073		
	Total	2.250	30	0.075		
Total		5.775	39	0.148		
Between People		10.500	11	0.955		
Within People	Between Items	0.833	3	0.278	2.500**	0.077**
	Residual	3.667	33	0.111		
	Total	4.500	36	0.125		
Total		15.000	47	0.319		

Table 4. Intraclass Correlation Coefficient

Source	ICC^b	95% Confidence Interval		F Test with True Value 0			
		Lower Bound	Upper Bound	Value	df_1	df_2	P
Single Measures*	0.521 ^a	0.206	0.820	5.354	9	27	0.000
Average Measures	0.813 ^c	0.509	0.948	5.354	9	27	0.000
Single Measures**	0.655 ^a	0.390	0.865	8.591	11	33	0.000
Average Measures	0.884 ^c	0.719	0.962	8.591	11	33	0.000
$\bar{x}$	0.588***						

Table 5. Implementation

Assessment indicators	Assessment score				
	1	2	3	4	5
The design of the training media is very interesting.				11	9
The use of training media is very practical.			1	6	13
The use of training videos is very helpful in mastering passing.				7	13
The use of training media is very helpful in learning passing.				5	15
The use of training media can motivate in learning passing.			1	4	15
Presentation of training materials relevant to passing training in futsal.			1	8	11
The practice materials presented are easy to understand.				8	12
The training media contains videos that can improve passing skills.				6	14
Presentation of training materials can help to perform passing movements correctly.			1	5	14
The shape, model and size of the letters are easy to understand and very clear.				4	16
Amount			4	64	132
Achievement score				928	
Maximum score				1000	
Percentage				92.80	

Development of Software for Achievement Analysis of IoT-Based Training Program in Pencak Silat Sports

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ABSTRACT

Background. Pencak Silat is a traditional martial art that requires individualized training programs to optimize an athlete's performance. However, the current training regimens often fail to consider each athlete's specific needs, leading to generalized approaches that may cause delays or errors in improving performance. There is a need for a more effective and personalized training solution that can provide tailored programs based on real-time analysis and data monitoring. **Objectives.** This research aims to develop an Internet of Things (IoT)-based software application, SAP-PS (Software for Analysis of Pencak Silat), designed to analyze and monitor the achievement of individualized training programs for Pencak Silat athletes. The goal is to create a system that enables precise, data-driven adjustments to training plans, enhancing the efficiency and effectiveness of athletic development. **Methods.** The study adopts the Borg and Gall development steps, consisting of three main stages: (1) Design and software characterization, (2) Laboratory testing and refinement, and (3) Real-world implementation. During the development process, experts validated and tested the software's functionality, reliability, and practicality. Testing was conducted through feedback from trainers and athletes to ensure that the program met the demands of personalized training. **Results.** The developed IoT-based software achieved a validity rate of 92.4%, demonstrating that the program effectively captured and processed relevant performance data. Furthermore, the software passed both reliability and practicality tests, indicating that it is accurate and feasible for real-world training scenarios. The system allows coaches to monitor athletes' progress in real-time and adjust training regimens accordingly. **Conclusion.** The IoT-based software developed in this study is a promising tool for optimizing individualized training programs in Pencak Silat. By offering real-time performance analysis, the software enhances accessibility, accuracy, and efficiency for coaches and athletes, supporting the creation of more personalized and effective training strategies.

KEYWORDS: *Pencak Silat, IoT, Software, Martial Art*

INTRODUCTION

Pencak Silat is an individual sport that significantly secures medals in various international events (1–4). As a key sport, it requires the application of various sports science approaches to ensure that performance always meets expectations (5,6). Training development has four essential components: physical condition, technique, tactics, and mental strength. These four components focus on developing training programs (7,8). In developing training programs, it is important to pay attention to the accuracy of data (information) through instruments with high validity and reliability (9–11). Coaches will then process the data and information from measurements into training programs.

In previous studies, the leader developed several digital measurement instruments for various physical conditions in Pencak Silat, including 1) kicking speed in 2017, 2) endurance in 2019, 3) agility in 2018, 4)

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punching power in 2018, 5) kicking power in 2018, 6) lower limb explosive strength in 2018, and 7) upper limb explosive strength (punching) in 2019. All of these instruments are digital. However, these instruments have not yet been integrated into one application's analysis system. This study will combine these instruments for final data presentation and supplement them with health measurements and motor skill assessments. The following diagram (Figure 1) explains this more clearly.

The Internet of Things (IoT) is a concept aimed at expanding the benefits of continuous internet connectivity. IoT can be utilized in buildings to control electronic devices, such as lighting, which can be operated remotely through a computer network. The application developed in this research is IoT-based. Several applications are used in the development of this software. Below are the applications integrated into this software (Figure 2).

This application is integrated into a single system connected to the internet, enabling easy access for coaches and athletes to carry out individualized training programs. The basic concept of this application is that it can be accessed anytime and anywhere.

MATERIALS AND METHODS

This research is a development study that is structured in three stages. The first stage involves designing and developing the software, as well as characterizing the software. The second stage focuses on testing and refining the tool in a laboratory setting, while the third stage involves refining and conducting field tests. The development approach follows the 10 steps outlined by Borg and Gall, which include (1) conducting research and gathering information, (2) planning the development, (3) developing the initial product prototype, (4) conducting initial field testing, (5) revising the main product, (6) conducting main field testing, (7) revising the product based on feedback and main field test results, (8) large-scale field testing, (9) final product revision, and (10) finalizing the product (Table 1).

The scope of this research will begin with determining the assessment criteria, designing the software, selecting the components to be used, choosing the network applications to display applications, assembling the control server, characterizing the software, and conducting testing. The stages of this research will be carried out over 2 years. The work plan for the first year of the research includes designing and determining the characteristics of the components, as well as the design of SAP-PS (Software Analysis for Pencak Silat Training Program) and the operational system of the application to be used.

RESULTS

The following section provides the results of the user interface analysis and a discussion regarding the Sport Analysis Application. Students from the Sports Science Department at the Faculty of Sport Science Universitas Negeri Padang provided data and respondents. Ten variables were included in the survey distributed to the students. Table I presents the identification of variables and questionnaire data. Sampling was conducted using the Systematic Random Sampling method, which involves selecting samples at regular intervals from a pre-ordered sampling frame or choosing specific individuals and members from the overall population. A total of 100 students participated as respondents in this study. We carefully selected questions relevant to each variable for faculty members and students.

Additionally, a Likert scale ranging from 1 to 4 was used for the questionnaire responses. By calculating the average score for each student, an overall score was established for each variable. This total score was then analyzed to gather feedback from the users.

A Likert scale was utilized to calculate the scores for each variable by presenting a series of statements related to the topic being studied.

CONCLUSIONS

This study employed Nielsen's heuristics to assess various key components of the user interface developed for the Sport Analysis Application. According to feedback from respondents, our user interface design was deemed sufficiently effective for real-life use, with scores ranging from a minimum of 50 to a maximum of 200. It was observed that Nielsen's heuristics proved to be suitable. The approach for this research and its principles could be applied to the study's topic. Like any set of rules, each option has its advantages and disadvantages. More features must be added to evaluate using different methodologies in future endeavors. Designing a user interface model becomes more intricate as application features become complex. Moreover, a user interface with robust functionality may receive diverse user comments. In summary, case studies involving various features and methodologies are still open for exploration and review. As a final step, special attention is needed during the evaluation of this application in the early stages of design and development to encounter fewer issues during implementation.

APPLICABLE REMARKS

- The IoT-based software developed can optimize individual training programs in Pencak Silat.

- By offering real-time performance analysis, the software improves accessibility, accuracy, and efficiency for coaches and athletes, supporting the creation more personalized and effective training strategies.

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AUTHORS' CONTRIBUTIONS

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Figure 1. Research roadmap



Figure 2. Applications Used in the Development of the Analysis Software

Table 1. Assessment Criteria

Heuristic Principle	Score
Visibility of system status	151
Match between system and the real world	152
User control and freedom	151.05.00
Consistency and standards	165
Error prevention	144.05.00
Recognition rather than recall	158
Flexibility and efficiency of use	154.05.00
Aesthetic and minimalist design	159
Help users recognize, diagnose, and recover from errors	154
Help and documentation	162

Development of Virtual Reality for Enhancing Motor Skills and Physical Activity in Children with Intellectual Disabilities

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ABSTRACT

Background. Virtual Reality (VR) has gained attention for its potential to enhance learning experiences, particularly for children with intellectual disabilities, who often struggle with motor skills and physical activity.

Objectives. This research aims to develop a VR-based intervention to improve motor skills and physical activity among children with intellectual disabilities using interactive and engaging technology. **Methods.** The study employed the Research and Development (R&D) approach to design a VR program to enhance motor coordination and physical activity. The intervention was validated by media and material experts, followed by a practicality test with teachers and feedback from 55 students. **Results.** Validation results showed excellent validity, with 97.42% for media and 99.24% for material. The practicality test with PJOK teachers yielded an average score of 98.89%, while student feedback showed an average score of 96%, indicating excellent engagement and effectiveness. **Conclusion.** The VR-based intervention proved highly valid and practical, effectively improving motor skills and physical activity in children with intellectual disabilities and providing an engaging and interactive learning experience.

KEYWORDS: *Virtual Reality, VR, Motor Skills, Physical Activity, Intellectual Disabilities*

INTRODUCTION

Virtual Reality technology creates a fully immersive experience by simulating a three-dimensional environment where users can interact and engage with virtual objects and scenarios (1–3). In educational contexts, VR has been shown to improve student engagement, motivation, and retention of knowledge by providing experiences that are both hands-on and experiential. VR's immersive nature allows students to actively participate in learning rather than passively receiving information through traditional methods.

For children with intellectual disabilities, VR offers a unique opportunity to engage them in skill-building exercises and physical activities that may be difficult to perform in the real world (4–6). Through virtual simulations, children can practice motor tasks, such as balance, hand-eye coordination, and strength training, in an environment that can be adjusted to their needs and abilities (7–11). These simulations can also help develop social skills, as children may engage with virtual characters or practice interaction scenarios. As such, VR can be an effective tool for children with special needs, offering them a safe, engaging, and supportive platform for learning and skill development. Developing a VR-based program for enhancing motor skills and physical activity in children with intellectual disabilities involves several key components, from selecting appropriate technology to designing specific learning modules that align with the children's developmental needs.

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MATERIALS AND METHODS

This study follows the Research and Development (R&D) methodology, specifically adapting the Borg and Gall model to develop a Virtual Reality (VR) program for enhancing motor skills and physical activity in children with intellectual disabilities.

RESULTS

Research and Data Collection Phase. In the initial phase of this study, data collection was conducted through a literature review and observations. A survey was distributed to teachers working with children with intellectual disabilities to understand the current educational media usage in this field. The survey found that, despite the increasing interest in technology, the use of interactive educational tools—especially Virtual Reality (VR)—in the context of motor skills and physical activity education for children with intellectual disabilities remains limited.

Planning Phase. The questionnaires were designed to ensure the reliability and validity of the research tools. The research focused on developing the VR tool with interactive content that could support motor skill development, especially in areas like coordination, balance, and gross motor skills, which are typically challenging for children with intellectual disabilities.

Product Development Stage. The application design incorporated several key learning elements: visual animations, quizzes, and interactive exercises to engage students while promoting motor skills improvement.

Media experts evaluated the application based on technical functionality, visual communication, and language. The average score from media experts was 97.42%, with recommendations to enhance animations for further engagement.

Material experts also reviewed the content based on its quality, relevance to locomotor motions, and accessibility for children with intellectual disabilities. The material received an average score of 99.24%, indicating that it effectively met the target group's needs. Experts suggested incorporating more varied motion examples to support diverse learning needs better.

Initial Field Trial Phase. The VR tool was tested for practicality in real classroom settings with PJOK teachers after validation. These teachers assessed the tool's usability and ability to facilitate motor skills development in children with intellectual disabilities. The results indicated that the VR tool was efficient, with an average score of 98.89%. Teachers noted that the tool was engaging, accessible, and suitable for students in special education settings. They suggested that the VR tool could complement traditional teaching methods for enhancing motor skills development.

The next phase involved conducting a large-scale trial with 55 students from three schools. The objective was to assess the effectiveness of the VR tool and the student's responses to it. Results showed that 96% of students rated the tool as "Very Good" regarding engagement and educational value. This feedback demonstrated that the VR tool successfully motivated students and improved their motor skills, especially in activities that are typically challenging for children with intellectual disabilities.

Initial Product Revision. The VR tool underwent several revisions based on the feedback from experts, teachers, and students. Key improvements focused on enhancing the variety of animations and introducing more diverse locomotor movement models. These revisions aimed to improve the tool's effectiveness by making it more engaging and inclusive for children with varying motor skill levels.

The revisions also addressed suggestions for increasing the interactive elements, such as adding new challenges and feedback mechanisms to help sustain students' attention and motivation. These adjustments were made to ensure the tool could effectively support students' motor skills development in individual and group settings.

DISCUSSION

The findings of this study provide a clear connection between the development of interactive learning media for physical education and the growing importance of Virtual Reality (VR) as a tool for enhancing motor skills and physical activity, particularly in children with intellectual disabilities (12,13). This is especially true in special education, where adapting teaching methods to individual learning needs is critical. Just as the teachers in this study could integrate interactive learning media into their classrooms effectively, so could they implement VR programs with appropriate training, ensuring that children with intellectual disabilities benefit from this innovative technology (14,15). The promising results from developing and validating such media indicate that VR technology can significantly enhance motor skills and physical activity learning in special education contexts. By creating immersive, engaging, and personalized learning experiences, VR can revolutionize how children with intellectual disabilities engage in physical education, providing them with opportunities for skill development, increased confidence, and active participation. As technology continues

to evolve, the integration of VR in education holds great promise for improving motor skills development and physical activity participation for children with intellectual disabilities, helping them achieve their full potential.

CONCLUSION

This study demonstrates that developing a Virtual Reality (VR)-based learning tool can effectively enhance motor skills and physical activity in children with intellectual disabilities. Validation results from media and material experts, along with teachers' practicality tests, showed excellent validity and practicality levels. Feedback from students also indicated very high levels of engagement and effectiveness. VR offers an immersive and engaging learning experience that helps address the motor skill challenges commonly faced by children with intellectual disabilities. Thus, VR can be a highly beneficial tool in special education, providing children with opportunities to develop motor skills, increase confidence, and actively participate in physical activities.

APPLICABLE REMARKS

- Currently, VR-based learning is an alternative that makes learning more interesting, primarily if VR-based learning is used and intervened in the learning of students with intellectual disabilities.
- This will make students more interested in learning and more enthusiastic.

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AUTHORS' CONTRIBUTIONS

Concept and design of the study: Yanuar Kiram, Anton Komaini. Data acquisition: Yovhandra Ockta, Muhamad Sazeli Rifki. Data analysis and interpretation: Padli, Gusril. I compiled the script for Anton Komaini and Yovhandra Ockta. Critical revision of the manuscript for important intellectual content: Anton Komaini. Statistical analysis: Yovhandra Ockta, Muhamad Sazeli Rifki. Administrative, technical, and material support: Yovhandra Ockta, Padli. Study supervisor: Yanuar Kiram.

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ETHICAL CONSIDERATION

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Figure 1. VR Initial View

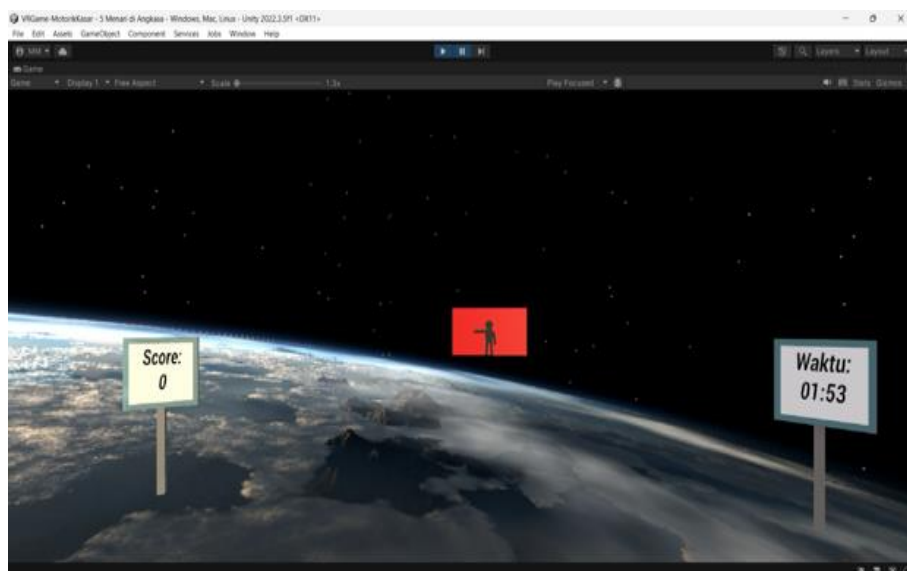


Figure 2. Game Forms

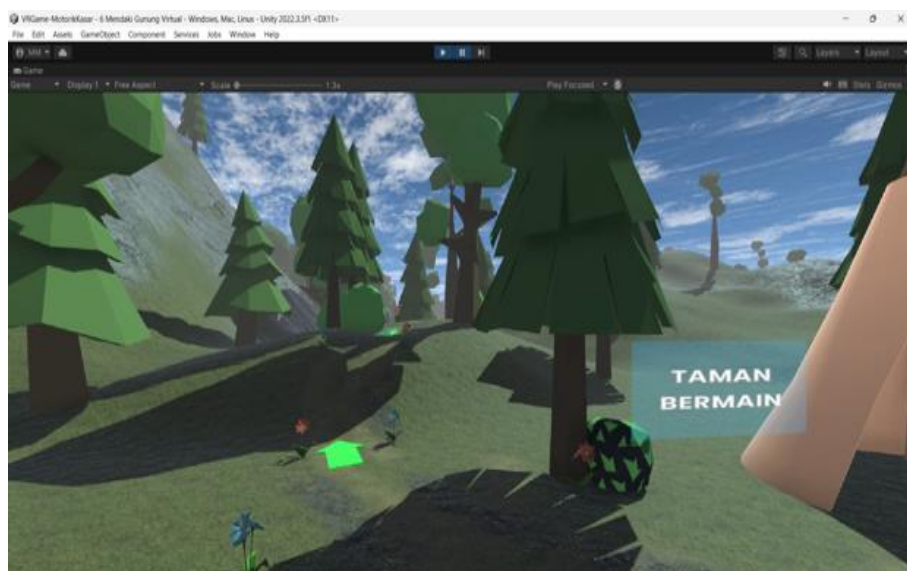


Figure 3. Quiz Form

Table 1. Average Media Expert Validation Results

Aspect	V1	V2	V3	Σ	Cat
Software	100%	100%	100%	100%	Very Good
Visual	89.29%	100%	100%	96.43%	Very Good
Language	100%	100%	87.5%	95.83%	Very Good
Average	96.43%	100%	95.83%	97.42%	Very Good
Software	100%	100%	100%	100%	Very Good

Table 2. Average Material Expert Validation Results

Aspect	V1	V2	V3	Σ	Cat
Content	95%	100%	100%	98.3%	Very Good
Serving	100%	95.83%	100%	98.6%	Very Good
Language	100%	100%	100%	100%	Very Good
Average	98.7%	98.96%	100%	99.2%	Very Good

Table 3. Average Results of PJOK Teacher Practicality Test

Aspect	V1	V2	V3	Σ	Cat
Content	100%	100%	91.6%	97.22%	Very Good
Serving	100%	100%	91.6%	97.22%	Very Good
Language	100%	100%	100%	100%	Very Good
Technical Aspects	100%	100%	100%	100%	Very Good
Average	100%	100%	96.6%	98.89%	Very Good

Table 4. Average Student Response Test Results

No	Interval (%)	F (Frequency)	%	Category
1	81% – 100%	53	96%	Very Good
2	61% – 80%	2	4%	Good
3	41% – 60%	0	0%	Moderate
4	21% – 40%	0	0%	Not Good
5	0% – 20%	0	0%	Bad

Fan Talk: How Social Media Changes the Language of Sports Fandom

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ABSTRACT

Background. This study investigates social media's impact on Indonesian sports fans' linguistic development.

Objectives. The emergence of social networks, such as X, Instagram, and TikTok, enables fans to integrate worldwide sports language with colloquial dialects, hence forming an unusual language. **Methods.** The study employs a qualitative methodology consisting of content analysis of the posts, comments, and hashtags by the fans. **Results.** The findings indicate that social media nurtures a sense of belonging, community, and nationalism by utilizing hashtags such as #TimnasDay. At the same time, there is always a danger of fan culture becoming commodified. **Conclusion.** The research illustrates the significance of social media channels in the complex temporality of contemporary sports fandom in Indonesia.

KEYWORDS: *Social Media, Sports Fandom, Indonesian Language*

INTRODUCTION

Sports fandom in Indonesia has been chiefly practiced in a local context (1–3); fans would, for instance, go to *warungs* and/or stadiums to support their teams while singing songs and using local phrases (4). Concerning the advancement of social media technology, this experience has also been globalized, allowing fans from the entire nation to come together and create a common sports lexicon. These popular social media platforms enable Indonesian supporters to combine foreign sports phrases with Indonesian expressions and build new terminologies that embrace their cultural and communal affection (5,6). This study focuses on the impact of social media on the linguistics of fans in Indonesia, including the social construction and media ecology frameworks that elaborate on essential aspects of fan interactions in the digital sphere. Despite plenty of focus on the sports communities in the Global West, only scant attention has been given to the global use of the Indonesian language in the context of fandom communities. Bridging this gap, this study analyzes the transformation of Indonesian sports fandoms in the social media sphere.

MATERIALS AND METHODS

The present work is qualitative and focuses on the language (7) of sports fans in the Indonesian context on social media. The research steps include active accounts from famous social platforms like X, Instagram, and TikTok and locating active Indonesian sports fandoms. Further, activities like fan postings, comments, and hashtags relating to a personal occurrence are carried out, singling out patterns of commonly used words,

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phrases, and other significant trends characteristic of fans – online culture. The data comprises publicly available posts on these sites with an emphasis on the context of the language of fans, culture, and mode of communication employed. This analysis seeks to understand the impact of social media on the fans' fandom expressions and how Indonesian sporting fans organize themselves as a group.

RESULTS

The exploration of Indonesian sports fans on social media examined their language, which combines international and local street language. Words like “GOAT” (Greatest of All Time), “clutch,” and “hat-trick” were thrown in often. However, Indonesian supporters had their versions too, for example, “sultan,” a term also for fans or team sponsors, which mocks rich people, and “*mabar*,” which is an abbreviation of *main bareng* that translates into ‘play together,’ this term originated from the gaming community but is now embraced by sports fans to mean watching or attending matches with someone else. Among these are #TimnasDay (in honor of the Indonesian soccer team) and #GarudaDiDadaku (translates as ‘Garuda in My Heart’). These networks have become inseparable parts of their fan culture, acting as modern-day battle cries for instilling nationalism. These provoked discussions and united the fans, every hashtag evolving into a ticket for support and community.

Fans' communication and interaction language in social media networks was determined to some extent by the platforms. Social media users on X preferred posting concisely, posting what they thought or how they felt at the moment in single statements – often an emoji or hashtag. As for Instagram and TikTok, domination of visual content took over as meme sharing, player moments, and game clips became a trend with added captions or texts. Many TikTok users also added a personal touch to classic clips by adding popular soundtracks or remixing them with funny elements of the trending memes. As we can assume, Instagram stories were usually enhanced with text overlays implying support for teams or athletes saying phrases like – *Semangat terus!* (Have a go!) or *Jangan menyerah!* (Do not give up!) to encourage these teams and players.

The paper further emphasized the effects of globalization on the language of Indonesian sports. Thanks to social networks, English sports terms, and memes became widespread, and Indonesian fans readily use the words 'clutch' and 'GOAT', which have American origins. Such global lexis was incorporated into the Indonesian context as the audience often edited worldwide memes or clips, primarily Western to Indonesian mosques. Such interaction of cultures shows how fans in different countries can be connected through social media regardless of distance, which helps them better understand and appreciate global sports- in this case, the Indonesians.

DISCUSSION

The results of this study are consistent with other studies on the use of social networks for sports fandom, such as (8–10), which showed that fans' use of voice in cyberspace promotes community and identity formation. The advantages of these findings are that fans from different regions across Indonesia are now brought together with more interactions and shared expressions. The hashtags #TimnasDay and #GarudaDiDadaku exemplify how the digital medium promotes national pride and love for local clubs. Moreover, their fans' ability to mix local content with international sports advances the idea of globalization. On the other hand, the disadvantages include the danger of commercialization or faddism of fandom through psychographic segmentation of the internet that may masquerade the true ideal of what a fan is through and through. In an environment where social media users are addicted to engagement (likes, retweets, shares, etc.) rather than qualitative discussion, the discourse will likely transform from genuine fan discourse to spam bombs (11–13). This commodification might eventually diminish integrity, fan identity's intensity, and developing features.

CONCLUSION

Thus, to conclude this research, social media has transformed how Indonesian sports fans interact with global terminology and local language to build community and identity. It does, however, enhance interaction with fans and national pride while reducing the complexity of the fan experience by focusing on viral entertainment. The research highlights the changing nature of contemporary sports culture as influenced by the global digital space.

APPLICABLE REMARKS

- Social media has transformed Indonesian sports fandom by blending global sports terminology with local expressions, fostering a unique, hybrid fan culture.

- Hashtags like #TimnasDay and #GarudaDiDadaku promote national pride, while platforms like X, Instagram, and TikTok cater to different fan communication styles, from concise, real-time posts to meme-based visuals.
- This digital convergence of global and local elements allows for stronger fan engagement and identity formation. Yet, it also risks commercialization, where the authenticity of fandom might be compromised for viral trends.
- Despite these challenges, social media has created a platform for greater fan unity, offering opportunities for targeted content creation and international collaboration that bridges cultural gaps.

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AUTHORS' CONTRIBUTIONS

Mario Fabrian and Alpin Herman Saputra were responsible for the study's conceptualization and methodology. Ardo Okilanda led the data collection and analysis and drafted the manuscript. Wuri Syaputri, Sawirman, Fadlillah, Raden Sudarwo, and Nidya Fitri contributed significantly to the data interpretation and provided critical revisions, helping to refine and finalize the manuscript.

CONFLICT OF INTEREST

The authors mention no "Conflict of Interest" in this study.

ETHICAL CONSIDERATION

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Table 1. The most commonly used sports-related hashtags

Hashtag	Meaning/Context	Frequency of Use
#TimnasDay	Celebrates Indonesia's national football team	High
#GarudaDiDadaku	Symbolizes national pride and support for Indonesian football	High
#BaliUnited	Fans of Bali United Football Club	Moderate
#PersijaJakarta	Fans of Persija Jakarta Football Club	Moderate
#AremaFC	Fans of Arema FC, a prominent Indonesian football club	Moderate

Table 2. The summarizes language trends across platforms

Platform	Language Style	Features
X	Concise, commentary	Hashtags, emojis, brief reactions
Instagram	Visual storytelling, meme-based language	Images, videos, text overlays
TikTok	Creative, meme-based with visuals/audio	Audio clips, meme remixes, player highlight videos

Digital Learning Media for Beginners to Learn Court Tennis: A Literature Review

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ABSTRACT

Background. Technology in sports education encourages the development of digital learning media, such as videos, applications, and virtual simulations, which effectively improve the motivation, understanding of techniques, and basic skills of court tennis for beginners. **Objectives.** This study aims to review the effectiveness of digital learning media in helping beginners learn court tennis independently and in a structured manner. This review literature will identify the most effective types of digital media, their benefits and limitations, and the impact of these media on the understanding of basic techniques of court tennis. **Methods.** A literature review collects and analyzes relevant research and articles from scientific journals, research reports, and sports education publications. The selected article discusses the effectiveness of digital learning media in the context of sports or, more specifically, in learning tennis. The literature studied was then analyzed to find patterns of use and effectiveness of these digital media in improving basic tennis skills. **Results.** A literature review shows that digital learning media significantly positively impacts beginners' learning of court tennis. Media such as instructional videos help beginners better understand basic techniques, while VR apps and simulations provide a more interactive and realistic training platform. However, the challenges faced include the accessibility of technology and the lack of direct feedback coaches typically offer. This digital media has also been proven to increase beginners' motivation, so they are more enthusiastic about practicing. **Conclusions.** Digital learning media is an effective alternative to help beginners learn tennis.

KEYWORDS: *Media, Court Tennis, Beginner*

INTRODUCTION

Sports education has undergone significant development with the integration of digital technology, including in-court tennis learning for beginners (1). Tennis, which demands complex technical and strategic skills, requires a flexible approach to learning and supports deep understanding, both in theory and practice. The presence of digital media, such as video tutorials, interactive applications, and virtual simulations, provides easy access for beginners to learn basic techniques outside the field independently. In addition, this digital media can increase motivation and involvement in the learning process because it presents an interactive and practical method. Thus, digital learning media is one of the promising alternatives to help beginners understand the basics of tennis effectively, although challenges such as limited access to technology and the need for guidance still need to be considered (2).

The current learning of court tennis shows the increasing use of increasingly sophisticated digital technology to support the mastery of sports skills, especially for beginners (3). Technologies such as AI-based applications, virtual reality (VR) simulations, and video analytics have become essential tools in interactive

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and adaptive learning, allowing users to learn basic techniques and game strategies independently (4,5). AI-based tennis learning apps, for example, can provide real-time feedback and movement analysis, making it easier for beginners to understand and improve their techniques (6). VR simulations also provide a realistic tennis experience and allow beginner players to practice in a virtual environment that resembles a real court. Video analytics is even more detailed, able to break down movements, show errors, and provide visual suggestions for improvement. The combination of these mediums forms a trend of tennis learning that is more accessible, efficient, and appealing to beginners, creating a learning experience that is limitless to the physical environment of the court (7).

MATERIALS AND METHODS

This research method uses a literature review approach to explore and analyze the effectiveness of digital learning media in court tennis learning for beginners. Data was collected from various academic sources, including journals, scientific articles, books, and recent research reports that focused on the use of digital technology in sports education, specifically tennis. The literature studied includes research related to video tutorials, AI-based learning applications, virtual reality (VR) simulations, and other digital media that support mastery of basic tennis techniques. The analysis was carried out by comparing the research results regarding the benefits and limitations of each type of digital media and its impact on the understanding and motivation of beginners in learning tennis. The results of this review were then synthesized to conclude the role of digital learning media as an effective means of learning tennis for beginners and identify factors that can optimize its use.

RESULTS

Table 1 is a critical appraisal analysis from 5 journals.

DISCUSSION

The study results show that digital learning media significantly positively impacts beginners in learning court tennis, especially in mastering basic techniques and increasing learning motivation (13). Video tutorials, for example, allow beginners to observe proper movement techniques, such as racket grip positions and footwork patterns, making it easier to understand basic concepts visually. AI-based learning apps provide an advantage in real-time feedback, allowing beginners to immediately identify and correct engineering errors independently. Research also shows that the interaction offered by this digital media can increase the interest and participation of beginners in the learning process because it is more accessible and flexible, independent of a specific time and place.

However, some limitations are found in using digital learning media for court tennis. One of the main obstacles is the limitation of providing direct physical feedback, which is often essential in sports to form the correct movements. Although digital media, such as virtual reality (VR) simulations, are close to real experiences in the field, direct coaching is still needed to ensure the correct understanding and mastery of techniques. Some studies have also shown that access to advanced devices, such as VR and AI-based applications, can be a barrier for some beginners due to the relatively high cost and limited infrastructure (14,15). Thus, while digital learning media offers many benefits, its optimal use requires a combination of physical exercise and supervision from a coach for more effective results in court tennis learning.

CONCLUSION

In conclusion, digital learning media has proven effective for beginners learning court tennis, especially in helping them master basic techniques and increase learning motivation. Despite some limitations, such as the lack of direct physical feedback and technology access challenges, media such as video tutorials, AI-driven apps, and VR simulations provide flexibility and accessibility that supports self-paced learning. With a combination of guidance from coaches, this digital media can be optimized to create a more comprehensive and practical tennis learning experience for beginners.

APPLICABLE REMARKS

- Digital learning media is an effective tool for teaching court tennis to beginners. It enhances both essential technique mastery and learning motivation through accessible, flexible formats like video tutorials and VR simulations.
- Combined with coach guidance, it offers a comprehensive approach to learning despite limitations in physical feedback and technology access.

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AUTHORS' CONTRIBUTIONS

Study concept and design: Damrah. Acquisition of data literature: Utama. Drafting the manuscript: Utama. Critical revision of the manuscript for important intellectual content: Utama.

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Table 1. Literature Review Summary of Results

Researchers	Article Title	Research Results
(8)	The application of deep learning-based technique detection model in table tennis teaching and learning	This proves that the proposed technology detection model has good algorithm performance and data analysis ability and can provide data support for table tennis training and teaching work.
(9)	The optimization of college tennis training and teaching under deep learning	This functionality offers robust support for practical training and coaching during matches. This paper aims to evaluate athletes' performance by constructing a diagnostic system, providing a solid reference for optimizing tennis training and education. The insights offered by this paper can potentially drive reforms in sports programs, particularly in tennis education.
(10)	Systematic training of table tennis players' physical performance based on artificial intelligence technology and data fusion of sensing devices	Deep learning and convolutional neural networks combined with large-scale video data make feature extraction of match footage more possible, greatly enhancing match information for viewers. The experimental findings demonstrate that table tennis human technical movement recognition accuracy reaches 98.88 % based on the enhanced AM-Softmax classification algorithm.
(11)	Real-time posture feedback for effective motor learning in table tennis in virtual reality	The results show that the participants significantly improved their technique and ball return quality. This work is the first VR table tennis system that provides real-time posture feedback using a low-cost depth camera. Additionally, the participants' significant improvement in playing posture over a short period shows the integral role of feedback in learning and further validates VR as an effective motor learning tool.
(12)	Innovation programs of the Royal Spanish Tennis Federation	This study should be the basis for designing practical management resources that will help the RFET and other NSFs advance in generating, managing, and assessing innovation programs in their sports settings.

The Complexities of Clean Sport: A Literature Review on Athlete Values, Doping Attitudes, and Educational Approaches in Anti-Doping Programs

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ABSTRACT

Background. The integrity of sport relies on clean practices, yet doping remains a significant challenge. Athletes' attitudes toward doping are influenced by personal values, external pressures, and the sporting environment, complicating efforts to foster clean sports cultures. **Objectives.** This review explores the relationship between athletes' values, doping attitudes, and the effectiveness of anti-doping education. It examines how explicit and implicit measures of doping attitudes inform educational strategies and influence doping behaviors. **Methods.** A comprehensive search of PubMed, Scopus, Web of Science, and Embase was conducted to select studies from the past decade focusing on athletes' values, moral identity, and anti-doping interventions. **Results.** The review found discrepancies between self-reported and implicit doping attitudes. Athletes with high-value consciousness were more resistant to doping, while egoistic motivations increased doping risk. Anti-doping education programs improve attitudes and moral identity, but elite and para-athletes require tailored approaches. **Conclusion.** Combining explicit and implicit assessments, focusing on value development, and tailoring education strategies are key to promoting clean sports behaviors.

KEYWORDS: *Clean Sport, Doping Attitudes, Anti-Doping Education, Athlete Values, Moral Identity*

INTRODUCTION

The integrity of sports is a cornerstone of competitive athletics, and maintaining fairness through clean sports practices is essential to ensuring athletes' health, safety, and the authenticity of their achievements (1–4). Despite efforts to combat doping, the persistence of substance abuse in sports highlights the complexity of fostering a clean sport culture. Personal values, perceptions of fairness, external pressures, and the broader sporting environment influence athletes' attitudes toward doping. As doping behaviors continue to pose significant challenges, understanding the psychological, ethical, and social factors that shape athletes' decisions is crucial to designing more effective anti-doping interventions.

This literature review examines the relationship between athlete values, doping attitudes, and the effectiveness of educational approaches in anti-doping programs. It draws on various studies, including implicit attitudes, athlete values, moral identity, and the role of education in shaping ethical decision-making. By exploring these interrelated aspects, the review aims to provide insights into how educational strategies can be improved to foster cleaner sports cultures and reduce doping prevalence. Specifically, the review addresses how explicit (self-reported) and implicit (cognitive) measures of doping attitudes may inform the development of more effective anti-doping education programs and how athletes' value systems intersect with their

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likelihood of engaging in doping behaviors.

MATERIALS AND METHODS

This literature review synthesizes findings from studies published in the past decade, focusing on athletes' values, attitudes toward doping, and the effectiveness of anti-doping educational interventions. The studies were selected through a comprehensive search of four major academic databases: PubMed, Scopus, Web of Science, and Embase. These databases were chosen due to their broad coverage of peer-reviewed sports science, psychology, and public health articles. The review examines explicitly research exploring the relationship between athletes' values, such as integrity, success, and moral identity, and their attitudes toward doping. It also includes studies that use explicit (self-reported) and implicit (cognitive) measures of doping attitudes, given the importance of understanding discrepancies between how athletes report their behavior and their unconscious attitudes. Additionally, the review considers studies on the effectiveness of anti-doping education programs targeting various athlete populations, including grassroots, elite, and para-athletes. Key themes explored include value consciousness, moral disengagement, and the impact of different educational strategies, such as workshops, case studies, and peer discussions, on shaping ethical decision-making.

RESULTS

Table 1 is a critical appraisal analysis from 7 journals.

DISCUSSION

A recurring theme across several studies is the significant gap between athletes' self-reported attitudes toward doping and their implicit or subconscious beliefs. The survey by Incongruence in Doping Related Attitudes, Beliefs and Opinions in the Context of Discordant Behavioural Data revealed that athletes often deny engaging in doping practices, even when objective measures such as hair analysis indicate otherwise. This suggests that self-reports may be influenced by social desirability bias or a lack of self-awareness, which can distort the accurate picture of doping behaviors. In contrast, implicit measures, such as response-time latencies and the brief implicit attitude test used in the study of bodybuilders, provide insights into athletes' subconscious attitudes, which may be more indicative of their actual stance on doping. The discrepancy between self-reported and implicit measures underscores the importance of using a combination of explicit self-reports and implicit assessments to improve doping detection and gain a more accurate understanding of athlete behavior. This approach could help design more effective anti-doping strategies addressing conscious and unconscious biases toward doping.

The role of personal values in shaping athletes' decisions regarding doping has also emerged as a key factor. The study on Elite Athletes' Values in Action identified three significant themes influencing athletes' ethical decision-making: value consciousness, intrapersonal value continuity, and value conflict management.

CONCLUSION

In conclusion, the research reviewed highlights the multifaceted nature of doping behaviors in sports, emphasizing the importance of addressing both conscious and unconscious attitudes, athletes' values, and the effectiveness of targeted anti-doping education. By focusing on athletes' values, improving moral identity, and providing context-specific educational interventions, anti-doping programs can be more effective in promoting clean sports. As the complexity of doping in sports continues to evolve, so must the strategies we use to prevent it, ensuring that athletes make ethical decisions that align with the true spirit of sport.

APPLICABLE REMARKS

- Integrating explicit and implicit assessments of doping attitudes is crucial for designing effective anti-doping education strategies that address diverse athlete profiles.
- Developing athletes' value consciousness and moral identity significantly reduces doping behaviors, highlighting the need for targeted educational approaches.
- Tailoring anti-doping programs for elite and para-athletes can enhance their effectiveness and foster a culture of integrity and clean sport.

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AUTHORS' CONTRIBUTIONS

Study concept and design: Hastria Effendi. Acquisition of data: Hilmainur Syampurma. Analysis and

interpretation of data: Hastria Effendi. Drafting the manuscript: Hastria Effendi. Critical revision of the manuscript for important intellectual content: Hastria Effendi. Statistical analysis: Eldawaty
Administrative, technical, and material support: Hastria Effendi. Study supervision: Rika Sepriani

CONFLICT OF INTEREST

The authors mention no "Conflict of Interest" in this study.

ETHICAL CONSIDERATION

This review adheres to ethical standards by including only studies that were ethically approved and publicly accessible. It synthesized all information from previously published research that adhered to relevant ethical guidelines.

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ARTIFICIAL INTELLIGENCE (AI) USE

There was NO use of artificial intelligence (AI) for preparation, writing, or editing this manuscript.

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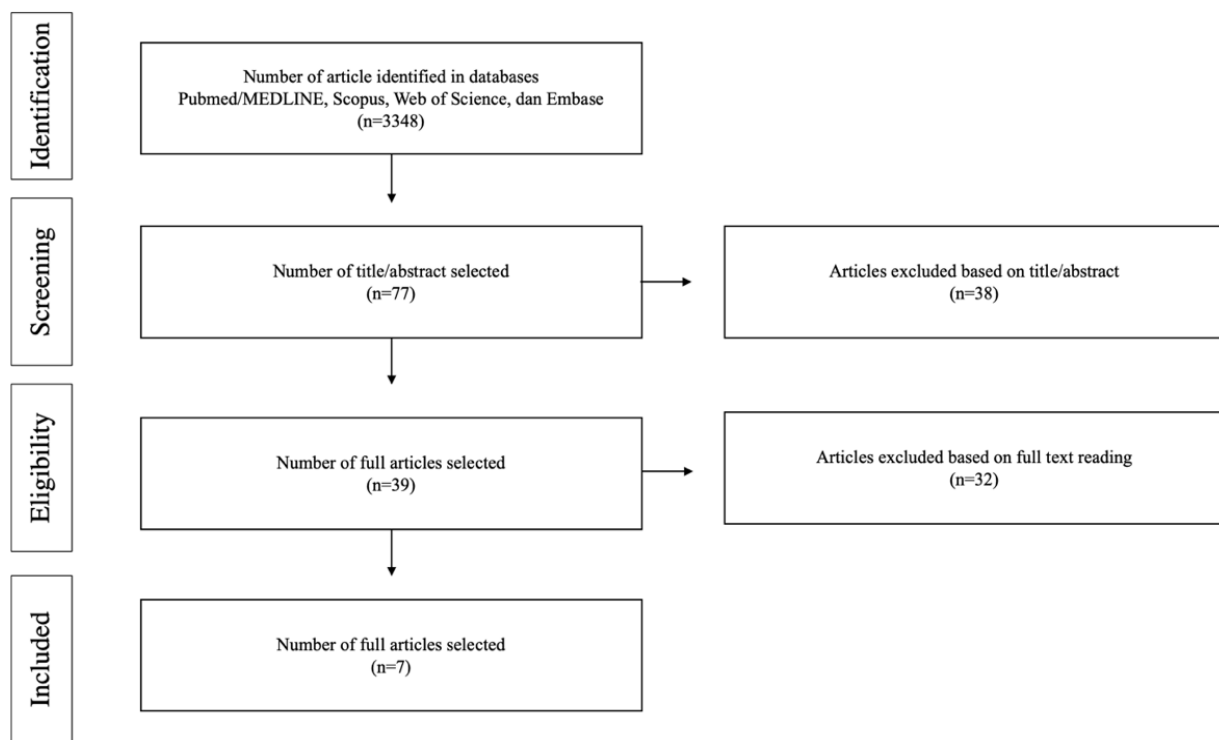


Figure 1. PRISMA flowchart of the article selection process

Table 1. Literature Review Summary of Results

Researchers	Article Title	Research Results
(5)	Incongruence in Doping-Related Attitudes, Beliefs and Opinions in the Context of Discordant Behavioural Data: In Which Measure Do We Trust?	This study reveals a significant discrepancy between self-reported doping behaviors and implicit cognitive measures, particularly among athletes who deny doping use despite positive hair analysis. It suggests that self-reports may be biased, and combining explicit self-reports with implicit assessments could improve doping detection and understanding of athlete behavior.
(6)	Elite athletes' values in action: an important yet complicated aspect of anti-doping education	This study identified three main themes related to athletes' values: (1) value consciousness and clarity, (2) intrapersonal value continuity, and (3) value conflict and management. High-value consciousness was seen as protective against cheating, while doping was often viewed as a way to fulfill egoistic values such as success and wealth.
(7)	Differences in Race Characteristics between World-Class Individual-Medley and Stroke-Specialist Swimmers	This study found significant differences in swimming performance between stroke specialists and IM swimmers. Breaststroke specialists swam faster and covered more distance per stroke than IM swimmers, while backstroke and front crawl specialists had faster underwater speeds. No significant sex differences were observed, but considerable stroke effects were found.
(8)	"I RUN CLEAN Project"—An Innovative and Self-Sustainable Approach to Develop Clean Sports Behaviours in Grassroots Athletes	This study evaluated the effectiveness of an anti-doping training and workshop program for athletes and coaches. The results showed improvements in self-efficacy, moral identity, attitudes towards doping in coaches, and a reduction in moral disengagement in athletes. The ambassador training also enhanced public speaking skills and reduced presentation-related stress.
(9)	#SafeSport: safeguarding initiatives at the Youth Olympic Games 2018	The study assessed athletes' understanding of "safe sport" and their perceptions of harassment and abuse at the 2018 Youth Olympic Games. Results showed a lack of awareness about harassment and abuse, with 34% of athletes acknowledging its occurrence in sports. Educational tools were generally well-received, but improvements in accessibility and training were suggested.
(10)	Addressing the unique needs for anti-doping and clean-sport education of para-athletes and athlete-support personnel: an international Delphi study	The results of Rounds 2 and 3 were used to create education recommendations for para-athletes and asP. In Round 4, most panel members fully accepted the para-athlete and ASP.
(11)	Using response-time latencies to measure athletes' doping attitudes: the brief implicit attitude test identifies substance abuse in bodybuilders	Prohibited substances were found in 43% of all tested urine samples. Dopers had more lenient attitudes to doping than non-dopers (Hedges's $g = -0.76$). D-scores greater than -0.57 (CI95 $= -0.72$ to -0.46) might indicate a relatively lenient attitude to doping. In urine samples, evidence of administration of combinations of substances, complementary administration of substances to treat side effects, and use of stimulants to promote loss of body fat were common.

The Effects of Massage Manipulation with Flexibility Exercises Against the Handling of Ankle Sprain Injuries of Football Athletes at Massage Gaselva

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ABSTRACT

Background. Football players mainly experience the risk of ankle injuries. If not handled properly, it will impact and affect the performance of athletes in matches, so reasonable preventive and rehabilitative efforts when they are in better post-injury conditions are needed. **Objectives.** The study aimed to determine the effect of massage manipulation with flexibility exercises on the handling of ankle sprain injuries of football athletes aged 15-30 years at Massage Gaselva. **Methods.** The research method used in this study is a quasi-experimental with a one-group pretest-posttest design. The population in this study consisted of Gaselva massage therapy laboratory patients and athletes who had sports injuries. Samples were taken using incidental sampling techniques so that the sample amounted to 15 people. Instrument to measure Range of Motion (ROM) in joints, namely visual analog scale. Before the data is analyzed, an analysis requirements test is carried out, namely the normality and homogeneity tests. Data analysis was performed with a t-test for pairwise data comparison, with a significance level of 5%. **Results.** It is shown that there was a significant effect between massage manipulation and flexibility training (with values t_o (19.00) > t_t (1.761)) on the management of ankle sprain injuries of soccer athletes aged 15-30 years at Massage Gaselva. **Conclusions.** This is known because ankle injuries experienced by soccer athletes must be handled properly, quickly, and precisely.

KEYWORDS: *Massage, Flexibility, Injury, Ankle Sprain, Football, Athlete*

INTRODUCTION

Football is the most famous sport worldwide, including in Indonesia, because it triggers passion and emotions that are different from other sports (1,2). Football development has brought progress in various aspects, including improving the quality and perfecting regulations. Almost all types of sports carry the risk of injury, both severe and minor, and we cannot avoid the possibility of such injuries. Football athletes often experience injuries in their sports activities. Injuries due to sports activities can occur in individuals of different age ranges (3–6).

Ankle Sprain injury is essential to note because, based on researchers' observations during their time as a masseur, this injury is quite common in everyday life, especially in those who often use the lower part of the body or actively walk and run (7–9). Some people or athletes do not know how to handle it and ignore this injury, hoping it heals by itself (10). An ankle sprain can interfere with daily activities and increase the risk of experiencing similar injuries in the future (4,11,12), so the existence of a strong ankle plays a vital role in maintaining stability during sports activities (12). Improper movement due to lack of stability in the Ankle can result in injury to the Ankle (13).

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MATERIALS AND METHODS

This research is a type of experimental research that uses the pre-experimental method with a one-group pretest-posttest design. This study measured a group before and after getting the Massage Manipulation treatment with Flexibility Exercises. The design of the study is as follows. The population in this study consisted of Gaselva massage therapy laboratory patients, consisting of athletes who had sports injuries. The sampling technique used is incidental sampling, so the total sample that meets the requirements is 15 people who undergo Massage Manipulation treatment with Flexibility Exercises. The instrument used in this study is the VAS (Visual Analog Scale). The data collected in this study results from testing and measurement on athletes who have suffered sports injuries. The data generated from the measurements are analyzed through analysis prerequisite tests, namely normality tests to assess the straightness of data distribution and homogeneity tests to verify the consistency of data variability. The data were analyzed using t-tests for pairwise data comparison, with a significance level of 5%.

RESULTS

The study's results were obtained as follows based on the data from the study, which used measuring instruments to measure the joints, namely the visual analog scale.

Based on the normality test calculation results, the pre-test data are known as the sig value $(0.952) > 0.05$, and the post-test data are known as sig values $(0.118) > 0.05$. These results suggest that all data come from a normally distributed population.

Based on the table above, the sig value is known from the homogeneity test value. Test homogeneity of variances of $0.183 > 0.05$ shows that pre-test and post-test data come from populations with relatively homogeneous variances. Next, hypothesis testing was conducted using a t-test for pairwise data comparison, with a significance level of 5%. T-test testing produces t values and probability values (p), which help test hypotheses regarding the presence or absence of a significant effect, a significance of 5%.

Based on the data above, it is known that the value of $t_0 (19.00) > t_t (1.761)$, it can be concluded that there is a significant influence between Massage Manipulation and Flexibility Training on handling ankle sports injuries sprain football athletes aged 15-30 years at Massage Gaselva. The difference in average scores between pre-test data (4.81) and post-test data (1.41) was 3.7 (76%) decreased the rate of ankle sports injuries in football athletes.

DISCUSSION

Massage therapy can be done in ankle injury rehabilitation, using massage manipulation techniques by friction and effleurage for muscle tension. After that, Traction and repositioning of the ankle joint are performed in place. Massage success is considered to be achieved if the criteria for normal ankle movement are met: 1) Able to flex and extend without experiencing pain or stiffness, and 2) Can perform rotational movements on the ankle. Massage is one method for overcoming injuries, while after injury, optimal recovery can be achieved through rehabilitation exercise programs. Athletes with an ankle sprain can do flexibility, strength, and proprioceptive exercises. This flexibility exercise uses static stretching for dorsiflexion, plantar flexion, inversion, and eversion movements (14). Each movement is performed twice in this stretch. The theory developed above can be used as a basis for the hypothesis in this study to prove whether Massage Manipulation with Flexibility Exercise affects the handling of ankle sports injuries by football athletes aged 15-30 years at Massage Gaselva.

CONCLUSION

Based on the study's results, it can be concluded that massage manipulation with flexibility training significantly influences handling ankle injuries sprained football athletes aged 15-30 years at Massage Gaselva. This can be known because ankle injuries experienced by soccer athletes must be handled properly, quickly, and precisely. A mistake in handling will cause a more serious injury, cause pain, and significantly interfere with daily activities and training time. Providing massage manipulation with flexibility exercises on ankle injuries can help athletes who experience ankle injuries recover quickly and not feel significant complaints so that they can move, walk, run, jumping without feeling pain or pain, besides that after being given massage manipulation with flexibility exercises can recover faster and be ready to follow the training process without pain, more confident without any fear of injury returning, and after being given massage manipulation with flexibility exercises can play more widely, straightforwardly, confidently without the burden of injuries he has experienced. Further research with larger sample sizes is needed to confirm and expand on these findings for broader sports rehabilitation applications.

APPLICABLE REMARKS

- This study highlights the significant benefits of combining massage manipulation with flexibility exercises in treating ankle sprains in football athletes.
- It is recommended that these interventions be incorporated into rehabilitation programs to speed up recovery, reduce pain, and improve joint mobility.
- Coaches, trainers, and medical staff should be trained to use these methods for injury prevention and rehabilitation, tailoring treatments to each athlete's needs.
- Regular follow-up assessments are essential to track progress, while athletes can also benefit from increased confidence and reduced risk of re-injury.

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Study concept and design: Bafirman, Fiky Zarya. Acquisition of data: Schillaci Valley Mucci. Analysis and interpretation of data: Schillaci Valley Mucci. Drafting the manuscript: Bafirman. Critical revision of the manuscript for important intellectual content: Fiky Zarya.

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The authors mention no "Conflict of Interest" in this study.

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This review adheres to ethical standards by including only studies that were ethically approved and publicly accessible. It synthesized all information from previously published research that adhered to relevant ethical guidelines.

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Table 1. Data Normality Test

Variable	Sig.	Nilai α	Conclusion
Pre-Test	0,952	0,05	Usual
Post-Test	0,118	0,05	Usual

Table 2. Homogeneity Of Variances Test

Variable	Sig.	Nilai α	Information
Pre-test with Pos-test	0,183	0,05	Homogeneous

Table 3. Hypothesis Testing (T Test)

Variable	N	Mean	Sig. (2-tailed)	t_o	t_t	Information
Pre-test	15	4,81	0,000	19,00	1,761	Significant
Post-test	15	1,14				

The Impact of Massage and Exercise Therapy on Mobility and Shoulder Function: A Case Study of Post-Injury Patients

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ABSTRACT

Background. Shoulder injuries are often a problem for a person carrying out daily activities, especially for athletes and sportsmen who need optimal shoulder strength and mobility. Massage and exercise therapy are usually post-injury rehabilitation approaches to restore shoulder mobility and function. **Objectives.** This study aims to test the impact of massage and exercise therapy on improving shoulder mobility and function in post-injury patients. **Methods.** The methodology used in this study is a quasi-experimental study with a group pretest-posttest design. This study uses massage and exercise therapy treatments at the Physiotherapy Service Center, Sports Science Faculty, Padang State University. **Results.** After undergoing massage therapy and exercise therapy given three times a week for four weeks, the patient experienced a significant improvement in mobility and pain reduction. **Conclusion.** Massage and exercise therapy effectively improve shoulder mobility and function in post-injury patients. Simultaneously, both methods can speed up recovery and improve the patient's quality of life. Further research is needed to evaluate optimal rehabilitation protocols with a broader population.

KEYWORDS: *Masase Therapy, Exercise Therapy, Mobility, Shoulder Function*

INTRODUCTION

Shoulder injuries and associated pain and disability are prevalent and debilitating health problems, affecting a large portion of the worldwide population (1)(2). Shoulder injuries can also involve joint pain (shoulder pain) due to various factors, including repetitive movement, overuse, and overhead movement, which significantly increases the risk of injury (3). In sports, the shoulder is often injured by repetitive activities of moving the arm above the head, such as in volleyball, tennis, and judo. As a result, athletes who ignore injuries tend to experience higher injury severity, which affects their participation, training volume, and performance (4).

Massage and exercise therapy are often used in rehabilitation to reduce pain and improve shoulder function. Massage therapy and exercise therapy are well-known methods of shoulder pain rehabilitation. Massage therapy is essential in improving blood circulation, reducing muscle tension, and improving the flexibility of the soft tissues around the shoulder. Massage therapy is used as an alternative in reducing pain and disability due to shoulder (5)(6)(7). On the other hand, exercise therapy, which includes stretching and strengthening the shoulder muscles, aims to improve the stability and mobility of the shoulder joint so that it can support the healing process (8). Exercise therapy to rehabilitate the periscapular muscles, deltoid, and rotator cuff elements is the proper and effective action as the first step in treatment cuff (9). By combining these two methods, it is hoped that patients can return to optimal shoulder function. Combining massage and exercise therapy can reduce pain more significantly than one type alone (10).

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MATERIALS AND METHODS

This case study involved 20 participants with a history of shoulder injuries who experienced limited movement and pain in their shoulder joints. The subjects of this study are athletes and sportsmen with inclusion criteria in the age range of 17-40 years (men and women). The research procedure consists of the following: Intervention Procedure.

Massage therapy: Patients undergo massage therapy thrice a week for 4 weeks. The techniques used include effleurage, friction, petrissage, and trigger point techniques targeted at the shoulder area and surrounding muscles.

Physical Exercise: The physical exercise is focused on stretching and strengthening the shoulder muscles, including the rotator cuff muscles and the shoulder stabilizer muscles. The exercise is carried out three times a week in the form of passive, active, isometric, and dynamic exercises with an intensity that gradually increases according to the patient's development. Measurements were taken before and after the rehabilitation program. Shoulder mobility was measured by a range of motion (ROM). In contrast, the level of pain and shoulder function was assessed by the Visual Analog Scale (VAS) and Shoulder Pain and Disability Index (SPADI)—statistical analysis For SPSS analysis statistics (Ver 25. IBM Co. USA) used in this study. The normality of the data distribution was analyzed using the Shapiro-Wilk method. Meanwhile, tests were carried out using paired t-tests and independent t-tests to test the hypothesis.

RESULTS

After undergoing therapy for four weeks, patients experienced significant improvements in mobility and pain reduction. The following are the study results based on the parameters measured: Descriptively, the results are presented in the form of min, max, and average values as well as standard deviations for each pretest and post-test variable. The data presented includes a decrease/increase in pre- or post-treatment with massage and exercise therapy, which are the interventions given in this study.

1. Pain Level (VAS): The VAS score dropped from the average pain level at the time of the pretest, and the SD was 6.8 ± 1.15 . After the average massage therapy and exercise therapy treatment and SD, the pain level results decreased to 2.00 ± 0.64 .

2. Range of Motion (ROM): There is an increase in the overall range of motion of the shoulder, especially in flexion, extension, abduction, and adduction movements that were previously very limited due to injury. Pretest and post-test results showed improvement (Flexion = 136.6 ± 24 vs. 174.00 ± 5.2 Extension = 39.5 ± 7.2 vs. 44.3 ± 2.4), abduction 138.8 ± 2.6 vs 174.00 ± 5.5 , adduction 38.8 ± 2.8 vs 39.8 ± 1.1).

3. Shoulder Function (SPADI): The SPADI score decreases (66.3 ± 20.62 vs 19.3 ± 6.59), indicating improved shoulder function in daily activities. For more clarity, the results of this study can be seen descriptively in Table 1.

DISCUSSION

This study shows that combining massage and exercise therapy significantly reduces pain and provides a consistent and long-lasting effect. Massage therapy helps improve blood flow and reduce muscle tension around the shoulder. It effectively reduces muscle stiffness, chronic pain, and post-injury recovery, where it helps relieve pain and speed up the healing process (11–13) and complements other rehabilitation techniques (14). In addition, the results of ROM measurements showed significant improvements in various shoulder movements, namely flexion, extension, abduction, and adduction. The results showed that the average ROM was on flexion. This improvement suggests that the combination of interventions can improve the functional ability of the shoulder joint, particularly in supporting overhead movements that are critical for athletes in various sports. Combination therapy is more effective for managing pain and disability than one form of therapy alone in patients with shoulder pain (15).

After the intervention, this decrease in SPADI score indicates an improvement in shoulder function in daily activities, which is essential for patients to return to sports and non-sports activities optimally. This is in line with previous research, which shows that the combination of massage therapy and exercise can have a synergistic effect. This study strengthens the evidence that combining massage therapy and exercise can significantly impact shoulder injury recovery. This rehabilitation approach provides advantages for patients with shoulder pain regarding pain reduction, increased range of motion, and restoration of shoulder function.

CONCLUSION

Massage and exercise therapy effectively improve shoulder mobility and function in post-injury patients. Massage therapy is a manual therapy that reduces nerves, improves blood flow, and improves mood and

comfort conditions. If the massage program is given with an adequate and measurable program, it can increase the effectiveness of healing. Simultaneously, both methods can speed up recovery and improve the patient's quality of life. Further studies are needed to evaluate optimal rehabilitation protocols and ensure their effectiveness in dealing with different types of shoulder injuries and the wider population. Future research with more extensive and diverse populations is recommended to validate these findings further and optimize rehabilitation strategies for various types of shoulder injuries.

APPLICABLE REMARKS

- The results of this study provide strong evidence that the combination of massage therapy and exercise therapy is efficacious in improving shoulder mobility and function in post-injury patients.
- These therapeutic methods can significantly reduce pain, improve range of motion (ROM), and enhance overall shoulder function, making them a valuable rehabilitation approach for recovering from shoulder injuries.
- The findings suggest that combining both therapies can accelerate recovery, particularly for athletes and individuals requiring optimal shoulder function for daily activities.
- Clinicians and rehabilitation specialists should consider integrating massage and exercise therapy into their treatment protocols for shoulder injury rehabilitation.

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AUTHORS' CONTRIBUTIONS

Liza, Alimuddin, and Deswandi contributed to the study design, data collection, and analysis. Masrun assisted in the methodology development and provided clinical expertise in therapy techniques. Muhamad Sazeli Rifki and Donal Syafrianto contributed to the data interpretation and manuscript writing. All authors reviewed and approved the final manuscript.

CONFLICT OF INTEREST

The authors mention no "Conflict of Interest" in this study.

ETHICAL CONSIDERATION

This study was conducted under ethical guidelines for research involving human participants. Informed consent was obtained from all participants, including students and teachers, before their involvement in the field trials. Participants were assured of their anonymity and confidentiality, with all personal data being securely stored and used solely for research purposes. The study adhered to ethical standards, ensuring that no harm came to the participants and that they were free to withdraw from the study at any time without consequence. Additionally, the research was approved by the relevant educational and institutional ethics committees to ensure compliance with ethical norms and guidelines.

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Table 1. Description of the average results of each post-test pretest group

Group	<i>n</i>	Min	Max	<i>M ± SD</i>
pre_pain	20	4.00	8.00	6.8 ± 1.15
post_pain	20	1.00	3.00	2.00 ± 0.64
pre_romf	20	70.00	166.00	136.6 ± 24
post_romf	20	160.00	180.00	174.00 ± 5.2
pre_romex	20	25.00	45.00	39.5 ± 7.2
post_romex	20	35.00	45.00	44.3 ± 2.4
pre_romab	20	85.00	170.00	138.8 ± 2.6
post_romab	20	160.00	180.56	174.00 ± 5.5
pre_romad	20	30.00	40.00	38.8 ± 2.8
post_romad	20	35.00	40.00	39.8 ± 1.1
pre_spadi	20	26	116	66.3 ± 20.62
post_spadi	20	10.00	30.00	19.3 ± 6.59

Sensor-Based Dynamic Balance Tools For Postural Stability Control: A Literature Review

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ABSTRACT

Background. The ability to maintain a position within the limits of stability or support is called equilibrium. It is shown that the posture control system plays a vital role in maintaining balance on a small support base. Assessing balancing capabilities concisely and thoroughly becomes difficult due to the complex process. This study builds on previous efforts by reviewing various papers assessing posture balance with various mechanical tools and providing a detailed overview of standard mechanical tools used to assess posture balance. **Objectives.** This review aims to find the right type and tools of exercise to control posture stability. **Methods.** We searched the database through electronic search through various leading journals using VOSviewer to analyze bibliometrics from the Scopus database from Elsevier and Google Scholar. A literature search yielded a total of 154 related items. After conducting a more in-depth evaluation, the selected literature only mentions mechanical tools to evaluate static and dynamic balance. From the evaluation, only 12 articles met the criteria. **Results.** Based on the search results, only four pieces of literature are directly related to sensor-based dynamic tools for postural stability control, including inertial balance sensors, Biodex Balance Systems, force plates, and 3D Joint Kinematic sensors. **Conclusions.** This sensor-based dynamic balance tool effectively evaluates and practices postural stability in various areas, from medical rehabilitation to training.

KEYWORDS: *Dynamic Balance, Postural Stability, Stability Control, Sensors*

INTRODUCTION

The ability to maintain a position outside the limits of stability or support is known as equilibrium. Maintaining, achieving, or restoring balance during any posture or activity is known as posture control (1). Patients with vestibular disorders usually exhibit postural instability and imbalance as increased body sway, impaired coordination between the visual and proprioceptive systems, decreased threshold of stability and functional ability, changes in gait, and falls. Various neuromuscular disorders are associated with falls resulting from postural imbalances (2). It is shown that the posture control system plays an important role in maintaining balance because the legs provide a small support.

Balance assessment for patients with various clinical conditions is essential because it is necessary to establish treatment goals, determine treatment methods, and provide progression and prognosis (3). One of the essential components of physiotherapist and orthopedic examination is the assessment of balancing ability (4). Functional tests are inherently subjective because most do not use instrumental measurement data in the assessment process (5). However, functional tests are practical because they do not require a lot of devices and

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instrumentation. Assessing balancing capabilities concisely and thoroughly becomes difficult due to complex processes like static body stability (stability to keep the body in a static position), pseudo mobility (dynamic and transfer body stability), and mobility (stability during the drive).

Although there is a growing body of evidence in favor of using mechanical tools to evaluate posture balance and dynamics, it is essential to remember that this area of research is still in its advanced stages (6). As mentioned, several additional systematic reviews have been published recently. This review evaluated how the sample population experienced postural imbalances due to various balance disorders. The study expands on previous efforts by reviewing numerous papers that use various mechanical tools to assess postural balance and provides a detailed overview of standard mechanical tools used to evaluate postural balance. This study aims to obtain data on tools for posture balance control exercises.

MATERIALS AND METHODS

The procedure for implementing a literature review is carried out by searching databases through electronic searches through various leading journals using VOSviewer to analyze bibliometrics. The articles reviewed are only from online electronic database sites from the Scopus database from Elsevier and google scholar. The data we obtain from relevant sources allows us to analyze and identify the keywords we obtain. The study included a comprehensive text analysis of approximately 154 articles from 2015 to 2024. The result of this analysis is a brief report that offers recommendations or a summary of the research based on bibliometric analysis.

RESULTS

Main information. A literature search yielded a total of 154 articles related to postural balance. After removing duplicates, posters, congressional abstracts, and other studies that did not mention mechanical tools for evaluating static and dynamic balance, 12 papers met the inclusion criteria for this review. In-depth, which is closely related to sensor-based balance tools, four tools were selected to assess and become balance training tools, including (1) Inertial balance sensor, (2) Biodex balance system, (3) Forceplate, (4) Inertial Sensor Based 3D Joint Kinematics.

The most popular scientific source. *Inertial balance sensor:* Inertial balance sensors are typically used to measure the balance or stability of a system by detecting its inertial force (7). It senses the force arising from the movement and can assess balance by analyzing acceleration, tilt, or vibration. Commonly used inertial sensing tools include accelerometers, gyroscopes, and magnetometers.

Sensors detect changes in motion (acceleration) and orientation, analyzing the force exerted on an object or system (8). It records changes in direction and rotational speed, offering data on an object's stability or imbalance based on its inertial behavior. Sensors can often adjust for vibrations and minor disturbances to filter out noise, providing a clear signal about movement or more significant imbalances.

The sensor is usually located on the trunk and limbs. An inertial sensor-based device is mounted on the participant's body (9). Participants were then asked to maintain their body's balance through various tests. Inertial sensor data is used for temporal and spatial-temporal gait parameters and angular and turn speeds.

Biodex balance system: The Biodex Scale System is a state-of-the-art device to assess and train individuals' balance, stability, and proprioception. It is widely used in physical therapy, sports training, rehabilitation, and research to evaluate balance abilities and help improve stability. These systems typically include a computerized platform with an adjustable level of stability, allowing for precise control and measurement of balance performance.

The Biodex balance system requires people to stand on a platform that can be moved at an angle of up to 20 degrees in any direction. (10). The LCD screen shows the subject visual feedback on the position of their COM compared to the periphery of the platform (11). A built-in safety handrail and an optional overhead harness system can be added if more support is required.

Forceplate: A force plate (or force platform) is a device that measures the ground reaction force produced by a person or object that is standing, moving, or interacting with its surface. Force plates are commonly used in biomechanics, sports science, physical therapy, and research to analyze movement patterns, balance, and force application.

The power plate can analyze the scale with software. For each subject, COP motion track data (in mm) was collected and decomposed into mediolateral (ML) and anterior-posterior (AP) components to be studied (12). Force plates are known for their accuracy and versatility. However, they need a stable and controlled environment and trained professionals to interpret data, as motion analysis can be complex and context-dependent.

Inertial Sensor-Based 3D Joint Kinematics Tool. The Inertial Sensor-Based 3D Joint Kinetics Tool is a system that uses a wearable inertial sensor (IMU) to measure and analyze the angle, movement, and

orientation of joints in a three-dimensional space (13). This examination revealed promising results from the magnetometer's independent sensor fusion algorithm, which showed no systematic deviations in the joint angle data. Therefore, a stand-alone system incorporating these algorithms provides the potential for application in clinical gait analysis and further implementation.

Inertial sensor-based 3D joint kinematics tools are potent assets in clinical and athletic environments, providing essential data on joint motion and movement patterns in various settings.

DISCUSSION

A Sensor-Based Dynamic Balance Tool for Postural Stability Control uses specific sensors to evaluate and train balance and posture stability. Clinical assessment with validated tools for balance control is essential for clinical practice and research (14). Researchers have shown much interest in recent years, as this review shows. A growing number of publications discuss the use of various mechanical tools in the field of assessment in clinical conditions or for training (15). Most of these selected papers discuss and analyze their various aspects. According to estimates, the benefits of using mechanical tools to measure balance results are clear and more reliable.

All tools fall into three main categories based on the balance components they measure. They include the following: Static Standing Balance, Strength Plates and Clinical Trials of Sensory Interaction, Static and Dynamic Standing Balance on Platform, Computerized dynamic posture and Biodex Balance System, and Static and Dynamic Standing Balance with Gait Analysis.

Some of the tools already mentioned are often used in rehabilitation, sports, and biomechanical research to help individuals improve balance abilities, reduce the risk of falls, and strengthen posture.

CONCLUSIONS

In conclusion, sensor-based dynamic balance tools, including inertial balance sensors, Biodex Balance Systems, force plates, and 3D Joint Kinematic sensors, provide effective solutions for evaluating and training postural stability. These tools enable comprehensive assessment and are valuable across various applications, such as medical rehabilitation and athletic training, offering reliable support in maintaining and enhancing balance and stability.

APPLICABLE REMARKS

- Sensor-based dynamic balance tools are suitable for various fields, including medical rehabilitation and athletic training, allowing for broad usability in various settings.
- Tools like inertial balance sensors, Biodex Balance Systems, force plates, and 3D Joint Kinematic sensors offer detailed evaluations, enabling a thorough understanding of an individual's balance and postural stability.
- These tools effectively train postural control by providing real-time feedback, which helps improve balance and stability through targeted exercises.

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AUTHORS' CONTRIBUTIONS

Study concept and design: Anton Komaini, Muhamad Sazeli Rifki. Acquisition of data: Sri Gusti Handayani. Analysis and interpretation of data: Nuridin Widya Pranoto. Drafting the manuscript: Alimuddin. Critical revision of the manuscript for important intellectual content: Alimuddin.

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Augmented Reality-Based Teaching Modules on the Improvement of Motor Skills in Early Childhood

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ABSTRACT

Background. This study was motivated by concerns about the potential impact of increased digital technology usage on the motor skills development of young children. While augmented reality (AR) technology holds promise for improving learning quality, its effect on early childhood motor skills remains unclear. **Objectives.** The research aims to explore the effectiveness of AR-based teaching modules in enhancing motor skills in young children. **Methods.** A pre-experimental design was used with 25 children aged 4-5 from four kindergartens. The children were divided into an experimental group (using AR modules) and a control group (using traditional methods). The Test of Gross Motor Development-2 (TGMD-2) was administered before and after the intervention. Data analysis involved descriptive statistics, paired t-tests, normality testing, and N-Gain score analysis. **Results.** The experimental group showed significant improvement in motor skills, with scores increasing from 2496 (pre-test) to 3680 (post-test). A paired t-test ($t = 13.621$, $p = 0.000$) confirmed a significant difference. The N-Gain score indicated moderate improvement (0.52). **Conclusion.** AR technology was effective in enhancing young children's motor skills. Further research is recommended to refine AR modules and optimize their implementation for maximum educational impact.

KEYWORDS: *Augmented Reality, Motor Skills, Early Childhood, Education, Interactive Learning*

INTRODUCTION

In recent years, information and communication technology advancements have led to substantial transformations across multiple sectors, including education (1). One technological innovation gaining popularity is Augmented Reality (AR), which enables users to engage with virtual objects within the real world via digital devices (2). By merging real-world elements with virtual content, AR technology offers a novel approach to accessing information and enhancing the learning experience (3). Specifically in early childhood education, AR holds considerable potential for fostering a more engaging and interactive learning environment, helping to boost children's curiosity and motivation for learning. Motor skills are crucial to early childhood development (4–10). These skills are essential for physical development and serve as a foundation for children's cognitive, social, and emotional development (11). Motor skills are divided into two main categories: gross motor, which involves large body movements such as running, jumping, and kicking, and fine motor, which involves small muscle movements such as writing, drawing, and holding objects (12).

As the use of digital technology increases among children, there is a concern that time spent in front of screens may reduce the time for physical activity, which is important for developing motor skills (13). This research aims to fill the gap by exploring the effect of AR technology-based teaching modules on improving

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early childhood motor skills. The teaching module explicitly designed for this study integrates physical activity with interactive learning, allowing children to use their body movements to interact with digital content. (14). Through this approach, children are expected to improve their understanding of the subject matter and develop essential motor skills. In addition, this study also aims to provide empirical evidence that educators can use to integrate digital technology effectively into the early childhood education process.

MATERIALS AND METHODS

The study used a pre-experimental design to assess the impact of augmented reality (AR)-based teaching modules on improving early childhood motor skills. It involved two groups: an experimental group using AR modules and a control group with traditional teaching methods. The teaching modules aimed at children aged 4-5 years focused on developing gross and fine motor skills through fun, interactive activities. Parental involvement was also emphasized to reinforce learning at home. The research sample consisted of 25 children from four kindergartens, assessed before and after the intervention using the Test of Gross Motor Development-2 (TGMD-2). This standardized test evaluated locomotor and object control skills, with scores categorized into five levels: Very Good, Good, Average, Poor, and Very Poor. Data from the TGMD-2 results were analyzed to determine any significant improvements in motor skills following the intervention.

RESULTS

Based on the results presented in Table 5, the Asymp. Sig. (2-tailed) values for the pre-test (0.171) and post-test (0.200) data are more significant than the alpha level 0.05. Therefore, it can be concluded that both the pre-test and post-test data are normally distributed, meeting the normality assumption required for further statistical analysis.

Based on the results in Table 6, there is a mean difference of 11.84 between pre-test and post-test scores, with a t-value of 13.621 and a significance value (Sig. 2-tailed) of 0.000. Since this value is much smaller than the alpha level of 0.05, it indicates a significant difference, confirming that the Augmented Reality-based teaching modules significantly enhance early childhood motor skills.

Based on the analysis results in Table 2, the N-Gain value 0.52 falls into the moderate category. This indicates that using Augmented Reality-based teaching modules significantly improves early childhood motor skills, although the improvement is not categorized as high. As presented in Figure 3, the N-Gain scores for each participant have been calculated and plotted. The red dotted line indicates the average N-Gain score of 0.52. A table displaying the N-Gain scores for each participant is shown above.

DISCUSSION

The results of this study indicate that using (AR) technology significantly improves motor skill development in early childhood children. This finding reinforces the value of AR as an innovative educational tool in early childhood education settings. This study specifically aims to explore the effects of AR-based teaching modules on children's gross motor skills and object control abilities, which are crucial areas for overall physical development. The findings show significant improvement in motor skills among children exposed to the AR modules, indicating that interactive and immersive digital environments can effectively stimulate physical activity and skill acquisition.

This study showed a significant increase in motor skills scores among children in the experimental group who used Augmented Reality (AR) after implementing the module. The mean motor skills score increased from 2496 in the pre-test to 3680 in the post-test, a statistically significant result confirmed by a paired t-test with a t-value of 13.621 and a p-value of 0.000. This result shows the improvement of AR technology's effectiveness in creating an engaging learning environment that encourages physical interaction. This finding aligns with research by (15), which showed that goal-orientated play activities can effectively improve early childhood motor skills, including running, walking on balance beams, and throwing a ball.

CONCLUSION

This study shows that Augmented Reality (AR) technology significantly enhances motor skill development in children, demonstrating AR's effectiveness as an educational tool. The research results indicate substantial improvements in gross motor skills and object control, validating the hypothesis that AR can enhance physical and cognitive learning. These findings suggest that educators integrate AR into early childhood education to create a more engaging and holistic learning environment. Despite the promising findings, the small sample size and geographical focus limit the study's generalizability, indicating the need for further research with diverse populations and long-term studies. Overall, this study supports using AR to promote comprehensive

child development, offering valuable insights into its potential to transform early childhood education.

APPLICABLE REMARKS

- Augmented Reality (AR) technology significantly improves the development of motor skills in children, demonstrating the effectiveness of AR as an educational tool.

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The researchers extend their heartfelt appreciation to the Research and Community Service Institute of Universitas Negeri Padang for their financial support, which allowed the entire research process to be conducted and completed successfully.

AUTHORS' CONTRIBUTIONS

Concept and design of the study: Masrun. Data acquisition: Rusdinal. Data analysis and interpretation: Khairuddin. Compiled the script: Serli Marlina. Critical revision of the manuscript for important intellectual content: Ardo Okilanda. Statistical analysis: Jannatul Khairoh. Administrative, technical, and material support: Masrun. Study supervisor: Masrun.

CONFLICT OF INTEREST

The authors mention no "Conflict of Interest" in this study.

ETHICAL CONSIDERATION

This research has met the standards of research ethics and has received approval to be a sample of all respondents.

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No institution, organization, or person supported this study. **ROLE OF THE SPONSOR** The funding organizations are public institutions and have no role in the design and conduct of the study, collection, management, and analysis of the data or preparation, review, and approval of the manuscript.

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The authors have no financial interests related to the material in the manuscript.

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Tabel 1. Normality Test Analysis Results

One-Sample Kolmogorov-Smirnov Test	Asymp. Sig. (2-tailed)	Alfa	Description
Pre Test	0,171	0,05	The data are normally distributed.
Post Test	0,200	0,05	The data are normally distributed.

Table 2. Paired t-test Analysis Results

		Mean	Std. Dev	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Pre Test - Post Test	11.84	4.35	0.87	13.63	10.01	13.621	24	0.000

Table 3. Analysis Result N Gain score

N Gain Score	Interpretation
0.52	Average

Application of Sensors in Footwork Testing Instruments for Badminton

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ABSTRACT

Background. Footwork refers to the movement of the feet that positions the body to effectively anticipate shots and place the shuttlecock in the opponent's court. **Objectives.** In practice, athletes must move swiftly, nimbly, and quickly without losing balance, maintaining good coordination to execute accurate returns with proper technique. **Methods.** The design of an appropriate training program can enhance a player's footwork ability in badminton. The foundation of developing a training program relies on initial data obtained through testing and measurement. A valid and reliable instrument is essential for this purpose. The use of digital instruments is highly recommended. Manual methods are still used to measure footwork in badminton to minimize human error, raising concerns about the measurements' accuracy. **Results.** While digital instruments are available, they have yet to fully capture the actual characteristics and definition of footwork, mainly due to the improper use of equipment (such as rackets) and the inaccurate representation of court dimensions. Therefore, there is a need for a precise, digital-based instrument to measure badminton footwork, ensuring the reliability of the obtained data. This study adopts a Research and Development (R&D) approach, following the Borg and Gall development model. The instrument design is based on a needs analysis, brainstorming sessions with practitioners, and improvements to previous footwork instruments. **Conclusions.** These instruments are refined to reflect actual court conditions, incorporating specialized sensors developed to collect data digitally and accurately.

KEYWORDS: *Test Instruments, Footwork, Badminton, Sensors*

INTRODUCTION

Basic techniques are essential for any badminton athlete striving to reach the highest level of performance. According to the Badminton World Federation (BWF), there are four fundamental techniques in badminton: stance, grip, strokes, and footwork (1–5). Footwork is a critical aspect of the game, as players need to move quickly and efficiently to reach the shuttlecock, position their bodies correctly for the shot, and then return to a central position. The basic principle of footwork in badminton is that the foot corresponding to the hand holding the racket should always align with the direction of the racket's movement when striking the shuttlecock. In essence, footwork is a fundamental skill that enables players to strike the shuttlecock accurately (6–11). Light and flexible footwork allows players to move smoothly toward the shuttlecock with coordinated movements, preparing to strike without losing balance. Therefore, mastering good footwork is crucial for badminton athletes. Digital technology is one approach that can support this need, mainly through software integrated into the instruments used for training. This study aims to develop a sensor-based instrument to measure and improve footwork. Generally, a sensor is a device that detects physical or chemical phenomena and converts them into an

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electrical signal, either as current or voltage. Physical phenomena stimulating a sensor to generate an electrical signal include temperature, pressure, force, magnetism, etc.

The primary function of a sensor is to selectively identify and measure physical, chemical, or biological parameters, such as pressure, light intensity, gas concentration, or the presence and concentration of biological analytes. The essential components of a sensor include one or more transducers (which may operate in series or parallel), signal acquisition and conditioning electronics, a power supply, a processor, storage media, and a display. Given the fundamental definitions and advantages of sensors, they can be effectively applied in developing footwork instruments for badminton. This aligns with the specific characteristics required for footwork in the sport.

MATERIALS AND METHODS

This study uses the Research and Development (R&D) method, focusing on applying the badminton footwork test instrument and assessing its effectiveness. According to Nurul, three key aspects must be considered in R&D: product validity, product practicality, and product effectiveness. The primary focus of this research is developing and applying the footwork test instrument. The development process follows the simplified R&D model of Borg and Gall, which includes several stages. The first stage involves conducting a needs analysis by collecting data from badminton athletes in West Sumatra using a designed instrument. Then, an initial design of the footwork test instrument is created using various electronic components. Experts validate this initial design to ensure its accuracy and functionality. Based on the feedback from the validators, the instrument is revised and tested in a small group of athletes to gather further input. After the second revision, a field trial is conducted with a larger group of athletes to assess the instrument's effectiveness and performance in real-world conditions. Based on the field trial results, final revisions are made (if necessary), and the refined instrument is evaluated to ensure it meets the desired criteria. Finally, the research results and the instrument developed are published in a journal article. This process illustrates the practical application of developing and testing the badminton footwork instrument, from design to field testing and evaluation.

RESULTS

Footwork Test Procedure for Badminton

- 1) The testee fills in their personal information in the "Badminton Training" Android app.
- 2) Connect the "Badminton Training" app to a laptop via Bluetooth (HC-05).
- 3) Input the data into Google Drive using a spreadsheet (Excel).
- 4) The testee stands on the sensor placed at the center of the court (central).
- 5) When the testee moves toward the corner of the court, the sensor will signal that the footwork test has started (start).
- 6) The testee moves to each corner of the court, which has 7 (seven) points and a sensor placed at each corner.
- 7) The testee moves towards a corner point and performs an underhead stroke technique.
- 8) After performing the stroke, the testee moves back to the central position (central), with one foot crossing the central sensor point. This counts as 1 (one) completed direction of movement.
- 9) The testee then moves to another corner point, performs the stroke, and returns to the center of the court.
- 10) The testee can decide which direction to move toward first without guidance from the test administrator or the test display.
- 11) The testee must complete all 7 (seven) corner points as indicated by the sensors in the shortest time possible.
- 12) The data obtained is immediately sent to the LCD (laptop) and stored in the Google Drive app (spreadsheet).
- 13) The test is repeated 3 (three) times.
- 14) The best performance from the 3 (three) repetitions is taken as the data.
- 15) Repetitions are done after a rest period of 15 seconds.
- 16) Footwork ability is measured by the number of times the testee reaches each corner point and returns to the center (central) within 7 minutes.

How the Device Works

- 17) Connect the power supply to activate the device.
- 18) The testee fills in their personal information in the "Badminton Training" Android app.
- 19) Connect the "Badminton Training" app to the laptop via Bluetooth (HC-05).
- 20) Input the data into Google Drive via a spreadsheet (Excel).
- 21) Each corner point of the court and the central point (central) will have a sensor that can detect the movement made by the testee.
- 22) The racket for hitting the shuttlecock will have a sensor to track movement.
- 23) The testee stands at the central point of the court, where the sensor is located.
- 24) The sensor will emit an audio signal (beep) indicating that the data and sensor are ready to be used.

- 25) As the testee moves, the sensor will emit a signal to start, and the timer will automatically begin until all 7 (seven) corner points are completed.
- 26) The testee moves toward a corner point of the court and performs an underhead stroke over the sensor placed at that point.
- 27) The testee returns to the central position, with one foot crossing the central sensor; this counts as 1 (one) completed direction of movement, and the data will be recorded into the microcontroller.
- 28) The testee then moves to another corner of the court, performs the stroke, and returns to the central position again.
- 29) The time and number of footwork repetitions, strokes, and returns to the center will be automatically calculated and displayed on the monitor as the performance data.
- 30) The time will stop and emit an audio signal (beep) indicating that it is up (finish). Press the reset button to start collecting data for the subsequent trial.

DISCUSSION

The product design is based on the brainstorming results and a needs analysis conducted during the preliminary research phase. This design represents the development stage of the third phase of the study and still requires validation by experts and product testing. Revisions and implementation of the product will also affect the final design's viability and functionality on the field. The design was developed to align with the actual needs and conditions of the court. It includes eight sensor points that must be reached using the racket, with a microcontroller directly connected to the sensors. Data will be recorded and displayed in real-time, monitored, and summarized in life or stored in the device's cloud storage.

CONCLUSIONS

Digitalizing the footwork test instrument and data measurement is crucial. Human error in manual footwork testing often leads to incorrect initial data interpretation, making it difficult for coaches to design effective training programs to achieve optimal performance. The brainstorming and needs analysis results, which involved both coaches and athletes, form the basis for developing this footwork instrument. The design of the sensor-based footwork test instrument, using a racket as the medium detected by the sensor, aims to replicate real-world conditions as closely as possible.

APPLICABLE REMARKS

- Based on this research, a product design consisting of eight sensor points, one microcontroller, an LCD screen, and a modified racket has been developed.
- During the prototype development phase, this product was designed with input from badminton experts, coaches, athletes, and IT professionals.
- However, the product still requires further testing to ensure it meets the intended goals of the research.

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The researchers extend their heartfelt appreciation to the Research and Community Service Institute of Universitas Negeri Padang for their financial support, which allowed the entire research process to be conducted and completed successfully.

AUTHORS' CONTRIBUTIONS

Muhammad Arnando conceived and designed the study and was responsible for data analysis and writing the original draft. Nurul Ihsan contributed to the methodology, data processing, and validation and assisted with the revision writing. Syafruddin conducted the investigation, provided resources, and contributed to the revision writing. Weny Sasmita focused on software, formal analysis, validation, and data visualization and contributed to the revision writing. Sepriadi managed the project, provided supervision, and contributed to the revision writing. Yovhandra Ockta also contributed to the conception and design of the study, provided supervision, and contributed to the revision writing.

CONFLICT OF INTEREST

The authors mention no "Conflict of Interest" in this study.

ETHICAL CONSIDERATION

This research has met the standards of research ethics and has received approval to be a sample of all respondents.

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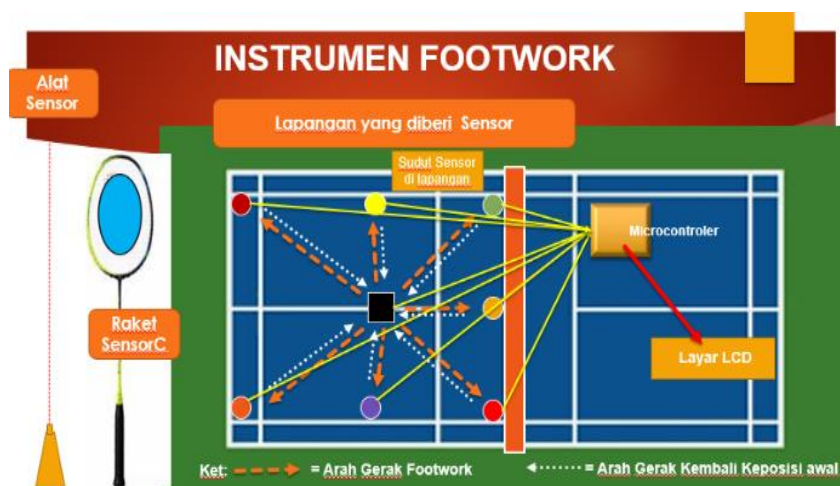


Figure 1. Product Illustration and Implementation Process

Concentration and Precision: Analyzing the Relationship between Mental Focus and Forehand Push Accuracy in Table Tennis

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ABSTRACT

Background. Forehand push accuracy is a fundamental skill in table tennis, where a player's mental focus heavily influences precision. **Objectives.** This study aims to investigate the relationship between concentration and forehand push accuracy, providing insights into the role of mental concentration in technical performance. **Methods.** A total of 25 table tennis players participated in the study. Data were analyzed using descriptive analysis, normality testing, and Pearson product-moment correlation to determine the association between concentration levels and push stroke accuracy. **Results.** The study revealed a significant positive correlation between concentration and forehand push stroke accuracy. This finding suggests that players with higher concentration levels tend to perform more accurately in forehand push techniques. **Conclusion.** Concentration plays a vital role in enhancing the accuracy of forehand push movements in table tennis. These results highlight the importance of mental focus in technical skills and suggest that concentration training could benefit table tennis training programs to improve performance.

KEYWORDS: *Concentration, Forehand Push, Table Tennis Stroke, Racket Sport, Shot Accuracy*

INTRODUCTION

Table tennis is widely regarded as one of the most popular and accessible sports worldwide, enjoyed by millions across diverse age groups and backgrounds (1). The stroke technique is a fundamental skill in table tennis, alongside other essential techniques that every player must master (2). One essential stroke in table tennis is the *push* technique. The push is executed by striking the ball forward, pushing motion while maintaining an open paddle angle. This technique is typically used to return an opponent's push or chop shots effectively. The push stroke is crucial for controlling the ball's spin and speed and setting up a more advantageous position in rallies, making it an essential defensive and countering move in the game.

In table tennis, a player's concentration level is closely linked to punch accuracy, driven by attentional mechanisms and visual-motor coordination (3). Additionally, skilled players demonstrate superior visual-motor coordination-synchronizing eye, head, and arm movements-which is essential for maintaining accuracy under various conditions (4).

Furthermore, table tennis athletes generally have enhanced executive control within attentional networks,

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supporting precise actions during gameplay (5). However, factors like sleep deprivation can impair concentration, leading to reduced anticipation and accuracy (6). This interplay between concentration and external factors underlines the complexities of maintaining high performance in competitive settings.

This research provides insights that could be beneficial for developing effective training strategies focused on mental concentration to enhance technical skills in table tennis performance.

MATERIALS AND METHODS

Participants. The research conducted in this study is correlational and aimed at examining the relationship between concentration and forehand push accuracy in table tennis. The sample consists of 25 students enrolled in the Basic Table Tennis course.

Research Design. This study was conducted with the approval of the table tennis course instructor and all participants. They were provided with an explanation regarding the purpose of the research and the procedure to be followed. Data collection began with administering the concentration test, followed by the push accuracy test.

The Grid Concentration Test was used to measure concentration. This test instrument consists of a 10 x 10 grid, with each box containing a two-digit number ranging from 00 to 99. The procedure for this test involves connecting the numbers with a line, starting from 00 and continuing to 99, within a one-minute time limit. The score is based on the highest number that can be successfully connected (7).

The subjects were required to perform warm-up exercises and initial training. Following this, the subjects repeated the backhand push movement 15 times, ensuring that the ball passed over the net above the tape without touching it, aiming for a target on the right side. After completing the 15 repetitions, the subjects were given a 3-minute rest. The same procedure was repeated 15 times, aiming for the target on the left side. The ball speed provided by the robot machine was set to a moderate level. Two individuals conducted scoring: one as the recorder and one as the observer, who ensured that the ball landed in the target area and passed below the tape. The score was calculated based on the number of successful shots on the target out of 30 attempts (8).

Statistical Analysis. This study's data analysis included normality testing, descriptive statistics, and Pearson correlation testing. Normality tests were conducted using the Kolmogorov-Smirnov and Shapiro-Wilk methods to determine whether the data followed a normal distribution.

RESULTS

It is important to provide an overview of the characteristics of the collected data before presenting the results of the descriptive statistical analysis.

Before conducting the hypothesis test, a normality test was performed to assess the data distribution. The outcome of this test will help ensure the validity of the subsequent hypothesis testing.

Based on hypothesis testing using simple correlation with a significance level of $\alpha = 0.05$ and a sample size of $n = 25$, the table value (r_{table}) was found to be 0.51, while the calculated correlation coefficient ($r_{\text{statistics}}$) was 0.59. Given that the calculated r-value ($r_{\text{statistics}}$) exceeds the critical r-value (r_{table}), it can be concluded that there is a significant relationship between concentration and forehand push accuracy in table tennis. This finding suggests that higher concentration levels are positively associated with improved accuracy in executing forehand push techniques.

DISCUSSION

Various studies support the significant relationship between a player's concentration level and punch accuracy in table tennis. Concentration is critical in improving a player's ability to execute precise movements, which is essential for achieving high accuracy in serves and strokes (9). The following sections provide a more detailed analysis of this connection, highlighting the importance of mental focus in technical performance.

Numerous studies emphasize the strong correlation between concentration and the accuracy of table tennis techniques. Research suggests that concentration significantly improves the precision of serves, particularly backhand backspin serves (10). Furthermore, players with higher concentration levels demonstrate better forehand serve accuracy than those with lower concentration levels (11). These findings indicate that concentration impacts a player's ability to perform consistent and accurate strokes and is key in optimizing specific techniques that require high precision.

The role of psychological states in table tennis performance further reinforces the connection between concentration and accuracy. Elite players often report that concentration, self-confidence, and positive thinking are essential for peak performance (12). A focused mental state allows players to execute their strokes more precisely, ensuring that accuracy remains high under pressure. However, stress can disrupt concentration, leading to decreased performance and accuracy. Despite this, studies show that maintaining longer Quiet Eye

durations- an indicator of sustained concentration- can mitigate the adverse effects of stress on performance (13).

While the general trend supports the idea that higher concentration leads to improved accuracy, it is crucial to acknowledge the potential influence of external factors, such as stress, which can undermine the relationship between concentration and performance. As such, players must learn to manage their mental states effectively to maintain consistent focus and accuracy during play. Mental focus is a critical factor in achieving precision in strokes and serves. However, external factors like stress must be considered, as they can disrupt this connection and negatively impact performance.

CONCLUSION

The study concludes that concentration is critical in achieving accuracy in forehand push movements in table tennis. The significant positive correlation between concentration and forehand push accuracy suggests that mental focus directly influences technical precision. Future research should explore strategies to help players manage these psychological factors to enhance their concentration and, ultimately, their technical skills. Future research could explore mental training interventions, such as cognitive training or biofeedback, to strengthen concentration and optimize technical execution. Players can enhance their precision by integrating mental focus training into regular practice routines, improving overall performance in competitive play.

APPLICABLE REMARKS

- This study highlights the significant role of concentration in enhancing forehand push accuracy in table tennis. Based on the findings, it is recommended that training programs for table tennis players incorporate mental focus exercises to improve concentration levels.
- Coaches should emphasize concentration techniques, such as mindfulness or visualization, to help athletes focus during high-pressure situations.
- Furthermore, it is crucial to consider the psychological aspects of training, particularly stress management, as external factors like anxiety can affect concentration and, consequently, performance.

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AUTHORS' CONTRIBUTIONS

Study concept and design: Jeki Haryanto. Acquisition of data: Arie Asnaldi. Analysis and interpretation of data: Jeki Haryanto. Drafting the manuscript: Eval Edmizal. Critical revision of the manuscript for important intellectual content: Bekir Erhan Orhan. Statistical analysis: Japhet Ndayisenga. Administrative, technical, and material support: Vlad Adrian Geantă. Study supervision: Jeki Haryanto.

CONFLICT OF INTEREST

The authors mention no "Conflict of Interest" in this study.

ETHICAL CONSIDERATION

This study was conducted under ethical guidelines for research involving human participants. Informed consent was obtained from all participants, including students and teachers, before their involvement in the field trials. Participants were assured of their anonymity and confidentiality, with all personal data being securely stored and used solely for research purposes. The study adhered to ethical standards, ensuring that no harm came to the participants and that they were free to withdraw from the study at any time without consequence. Additionally, the research was approved by the relevant educational and institutional ethics committees to ensure compliance with ethical norms and guidelines.

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Table 1. Statistics descriptive of concentration and forehand push stroke

Variables	N	Minimum	Maximum	Mean	SD
Concentration	25	10	17	14	2,18
Forehand Push Stroke	25	13	37	22	7,03

Table 2. Normality Test

Variables	L _{statistics}	L _{Tabel}	Conclusion
Concentration	0,13	0,17	Normal
Forehand Push Stroke	0,11	0,17	Normal

Table 3. Hypothesis Testing Results

Variables	N	r _{statistics}	r _{table}	Conclusion
Correlation between concentration and forehand push stroke	25	0,59	0,51	Fairly strong relationship

The Role of Hand-Eye Coordination in Enhancing Backhand Push Shot Accuracy in Table Tennis

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ABSTRACT

Background. The backhand push is a frequently used stroke in table tennis, emphasizing the need for practical training in this technique. **Objectives.** This study investigates the relationship between hand-eye coordination and the accuracy of the backhand push in table tennis. **Methods.** A correlational research design was employed, with a sample of 25 participants. Data analysis included descriptive analysis, the Lilliefors normality test, and the Pearson product-moment correlation test to assess relationships among variables. **Results.** The findings revealed a positive and significant correlation between hand-eye coordination and backhand push accuracy in table tennis. This indicates that improved hand-eye coordination contributes significantly to the precision of the backhand push. **Conclusion.** It is recommended that coaches incorporate training methods that enhance hand-eye coordination to improve backhand push performance in table tennis.

KEYWORDS: *Hand-Eye Coordination, Backhand Push Accuracy, Table Tennis Stroke, Physical Conditioning Analysis*

INTRODUCTION

Table tennis is a fast-paced sport that demands precision and agility. The accuracy of various strokes plays a pivotal role in determining a player's success (1). The backhand push is frequently utilized among these strokes, particularly in defensive situations, and requires high control and precision. Hand-eye coordination is a critical factor influencing this stroke's accuracy, allowing players to effectively link visual information with motor actions (2).

Hand-eye coordination is vital in sports, enabling athletes to perform complex movements with accuracy and timing. In table tennis, tracking the ball's trajectory, adjusting one's positioning, and executing a precise backhand push are fundamental to consistent performance (3). A player demonstrates good coordination in table tennis when they can move toward the ball, swing their racket, and execute the stroke correctly. Players with effective hand-eye coordination tend to make more accurate forehand shots and are better at anticipating and countering the ball (4). Observing the opponent's movements and reading the ball's trajectory allows players to adjust their racket swing for a more precise response. This coordination between vision and motor control is key to improving performance (5), (6).

This study aims to fill this gap by investigating the relationship between hand-eye coordination and the

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accuracy of the backhand push in table tennis. The findings could provide valuable insights into the role of physical conditioning and skill development in table tennis, contributing to enhanced player performance at all levels.

MATERIALS AND METHODS

Study Design and Participants. This study involved 25 students enrolled in a basic table tennis course. This correlational study aimed to examine the strength of the relationship between hand-eye coordination and push stroke in table tennis.

Hand-eye coordination. The eye-hand coordination test, adapted from Utama et al. (3), involves throwing a ball with one hand like a table tennis stroke and catching it. The number of successful throws caught within 30 seconds was recorded by trained staff. Each participant performed the test twice, with the better attempt used for analysis.

Backhand Push Accuracy. Subjects first completed warm-up exercises and initial training. They then performed the backhand push 15 times, aiming to clear the net above the tape and hit a target on the right side. After a 3-minute rest, they repeated the process, aiming for a left-side target. The robot set a moderate ball speed. Two evaluators recorded scores: one tracked the result, while the other ensured each shot landed in the target zone and cleared the tape. The score was based on successful target hits out of 30 attempts (7).

Statistical Analysis. The data in this study was processed using descriptive statistics, followed by normality testing and Pearson correlation analysis to examine the relationship between variables. The results were analyzed using Microsoft Excel with a 95% significance level, or $\alpha = 0.05$.

RESULTS

The descriptive analysis provides a general overview of the research data, followed by preliminary tests for analysis requirements, including the Lilliefors normality and Pearson correlation tests. The inferential analysis then examines the study's hypotheses. Table 1 below presents the descriptive statistics for each variable, highlighting backhand push accuracy in table tennis.

The normality test determines whether the collected empirical data follows a normal distribution. Table 2 below shows the normality test results for the study's three variables.

The Pearson product-moment correlation test aims to determine the significance of the relationship between the independent and dependent variables. Table 3 below presents the results of the correlation analysis between these variables.

DISCUSSION

The relationship between hand-eye coordination and punch accuracy in table tennis is well-established, as these factors are critical to optimal performance. Effective hand-eye coordination enables players to time their strokes accurately, directly impacting their punches' precision during a match. Eye-hand coordination tests are predictive of competitive performance in table tennis. A study by Faber et al. (8) highlighted that players who excel in eye-hand coordination tasks, particularly those involving a table tennis ball, demonstrated better match accuracy, as evidenced by a significant correlation. This suggests that players who can coordinate their vision and motor skills are more likely to perform precisely in competitive settings.

Kinematic analyses further support the importance of coordination, showing that skilled players tend to track the ball more efficiently than their less experienced counterparts. These players maintain stable gaze fixation and initiate tracking earlier, enabling them to react more swiftly and accurately to the ball's trajectory. Rodrigues et al. (9) found that this ability to synchronize visual information with motor responses is crucial for executing precise strokes under different time constraints. In addition, research into saccadic eye movements has revealed that table tennis players demonstrate enhanced abilities to track fast-moving objects. This ability is attributed to the extensive visual experience gained through practice in the sport. Nakazato et al. (10) found that players with more advanced hand-eye coordination exhibit greater spatial accuracy and precision in their saccadic movements, which allows them to predict the ball's trajectory with greater confidence, thereby improving shot accuracy. Moreover, a study found that distributed practice was more effective than massed practice in improving forehand topspin accuracy in table tennis. Athletes with higher hand-eye coordination also showed better accuracy, highlighting the importance of coordination in performance (11). Furthermore, the findings of this study revealed a significant positive correlation between eye-hand coordination and backhand drive stroke accuracy in table tennis. Additionally, males outperformed females in accuracy and coordination measures, highlighting gender differences (12).

CONCLUSION

This study reveals a significant relationship between hand-eye coordination and the accuracy of the

backhand push in table tennis. The results highlight that enhancing these skills can improve backhand push performance. Coaches should consider incorporating training methods that focus on improving hand-eye coordination. Future research could explore the effects of various training interventions on these skills and investigate the impact of psychological factors like stress and fatigue on backhand push accuracy.

APPLICABLE REMARKS

- The findings of this study emphasize the importance of hand-eye coordination in improving the accuracy of the backhand push in table tennis.
- Coaches and trainers should integrate exercises that enhance hand-eye coordination into their training programs to optimize players' performance.
- This could include specific drills that improve visual tracking, reaction times, and motor control.
- Additionally, future research could focus on training interventions and the role of psychological factors, such as stress or fatigue, on the precision of strokes in table tennis.
- These insights can help develop more effective training methodologies for athletes at various levels.

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AUTHORS' CONTRIBUTIONS

Study concept and design: Jeki Haryanto. Acquisition of data: Ardo Okilanda. Analysis and interpretation of data: Eval Edmizal. Drafting the manuscript: Eval Edmizal. Critical revision of the manuscript for important intellectual content: Jeki Haryanto. Statistical analysis: Japhet Ndayisenga. Administrative, technical, and material support: Vlad Adrian Geantă and Mohamad Nizam Nazarudin. Study supervision: Jeki Haryanto.

CONFLICT OF INTEREST

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Table 1. Descriptive Analysis Results for Each Variable

Variable	N	Mean	SD	Min	Max
Backhand Push Accuracy	25	22	9,5	11	48
Hand-Eye Coordination	25	173	6,9	160	183

Table 2. Normality Test Results

Variable	L statistics	L table	Conclusion
Backhand Push Accuracy	0,14	0,17	Normal
Hand-Eye Coordination	0,16	0,17	Normal

Table 3. Pearson Product-Moment Correlation Test Results

Variable	r statistics	r table	Conclusion
Hand-eye Coordination and Backhand Push Accuracy	0,62	0,51	Strong positive correlation

The Effectiveness of Shooting Free Throw Basketball in Junior High School Students: A Comparison of Animals Names and Command Styles

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ABSTRACT

Background. Learning resources using animal name modifications and command styles are learning resources that are often used by teachers in the field of sports, especially in the learning process of basic techniques of shooting free throw basketball games. **Objectives.** This study aims to determine the difference in the effectiveness of the animal name-based learning model and command style on the ability to shoot free throws in junior high school students in basketball games. **Methods.** This type of research is experimental research with a quantitative approach. The population in this study is 112 students. The sample in this study amounted to 40 students taken based on the inclusion criteria set by the researcher, including 12-13 years old and male subjects in good health. The instrument in this study used a drill to shoot a free throw 10 times. **Results.** The results of this study show that animal name-based learning significantly improves the movement of shooting free throw skills in basketball games; this can be seen in the pre-test results of the experimental group, which found a std. The deviation value of 4.087, the control group of 4.652, and the post-test results of the experimental group were found to be std. Deviation of 5.44 and the control group of 5.77. **Conclusions.** Then, the researcher concluded that the animal name-based learning model improved students' skills in shooting free throw techniques in basketball games.

KEYWORDS: *Animals Name, Command Style, Shooting, Free Throw, Student*

INTRODUCTION

A person's skills are a benchmark in carrying out various activities, both professionally and non-professionally, because a player will make a lot of technical and tactical movements and actions when on the field or in the match arena (1). Many findings prove that a human skill will provide convenience in carrying out various activities, for example, doing enough physical activity to provide good benefits for the human body/health (2). In the learning process of physical education, three aspects are the main focus and are very important for humans in general and students: psychomotor, cognitive, and affective. Education is critical in parts of the world to improve the quality of a country's human resources in various fields, and this is also in line with physical education that applies at all levels of education starting from elementary school (SD), junior high school (SMP), high school (SMA) and higher education (3). These three aspects play a vital role in developing a student's ability to improve skills in various fields that are preferred or pursued through a

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continuous learning process, exploring, modifying, reviewing, and developing learning models according to the needs of students (4).

Improving a student's skills is not easy because it takes a long time to stabilize a student's skills for an activity carried out (5). In today's modern era, physical fitness is superior and a factor in mental development and intelligence (6). However, it should be noted that a student is constantly faced with difficult choices; for example, students play a dual role as a student and an athlete, and this will increase excessive anxiety in the student (7). Whether or not a student's skills improve is influenced by two important factors: intrinsic and extrinsic factors (8). Intrinsic factors come from the student's personality, while extrinsic factors come from outside the student's personality (9). Another factor that affects the improvement of student skills is the role of teachers in choosing the right learning model, which can be used as a medium to present the materials needed by a student, not the needs of teachers alone (10). In addition, the motivation and activeness of practicing in the student's personal must be in harmony with their interests and talents/wills, not the compulsion of others. When motivation, the learning model, the role of the sports teacher, and the will of a student have been fulfilled, then automatically, a student's skills will change or experience improvement and form the character of the student through sports because sports lead to the improvement of culture and achievement (11). Shooting techniques in basketball games can be said to be the determining factor in the victory of a team or an amateur or professional club (12). Through this shooting technique, a basketball player will score as many points as possible for his team to win a match. The sport of basketball is synonymous with many explosive short movements, such as running at high speed, jumping, and making changes of direction using the ball or without it at high speed (13).

MATERIALS AND METHODS

The sampling technique used in the study is purposive sampling. So, the sample in this study is 40 subjects. The study used in this study is a quantitative study with the nature of quantitative data; the data collected will then be analyzed to get valid results in this study. The design used in this study is a pseudo-experiment with a non-equivalent control group design approach. Both groups were given pre-test and post-test treatment, but the models used differed. The experimental group was given treatment in the form of a learning model of basic basketball techniques with the approach of animal names, while the control group was given the treatment of the Commando Style learning model.

RESULTS

Based on the statistical analysis of the normality test that has been carried out using the Mean Rank test of the Mann-Whitney Test, the result data in the group of learning models based on animal names and the pretest Command Style learning model was obtained from the results of the data normality test carried out with a significant level of 4.08770, which means $p > 0.05$ which means standard distribution data. Meanwhile, in the post-test normality test data in the experimental group, there is a significant level of 5.44214, which means $p > 0.05$, the normal distribution data.

Based on the results of the table above, it can be concluded that there is a significant increase in the pre-test and post-test. Researchers can use this as a reference to provide more creative and innovative treatments.

DISCUSSION

A learning or practice model implemented and running well is a dream for all teachers or trainers [13]. Some factors that play a role in the success of implementing the learning model include the readiness of good teachers, the proper selection of media, the presentation of unrigid materials, and the agility of students in following the learning process [6]. The learning model of animal names used in this study is the first step to provide a more advanced mindset, to make teachers, especially sports teachers, use a learning model that is simple, fun, and does not make students afraid or rigid to participate in learning, for example, learning basic techniques in basketball.

There are quite a lot of fundamental techniques in the game of basketball with various variations according to needs, but only one technique that will produce a score that can be created by a player in a game is shooting the ball toward the goal or hoop (14). In line with the study's results (15), shooting technique in basketball is the only scoring method for a team. Then, it was emphasized That many learning models can be used by a teacher in the learning process at school, especially teachers of physical education, health, and recreation subjects, for example, traditional game-based learning models role-playing learning models, including learning based on animal names. However, the penjas teachers are only focused on the learning process of the Command Style, such as lectures, assignments, questions and answers, discussions, and authoritarianism.

CONCLUSION

Based on the research results, the two learning models used in the learning process of shooting techniques in basketball games have a level of effectiveness. However, the two models significantly differ from the average results of student scores that use the learning model based on animal names and the learning model based on Command Style. This can be seen from the higher scores created by students who use the animal names model because the model makes students interested and excited to follow the learning process.

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AUTHORS' CONTRIBUTIONS

Concept and design of the study: Suryo Utomo. Data acquisition: Bafirman. Data analysis and interpretation: Ali Murni. Compiled the script: Fiky Zarya. Critical revision of the manuscript for important intellectual content: Ilham. Statistical analysis: Cerika Rismayanthi. Administrative, technical, and material support: Thesya Alda Nia. Study supervisor: Sumaryanti.

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Table 1. Normality Test
One-Sample Kolmogorov-Smirnov Test

One-Sample Kolmogorov-Smirnov Test		
N	20	
Normal Parameters ^{a,b}	Mean	.0000000
	Std. Deviation	4.13748121
Most Extreme Differences	Absolute	.131
	Positive	.131
	Negative	-.128
Test Statistic		.131
Asymp. Sig. (2-tailed)		.200 ^{c,d}
a. Test distribution is Normal.		
b. Calculated from data.		

Table 2. Pre-test and post-test data of the learning model of animal names and Command Style

Category	N	Minimum	Maximum	Mean	Std. deviation
Experiment (Pre-test)	20	60	75	71,30	4,08770
Control (Pre-test)	20	60	75	69,01	4,65281
Experiment (Post-test)	20	89	126.01	121.65.001	5,44214
Control (Post-test)	20	77	108.00	90.2100	5.77731

The Learning Methods in Improving High Jump Ability Straddle Style

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ABSTRACT

Background. The high jump is a track and field event requiring explosive strength, speed, and precise technique. Different learning methods and varying levels of motivation can influence an athlete's ability to perform the straddle high jump technique. Motivation can be intrinsic or extrinsic, which play significant roles in athletic performance. This study examines the effects of learning methods and motivation levels on improving the straddle style high jump ability. **Objectives.** To investigate how learning methods (inductive vs. deductive) and motivation levels (high vs. low) impact students' straddle high jump ability in an introductory athletics course and explore the interaction between these factors. **Methods.** This quasi-experimental study involved 73 students from the Faculty of Sports Sciences, State University of Padang. Data were collected using a questionnaire to assess motivation and a high jump ability test for the straddle style. Normality and homogeneity of variance tests were conducted, followed by Two-Way ANOVA to analyze the effects of learning methods and motivation levels on high jump performance, with post-hoc Tukey testing to investigate significant interactions further. **Results.** The findings indicated significant effects of learning methods and motivation on high jump performance. The inductive learning method proved more effective than the deductive method for students with high motivation, while the deductive method was more effective for those with low motivation. A significant interaction between learning methods and motivation was observed, with high motivation amplifying the effectiveness of the inductive method. **Conclusion.** The study concludes that learning methods, particularly the inductive approach, significantly improve high jump performance in students with high motivation. Conversely, the deductive method is more beneficial for students with low motivation. These findings emphasize the importance of tailored learning strategies based on motivation levels to enhance athletic performance in high jump training.

KEYWORDS: *Athletics, Athletic Learning, Learning Motivation*

INTRODUCTION

A high jump is a track and field event where an athlete attempts to jump over a horizontal bar set at a specific height, using one leg for takeoff and aiming to soar upwards as high and fast as possible (1–3). This event involves a quick and powerful repulsion from the ground to reach maximum height, clearing the bar, and landing safely on a mat. The high jump is an anaerobic activity, requiring explosive strength and speed to achieve the best possible jump. There are different high jump techniques, each with advantages and disadvantages (4–6). Currently, the "flop" technique is the most widely used, as it has a high success rate for clearing the bar. The high jump consists of four main phases: the approach, the repulsion, the bar clearance, and the landing.

For example, the straddle high jump technique is a fluid sequence of movements that requires precision,

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flexibility, and smooth execution. Learning this technique involves following a structured approach, progressing from more uncomplicated to more complex steps (7–11). A well-organized learning process helps athletes improve their performance gradually. Motivation plays a key role in learning and mastering the high jump. It can stem from internal factors, such as a personal drive to succeed, or external factors, such as rewards or a supportive learning environment. Intrinsic motivation arises from an internal desire to improve and achieve, while extrinsic motivation is driven by external rewards or encouragement. Both types of motivation are important in fostering continued effort and progress in training.

MATERIALS AND METHODS

The research method used in this study is the experimental Quasi method. The research was conducted in the lecture field of the Faculty of Sports Sciences, State University of Padang, in the July-December 2023 semester, one week before the treatment, and was used to collect data on learning motivation as a Moderator Variable and this data was used to group the sample into groups of high learning motivation and low learning motivation. The population in this study is all students majoring in sports coaching who take introductory athletic courses, as many as 159 people. In this study, the purposive sampling technique was used. In purposive sampling, sampling is based on the researcher's consideration. The sample is students of the Faculty of Sports Sciences majoring in Sports Coaching and taking introductory athletics courses in this section on Mondays, Tuesdays, and Wednesdays. Based on these considerations, the sample taken was only 73 students. The data collection technique in this study uses a questionnaire instrument and a straddle force high jump ability test, as well as a questionnaire instrument (questionnaire) and a straddle force high jump ability test. The collected data will later be analyzed using the normality test statistics and the Homogeneity Variance test and continued with the Tukey test.

RESULTS

The population in this study is all students majoring in sports coaching who take introductory athletic courses. In this study, the purposive sampling technique was used. In purposive sampling, sampling is based on the researcher's consideration. The sample is students of the Faculty of Sports Sciences majoring in Sports Coaching and taking introductory athletics courses in this section on Mondays, Tuesdays, and Wednesdays. Based on these considerations, the sample taken was only 73 students. The data collection technique in this study uses a questionnaire instrument and a straddle high jump ability test, as well as a questionnaire instrument (questionnaire) and a straddle high jump ability test.

Normality and Data Homogeneity Test. The normality and homogeneity of variance test determines whether the data distribution and variances across groups are normal and equal. This is typically tested using the Bartlett test at a significance level of $\alpha = 0.05$. The null hypothesis (H_0) states that the variances are homogeneous, and it is accepted if the p-value is greater than 0.05 ($p > 0.05$).

Data Hypothesis Testing. Two-Way ANOVA is used to examine the impact of learning methods and motivation levels on high jump performance using the straddle style. If a significant interaction is found, the Tukey Test identifies which combinations of methods and motivation levels lead to the most remarkable improvement in performance.

DISCUSSION

If strong motivation moves individuals to carry out an activity to the maximum, then learning methods will be easy to apply to achieve the training goals (12–14). So, high learning motivation is an absolute must to train students taking basic athletic courses to achieve a structured learning program that aims to see the straddle style of high jump ability of training students taking athletics courses. As described above, the interaction between learning methods and motivation can be described by comparing the average difference in start-style high jump ability training students who take introductory athletic courses between groups of members with high and low learning motivation with different treatments.

CONCLUSIONS

Based on the findings of the research and the discussion of the research results, it can be concluded as follows: 1) The inductive learning method is more effective for students in the straddle high jump ability of students majoring in coaching who take introductory athletic courses than the deductive learning method. 2) In the high category of learning motivation group, there was a more significant difference in straddle style high jump ability training students who took introductory athletic courses compared to the group with low learning motivation. 3) There is an interaction between learning methods and motivation on the difference in high jump ability straddling style in coaching students who take introductory athletic courses. 4) Regarding high learning motivation, the inductive method is more effective than the deductive learning method regarding the difference in high jump ability; the straddling style trains students who take introductory athletic courses. 5) With low learning motivation, the

deductive method is more effective than the inductive learning method. Against the difference in high jumping ability, the straddle style trains students who take introductory athletic courses.

APPLICABLE REMARKS

- This study emphasizes the importance of adapting teaching methods to students' motivation levels for optimal high jump performance.
- The inductive learning method is more effective for highly motivated students, while the deductive method works better for those with lower motivation.
- Coaches and educators should tailor their approach, using more student-centered, discovery-based methods for motivated athletes and structured, teacher-led instruction for less-engaged students.
- Fostering intrinsic motivation through goal setting and positive reinforcement can enhance learning outcomes.
- These findings can guide curriculum design and coaching strategies to improve athletic performance in high jump training.

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AUTHORS' CONTRIBUTIONS

Arie Desman contributed to the conceptualization and design of the study, data analysis, and the writing of the initial draft of the article. Alnedral was involved in data collection, statistical analysis, and article revision. Arsil was responsible for data collection and analysis and contributed to the article's writing. Ardo Okilanda, as the corresponding author, coordinated the research, collected data, wrote the draft article, and performed substantial revisions. Khairuddin played a key role in data analysis, interpretation of results, article writing, and article revision. Syahrastani was involved in data collection and statistical analysis and contributed to the writing and revising of the article. Arie Desman. Contributed to writing the article, revising and editing, and data collection and interpretation of results.

CONFLICT OF INTEREST

The authors mention no "Conflict of Interest" in this study.

ETHICAL CONSIDERATION

This research has met the standards of research ethics and has received approval to be a sample of all respondents.

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Table 1. Summary of Research Data Normality Test

Tests of Normality				
Motivational Media		Kolmogorov-Smirnov ^a		
		Statistic	Df	Sig.
Mark	A1	0.106	12	.200*
	A2	0.125	12	.200*
	B1	0.105	12	.200*
	B2	0.135	12	.200*
	A1B1	0.153	6	.200*
	A2B1	0.259	6	.200*
	A1B2	0.207	6	.200*
	A2B2	0.166	6	.200*

Tabel 2. Summary of Research Data Homogeneity Test

Tests of Homogeneity of Variances					
		Levene Statistic	df1	df2	Sig.
Mark	Based on Mean	0.612	7	64	0.744
	Based on Median	0.501	7	64	0.830
	Based on Median and with adjusted df	0.501	7	54.737	0.830
	Based on trimmed mean	0.597	7	64	0.756

Tabel 3. Summary of Research Data Hypothesis Testing

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	49027.278 ^a	11	4457	267	0.000	0.980
Intercept	222227	1	222227	13325	0.000	0.996
Learning Methods	817	1	817	49	0.000	0.449
High Jump Ability	48544	7	6935	416	0.000	0.980
Learning Methods * High Jump Ability	2.8	3	0.917	0.055	0.983	0.003
Error	1001	60	17			
Total	240784	72				
Corrected Total	50028	71				

a. R Squared = .980 (Adjusted R Squared = .976)

Trends And Patterns in Research on Physical Activity and Mental Health in Workers: A Bibliometric Approach

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ABSTRACT

Background. Research on physical activity and mental health in workers has experienced significant growth over the past decade. **Objectives.** This study investigates trends and patterns in this field using a bibliometric analysis approach. **Methods.** By analyzing 907 articles from 2013 to 2023, the research aims to explore the evolution, focus, and key contributions of scientific publications related to physical activity and mental health in workers. Bibliometric data were obtained from the Scopus database, and VOSviewer software was used to visualize collaboration networks between researchers, institutions, and emerging research topics. **Results.** This study analyzes trends, key contributions, and collaboration in research on mental health and physical activity among workers, noting a recent surge in publications reflecting growing interest. Key contributors and impactful works, like Shechter et al.'s (2020) study on healthcare workers' psychological distress during COVID-19, underscore significant advancements, with the United States leading in both productivity and citations globally. **Conclusion.** Additionally, the study includes a systematic review of the literature to map potential future research directions based on current trends, offering valuable insights for future scholars and practitioners.

KEYWORDS: *Physical Activity, Mental Health, Workers, Bibliometric Analysis, Research Trends*

INTRODUCTION

Physical activity in the workplace is a crucial factor in employees' overall health and well-being, playing a significant role in their physical, mental, and social development (1–3). Throughout various stages of their professional lives, workers face unique challenges that can be mitigated through regular physical activity. Workplace physical activity helps employees improve motor skills and cardiovascular health and develop sustainable healthy lifestyle patterns (4). Research indicates that regular engagement in physical activity not only enhances physical health but also has a positive impact on mental health, reducing stress and improving social interactions among workers (5–7). Physical activity programs in the workplace offer opportunities for employees to stay active, alleviate mental fatigue, and boost self-confidence, contributing to their ability to interact positively with their environment (8). Therefore, understanding the trends and patterns in research on the relationship between physical activity and mental health in the workplace is crucial for designing effective interventions that promote worker well-being and productivity (9–11).

Bibliometric analysis has emerged as a leading method for comprehensively investigating trends, patterns, and advancements in the scientific literature (12). In physical education, bibliometric analysis provides valuable insights into research trajectories, key themes, and scholarly collaborations. The primary focus of this

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study is to conduct a bibliometric analysis of research related to the intersection of physical activity and mental health in workplace settings from 2013 to 2023. This analysis aims to explore the network of occurrences associated with keywords chosen by the authors, examine publication and citation growth trends, and identify seminal papers, leading authors, influential journals, and active countries in this area. By synthesizing these findings, researchers and practitioners can track the development and expansion of topics concerning physical activity's impact on mental health at work and gain insights into current and emerging areas of inquiry.

MATERIALS AND METHODS

We commenced our investigation by utilizing bibliometric analysis to gather a substantial body of literature related to the role of physical activity in promoting mental health in workplace settings. Bibliometric analysis is an effective tool for mapping large volumes of scholarly work, similar to systematic literature reviews, allowing for a comprehensive assessment of trends while ensuring the reliability and accuracy of the information gathered and the outcomes derived from the research (13). Bibliometric analysis enables researchers to explore collaboration networks among authors, countries, and research topics, which in turn can reveal underlying relationships between these entities (14). Using a science mapping approach, we analyzed the existing literature by extracting bibliographic data from various workplace wellness and mental health research documents.

We utilized keywords such as "Physical Activity," "Mental Health," and "Worker," applying filters to focus on studies related to workplace wellness and mental health promotion.

RESULTS

Published Document Analysis. There was further growth in subsequent years, with 19 articles published in 2007 and 23 in 2008 and 2009. In 2010, the number of published articles rose slightly to 23, then to 39 in 2012 and 25 in 2013. In 2014, the number of articles published grew to 39. By 2015 and 2016, the numbers slightly increased to 46 and 38, respectively. In 2023 and 2024, the upward trend persisted, with 127 and 112 articles published, respectively.

This table summarizes the most influential articles and their respective citation counts in the field, providing valuable insights into impactful research contributions regarding physical activity and mental health in workplace environments.

Author Analysis. Figure 3 highlights the leading contributors to research on mental health and physical activity in workers, showing a range of productivity and citation impact. This variation in productivity and citation influence underscores the key contributors to the field of mental health and physical activity among workers.

Country Analysis. Table 4 showcases the top 10 countries contributing to research on mental health and physical activity in workers.

Co-occurrence Analysis of Keywords. Keywords can provide core information about the content of an article, and when two or more keywords appear together in the same article, they are referred to as co-keywords. Co-keyword analysis explores the relationships between concepts or themes within a body of literature, revealing patterns of association and helping to identify clusters of related research topics.

DISCUSSION

Based on the study's findings, several key insights emerge regarding research trends and contributions to workers' mental health and physical activity. The analysis of publications highlights a dynamic research landscape with fluctuating interest, notably peaking in recent years, suggesting growing attention to the intersection of workplace environments and mental well-being. Regarding research productivity, the United States leads with 289 documents and 8,959 citations, followed by the United Kingdom and Brazil, which contribute significantly to the body of knowledge in this field.

CONCLUSION

In summary, this study thoroughly analyzes the trends, contributions, and collaborative dynamics in research on mental health and physical activity among workers. The United States leads in document production and citations, followed by substantial contributions from countries like the United Kingdom and Brazil, illustrating their global leadership and collaboration in this research area. However, limitations related to language bias, publication selectivity, and the scope of bibliometric analysis suggest the need for future research to incorporate a broader range of sources and methodologies, including qualitative insights, to enrich understanding in the field further. Further studies should also explore underrepresented regions and incorporate diverse methodologies to enhance the global understanding of this crucial topic.

APPLICABLE REMARKS

- This bibliometric analysis highlights the growing importance of mental health and physical activity research in the workplace, with significant contributions from countries like the United States, the United Kingdom, and Brazil.
- Given the increasing number of publications, future research should continue exploring the intersection of workplace wellness and mental health, mainly through cross-disciplinary collaborations.
- Additionally, practical implications for workplace interventions can be derived from emerging trends, such as integrating physical activity programs to improve mental well-being.
- Policymakers and employers should consider these insights when designing wellness initiatives, ensuring they are based on the latest evidence to foster healthier, more productive work environments.

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AUTHORS' CONTRIBUTIONS

Mustika Fitri conceptualized the study, designed the research framework, and led the data analysis. Afianti Sulastris contributed to the literature review, assisted in data collection, and helped interpret the findings. Wulandari Putri supported the methodology development, conducted statistical analysis, and contributed to the discussion of the results. Hilmy Apriady provided valuable input on the research design, assisted in writing and editing the manuscript, and helped synthesize the final findings. Mustika Fitri contributed to the data collection, reviewed relevant literature, and supported the manuscript revisions. All authors contributed to the critical review of the manuscript and approved the final version for publication.

CONFLICT OF INTEREST

The authors mention no "Conflict of Interest" in this study.

ETHICAL CONSIDERATION

This study adhered to ethical guidelines by obtaining informed consent from all participants, ensuring voluntary participation and confidentiality. Data was anonymized and used solely for research purposes. An ethical review board approved the study, and all procedures followed privacy and data protection regulations. No conflicts of interest were reported.

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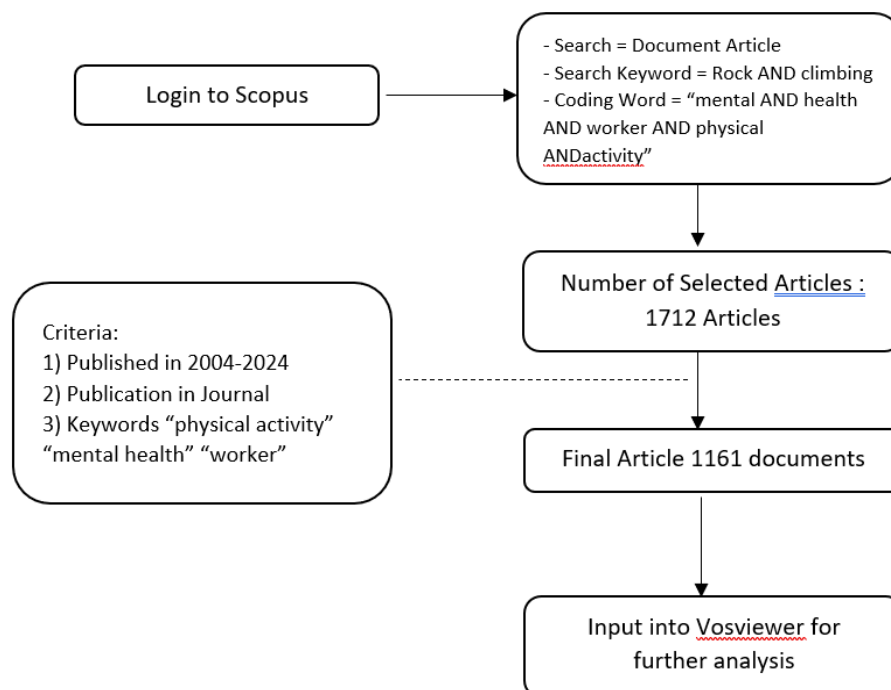


Figure. 1. Document Article Filtering Process in Scopus

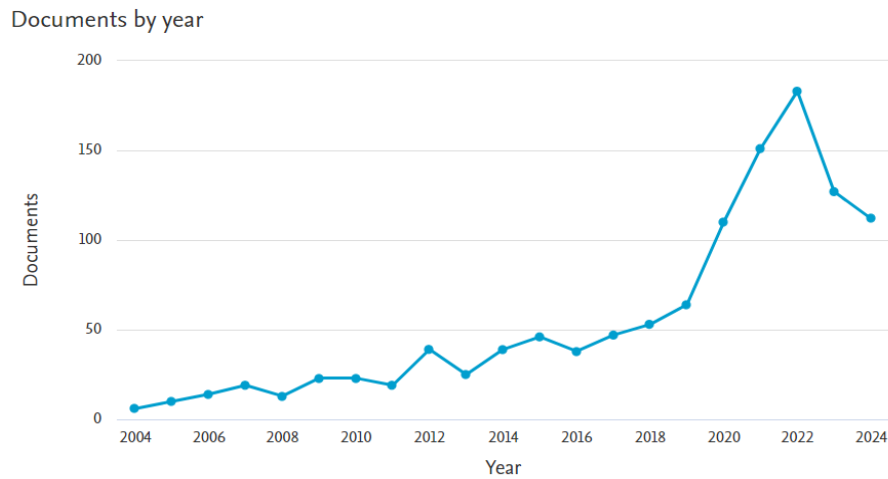


Figure. 2. Document Published on Scopus Databased

Table 1. Top 10 articles with the most citations on Scopus

No	Document title	Authors and Year	Citation
1	Psychological distress, coping behaviors, and preferences for support among New York healthcare workers during the COVID-19 pandemic	Shechter et al., 2020	721
2	Work stress precipitates depression and anxiety in young, working women and men	Melchior et al., 2007	444
3	Geriatric care management for low-income seniors: A randomized controlled trial	Counsell et al., 2007	418
4	Associations between sex work laws and sex workers' health: A systematic review and meta-analysis of quantitative and qualitative studies	Platt et al., 2018	274
5	Increased mortality in schizophrenia due to cardiovascular disease - a non-systematic review of epidemiology, possible causes and interventions	Ringen et al., 2014	271
6	Understanding the care and support needs of older people: A scoping review and categorization using the WHO International Classification of Functioning, disability and Health Framework (ICF)	Abdi et al., 2019	265
7	Unmet adolescent and young adult cancer survivors information and service needs: A population-based cancer registry study	Keegan et al., 2012	261
8	Work ability assessment in a worker population: Comparison and determinants of Work Ability Index and Work Ability score	El Fassi et al., 2013	260
9	The humanistic burden of hereditary angioedema: Impact on health-related quality of life, productivity, and depression	Lumry et al., 2010	256
10	Impact of windows and daylight exposure on overall health and sleep quality of office workers: A case-control pilot study	Boubekri et al., 2014	253

Table 2. Authors, documents, and citations.

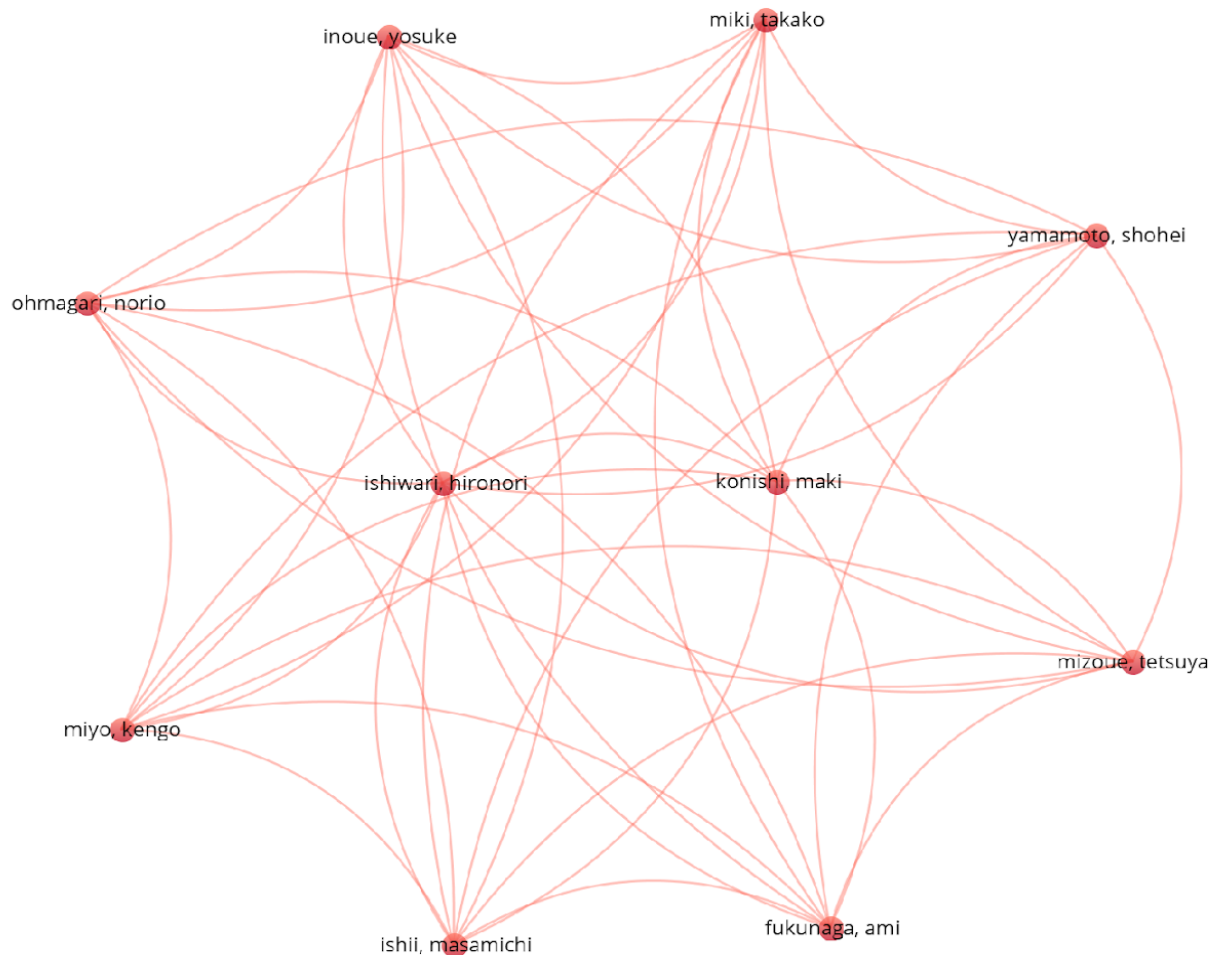
Rank	Author	Doc.	Cite	Rank	Author	Doc.	Cite
1	Andersen, L.L.	12	291	6	Magnavita, N.	7	700
2	Vahtera, J	8	56	7	Rosenbaum, S	7	54
3	Watanabe, K.	8	34	8	Coggon, D.	6	32
4	Blom, V	7	140	9	Kallings, L.V.	6	37
5	Kai, Y.	7	129	10	Nagamatsu, T	6	122

Table 3. Country, documents, and citations.

Rank	Author	Doc.	Cite	Rank	Author	Doc.	Cite
1	United States	289	8959	6	Italy	92	2150
2	United Kingdom	160	5145	7	Japan	88	1225
3	Brazil	115	1178	8	Netherland	78	1877
4	Canada	95	2875	9	China	77	905
5	Australia	94	2188	10	Spain	70	1378

Table 4. Clusters and Keywords based on VOSViewer

Cluster	Item	Color	Percent	Total
Cluster 1	Care, cluster, community, design, development, effectiveness, intervention, older adult, older person, person protocol, randomized controlled trial, result, study protocol, trial.	Red	25%	16
Cluster 2	Anxiety associations, Brazil, burnout, burnout syndrome, COVID, cross-sectional study, depressive symptom, experience, healthcare worker, nurse, occupational stress, pandemic, prospective cohort study, psychological distress, risk.	Green	25%	16
Cluster 3	Child, China, disability, employment, evidence, health status, healthcare professional, influence, life, quality, relation, risk factor, year.	Blue	20%	13
Cluster 4	Case study, prevention, scoping review, strategy, use, workplace.	Yellow	17%	6
Cluster 5	Meta-analysis, office worker, qualitative study, systematic review.	Purple	13%	4
Total			100%	75

**Figure 3. Productive Authors based on Documents and Citation**

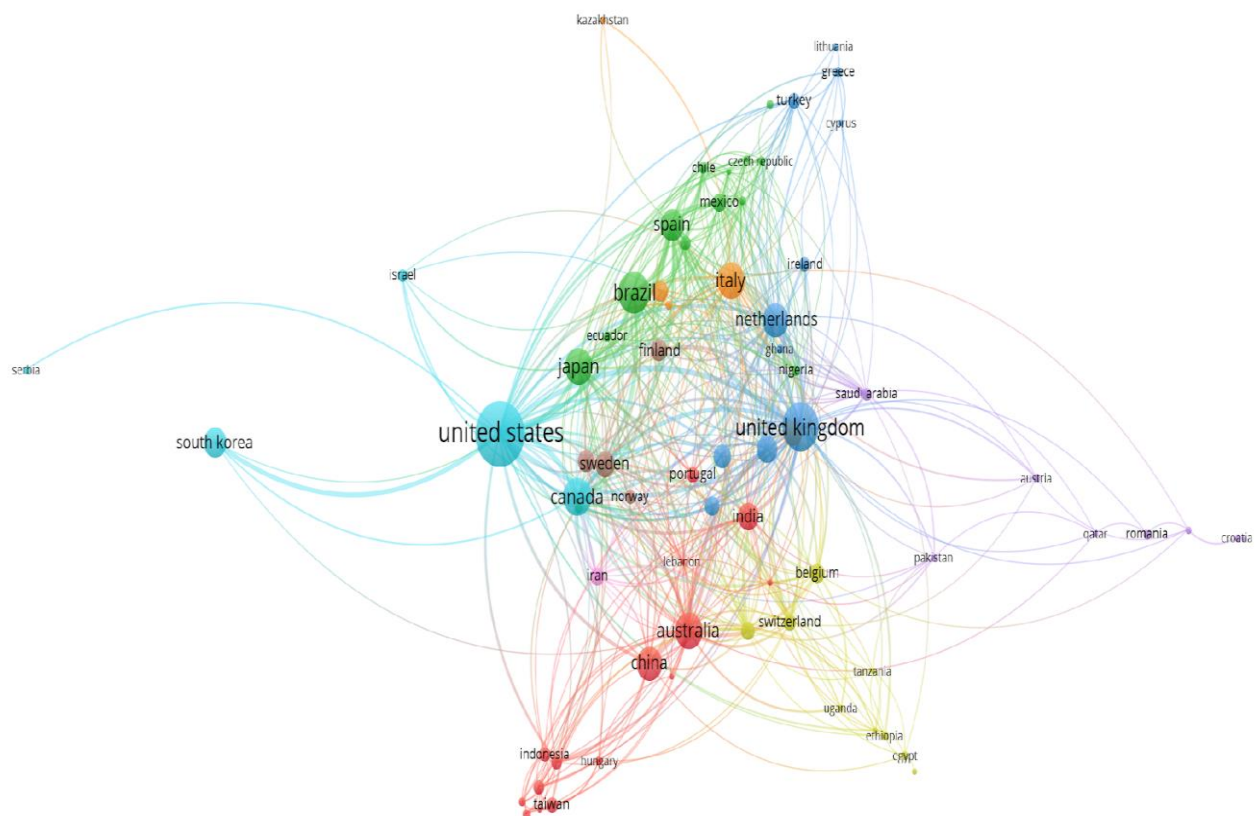


Figure 4. Most productive countries based on documents and citations

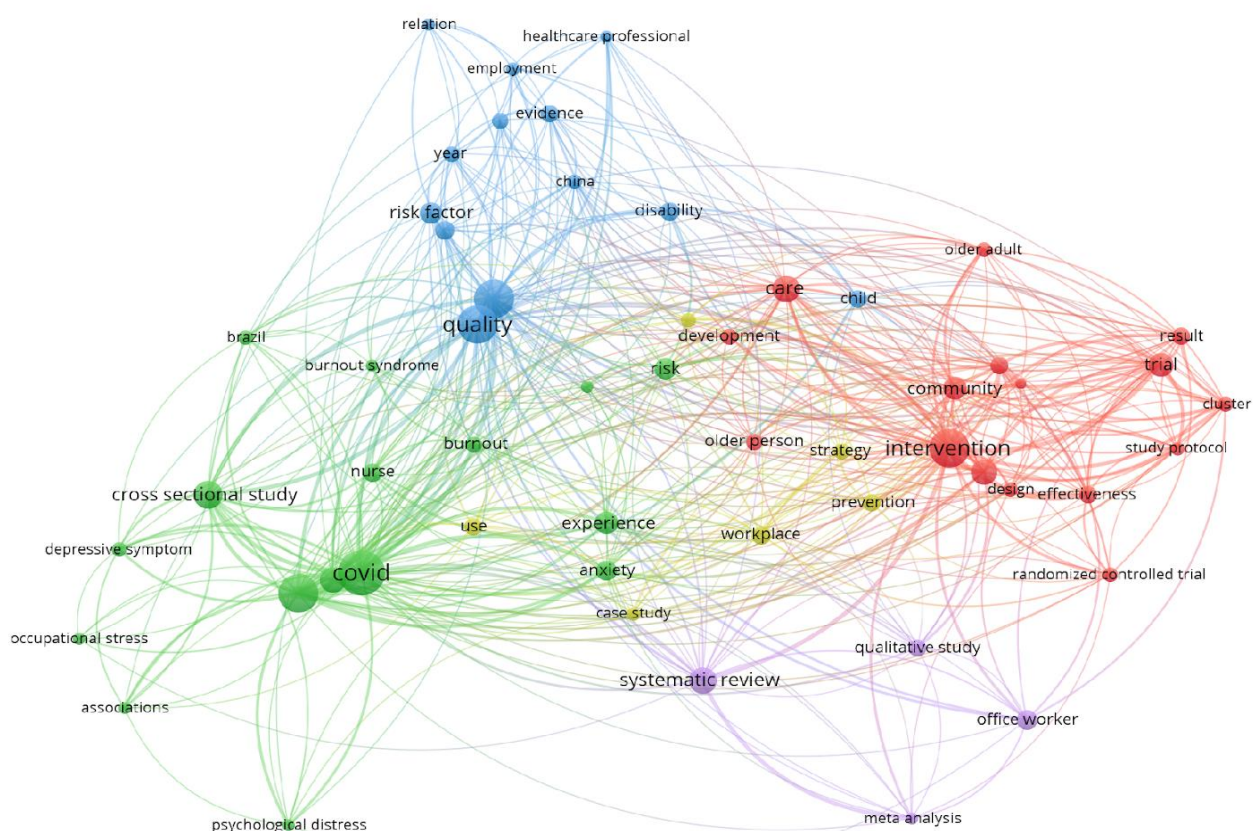


Figure 5. Keyword Analysis

The Effect of Aerobic Exercise on Reducing Blood Glucose Levels in Diabetics: An Experimental Study

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ABSTRACT

Background. DM is one of the chronic diseases that people of all ages and genders can suffer. Most people with type 2 diabetes are obese. Aerobic exercise is one of the therapies used in the treatment of diabetes. **Objectives.** To find out the effect of aerobic gymnastics on reducing blood glucose levels. **Methods.** This study used a quasi-experimental design with pre and post-design, where the treatment group was divided into two groups, namely the control group and the experimental group, with eight treatments given within one month. The population in this study is 30 people. And the research sample with saturated sampling. The research procedure is done by taking an initial test, then giving a gymnastics treatment, and then taking a final test. The data in this study was analyzed using the t-test. **Results.** After the eighth session, the average blood glucose levels of the test group were lower than in the control group. However, the difference was not statistically significant. **Conclusion.** Aerobic exercise for 1 hour twice a week can significantly reduce blood glucose levels in people with type 2 diabetes mellitus.

KEYWORDS: *Exercise, Aerobics, Blood Glucose, T2DM, Type II Diabetes Miletus*

INTRODUCTION

Diabetes Mellitus is a chronic disease affecting people of all ages and races. Increased glucose levels in the blood characterize the disease because the body cannot produce sufficient amounts of the hormone insulin or use insulin effectively (1). Diabetes is one of the challenges of the health epidemic around the world. People with diabetes are usually recommended to do physical exercise and fitness that are under the pathological criteria of people with Type 2 diabetes mellitus. Efforts to treat diabetes mellitus patients as well as prevent complications are to carry out efforts to control diabetes mellitus, one of which is the regularity of diabetic mellitus patients in carrying out sports activities. By exercising, it is hoped that it will improve insulin sensitivity so that it can improve blood sugar levels. Physical activity that is also often recommended is diabetes mellitus gymnastics (2,3). Physical activity is one of the pillars of managing diabetes mellitus M. Based on this information. It can be said that one of the solutions to reduce blood sugar levels is to do sports such as gymnastics. One of the benefits of gymnastics is to prevent obesity by burning body calories so that blood glucose can be used for energy (4). In addition, aerobic exercises such as walking, swimming, and gymnastics play an essential role in preventing and treating diabetes(5,6). These activities are carried out regularly to control blood glucose levels thrice a week for 15 to 60

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minutes (7,8). Based on this information, it can be said that one of the solutions to reduce blood sugar levels is to do gymnastics because, in addition to being one of the management of diabetes mellitus, one of the benefits of gymnastics is to prevent obesity by burning body calories so that blood glucose can be used for energy (9).

MATERIALS AND METHODS

This study refers to experimental research with comparative analysis studies. In the survey, pre-post design testing, saturation sampling methods, and blood glucose checks were carried out to see the effect of gymnastics on patients with Type 2 Diabetes Mellitus. Before implementing the research, the management of Ethical Clearance No.38.01/KEPK-UNP/IV/2023 was carried out. The data collection technique in this study is the measurement of glucose levels in the blood using the POCT (Point Care of Testing) tool, after which it will be divided into two groups, namely a control group and an experimental group. Data analysis in this study was carried out using SPSS with t-test analysis.

RESULTS

All 30 study samples (15 in the test group and 15 in the control group) completed the study without any problems. The following are the research results.

Based on Table 1, it is known that the Blood Glucose level in patients with Diabetes Mellitus before being given aerobic exercise is at the lowest level of 89 mg/dL, 348 mg/dL at the highest level, and the average is 161.2 mg/dL.

Based on Table 2. It is known that the Blood Glucose level in patients with Diabetes Mellitus after being given Diabetic Exercises is at the lowest level of 82 mg/dL, 305 mg/dL at the highest level, and an average of 148.3 mg/dL.

Based on Table 3, it is known that after aerobic exercises, Blood Glucose levels decreased in patients with diabetes mellitus at the Annisa Clinic. This data shows that the average before and after giving diabetic gymnastics decreased by 12.4%, from 161.2 mg/dl to 148.3 mg/dL.

Meanwhile, the results of the *paired sample T-Test* test obtained a t-value of 4.207 with p 0.000 or < 0.05 , which means that there is a significant difference in Blood Glucose levels between the *pre-test* and the *post-test*, where in this case, aerobic gymnastics is categorized as effective in reducing Blood Glucose levels in patients with type II Diabetes Mellitus at Annisa Clinic.

DISCUSSION

There was no significant difference between the experimental and control groups regarding average blood glucose. In addition, the mean blood glucose levels of the control group showed no significant changes during the study. However, in the test group, eight sessions of aerobic gymnastics reduced both values statistically insignificantly. The reduction became significant after the eighth session.

Aerobic exercise can help control blood sugar better in patients with type II diabetes (10–12). They believe that aerobic exercise increases insulin binding to monocyte receptors, leading to higher insulin production and, thus greater glucose absorption, ultimately reducing blood sugar levels (3,13).

One form of exercise for people with Diabetes Mellitus that has been proven through several studies is aerobic exercise (11). Diabetic exercise is a type of low-impact aerobics. Exercise that emphasizes rhythmic movements of muscles, joints, blood vessels, and nerves in the form of stretching and relaxation (8). This effort is very appropriate in treating diabetic mellitus patients and preventing complications by controlling diabetic mellitus patients (9,11). Diabetes exercises are carried out to reduce and control blood sugar levels in people with diabetes mellitus (6,13-15). After diabetic exercise treatment, it was found that almost all people with diabetes experienced a decrease in blood sugar levels.

CONCLUSION

According to the results of this study, aerobic exercise can reduce blood glucose levels before and after exercise, effectively lowering blood sugar levels in patients with type II diabetes mellitus.

APPLICABLE REMARKS

- Aerobic exercise can lower blood glucose levels in people with type II diabetes mellitus before and after exercise.

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AUTHORS' CONTRIBUTIONS

Concept and design of the study: Sri Gusti Handayani. Data acquisition: Anton Komaini. Data analysis and interpretation: Nguyen Tra Giang. Compiled the script: Jaffry Zakaria. Critical revision of the manuscript for important intellectual content: Zul Akhbal. Statistical analysis: Siska Alicia Farma. Administrative, technical, and material support: Elsa Yuniarti

CONFLICT OF INTEREST

The authors mention no “Conflict of Interest” in this study.

ETHICAL CONSIDERATION

The study met the ethical standards, and all respondents consented to the sample.

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Table 1. Blood Glucose Levels in Pre Test

No	Glucose Levels Before Gymnastics (<i>Pre Test</i>)	Value
1.	Minimum Values	89 mg/dL
2.	Maksimum Values	348 mg/dL
3.	Average	161,2 mg/dL

Table 2. Blood Glucose Levels at Post Test

No	Glucose Levels After Gymnastics (<i>Post Test</i>)	Nilai
1.	Minimum Values	82 mg/dL
2.	Maksimum Values	305 mg/dL
3.	Average	148,3 mg/dL

Table 3. Differences in Blood Glucose Levels in Pre Test and Post Test (with paired sample t-Test)

No	Kadar Glukosa Darah	Mean	P Value	t
	<i>Pre Test</i>	161,2 mg/dL	0,000	4,207
	<i>Post Test</i>	148,3 mg/dL		

The Effect of Alternate Leg Bound Exercise Variations on Leg Muscle Explosive Power in Spartan Athletic Club

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ABSTRACT

Background. The explosive power of leg muscles is crucial for athletic performance. However, many athletes at the Spartan Athletic Club face limitations in their training programs due to a lack of variation. Improving this aspect of training is essential for enhancing overall performance. **Objectives.** This study aimed to evaluate the effect of alternate leg-bound exercise variations on increasing the explosive power of leg muscles in Spartan Athletic Club athletes. **Methods.** A one-group pre-test-post-test experimental design was employed, involving 15 male athletes. The athletes underwent a training intervention consisting of alternate leg-bound exercises, with measurements of leg muscle explosive power taken before and after the intervention using the standing broad jump test. **Results.** The analysis revealed a significant increase in the explosive power of the leg muscles following the intervention (T count = 5.246, T table = 2.145), indicating the effectiveness of the alternate leg-bound exercise variation. **Conclusion.** The findings suggest that alternate leg-bound exercise variations effectively improve the explosive power of leg muscles in Spartan Athletic Club athletes. The study recommends incorporating these exercises routinely into training programs and suggests conducting follow-up research with a larger sample size to validate the results further and explore long-term effects.

KEYWORDS: *Alternate Leg Bound, Leg Muscle Explosiveness, Athletic*

INTRODUCTION

The main problem in this study is the lack of variety in exercise, thus stopping the increase in the explosive power of the leg muscles. The study offered an Alternate leg-bound exercise to increase the explosive power (1,2). The study found the main problems with exercise programs and offered solutions to those problems through planned and measured exercise variations. Appropriate and programmed physical training is crucial for optimizing athletes' performance in various sports (3). One significant aspect of athletic fitness is leg muscle explosive power, which plays a significant role in activities requiring explosive strength, such as sprinting, long jumping, and various other sports. Effective training variations can help enhance this ability. The Alternate Leg Bound exercise is one standard method to improve the leg muscles' explosive power.

Physical condition is essential in improving athlete performance, especially in various sports (4–6). Therefore, good physical condition is expected to contribute positively to athletes' mastery of sports techniques. The main focus in improving athlete performance is through specially designed training. One effective training method is plyometric training. This training is considered effective in achieving optimal physical conditions for an athlete and can be applied to various sports to improve physical fitness.

Athletics, one of the disciplines competed in at various levels, includes various competition numbers. Athletics plays an essential role because it includes various competition numbers, including (1) walking

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numbers, which involve casual walking and fast walking; (2) running numbers, which include sprints, relays, hurdles, marathons, and obstacle courses; (3) jumping numbers, which consist of long jump, high jump, triple jump, and pole vault; and (4) throwing numbers, which involve javelin, discus, shot put, and hammer throw(10). Each number has its characteristics and challenges, creating diversity in athletic competitions. With this broad scope, athletics is one of the sports that attracts attention at various levels of competition.

MATERIALS AND METHODS

This study aims to determine the impact of alternate leg-bound training on leg muscle explosive power using an experimental pre-test-post-test design. The research involves measuring explosive power through the standing broad jump test before and after the intervention. The sample consists of 34 athletes from the Spartan Athletic Club, selected using quota sampling to ensure proportional representation based on characteristics such as age, gender, or experience level. Data collection involves administering the standing broad jump test at both the pre-test and post-test stages, with results categorized based on jump distance norms for males and females. Data analysis will be conducted using a t-test to test the hypothesis, following checks for normal distribution and homogeneity of variance.

RESULTS

The normality test determines whether the research subjects have a standard data distribution. The normality test is the Lilliefors test, with the criteria $L_{\text{count}} < L_{\text{table}}$. Based on the L_{count} results obtained from the analysis of the Lilliefors pre-test and post-test tests in the table above, it can be concluded as follows:

Based on the Lilliefors test analysis results, the L_{count} value for the pre-test and post-test data is smaller than the L_{table} , respectively $0.0914 < 0.22$ and $0.1987 < 0.22$. Thus, it can be concluded that the pre-test and post-test data have a normal distribution.

The homogeneity test aims to see whether the pre-test and post-test data have homogeneous variations. The formula used is the F test, considered homogeneous if $F_{\text{count}} < F_{\text{table}}$.

At the significance level of $\alpha = 0.05$, then obtained $F_{\text{table}} = 2.48$. Then, the result of $F_{\text{count}} < F_{\text{table}}$ ($1.51 < 2.48$) means the data above is homogeneous.

After the normality and homogeneity tests are carried out, the next step is to conduct a hypothesis test using the t-test to determine whether variations in alternative leg training influence the explosive power of the Spartan Athletic Club's leg muscles.

Based on the table data above, it can be seen that with the number of samples of 15 people and $T_{\text{count}} 5.246941$, it is necessary to see whether hypothesis H_0 or hypothesis H_1 is accepted.

Under the explanation above, it can be obtained that $T_{\text{count}} > T_{\text{table}}$ ($5.246 > 2.145$). This means that hypothesis H_1 is accepted, and hypothesis H_0 is rejected. So, it can be concluded that variations in alternative training influence the explosive power of the *Spartan Athletic Club's* leg muscles with $T_{\text{count}} > T_{\text{table}}$.

DISCUSSION

There was a significant effect between double-leg bound training and the explosive power of leg muscles (7). In addition, a study by Markovic also supports these results, where plyometric training significantly increased vertical jump height, indicating increased muscle explosive power (8). Ramirez-Campillo et al. found that different plyometric training frequencies significantly impacted physical fitness components, including muscle explosive power in amateur soccer players (9). Furthermore, de Villarreal et al. revealed that combining plyometric and traditional strength training effectively improved sprint and strength performance, which is closely related to increased muscle explosive power (10). These studies confirm that plyometric training, including alternate leg bound, effectively increases leg muscle explosive power.

CONCLUSION

This research aims to demonstrate that Alternate leg-bound training effectively enhances the explosive power of leg muscles. The results indicated a notable improvement, concluding that this training method is effective and can be recommended as part of a training regimen for athletes requiring explosive strength. It is suggested that coaches and athletes incorporate plyometric exercises like Alternate Leg Bound into their training routines to achieve optimal performance gains. Additionally, further studies are needed to investigate this exercise's long-term impacts and explore combinations with other exercises that might yield even better outcomes. The findings also indicated that Alternate Leg Bound effectively targets the primary leg muscles, including the quadriceps, hamstrings, and gastrocnemius, which are crucial for explosive movements. This exercise also enhances coordination and balance, vital for athletic performance. Alternate Leg Bound requires muscles to generate maximum power quickly, which can enhance tendon elasticity, muscle strength, and neuromuscular adaptation.

The implications of these research findings suggest that integrating Alternate Leg Bound into training

programs can be essential for athletes, especially those requiring high explosive power in their performance, such as football players, runners, and jumpers. Incorporating plyometric exercises like this into training routines can enhance performance by maximizing muscle explosive power and movement efficiency. Such exercises can be crucial in athlete development programs to enhance the explosive strength needed across various sports disciplines.

Based on the study's findings, it is recommended that coaches and athletes incorporate plyometric exercises, such as Alternate Leg Bound, into their regular training routines to enhance the explosive power of leg muscles effectively. These exercises should be performed 2-3 times per week, with intensity and volume tailored to the athlete's fitness level. Training programs should be flexible and adjusted to the individual needs and the specific sports requirements of the athletes, ensuring proper volume and intensity to prevent injuries and promote optimal development. Further research is needed to examine this exercise's long-term effects and explore other training combinations that might yield superior results. Emphasizing sport-specific adaptations and technique improvements can provide additional insights to enhance the effectiveness of plyometric training. Future research should explore the long-term effects of this exercise and examine its combination with other training methods to further optimize performance. Overall, alternate leg-bound exercises offer a practical and efficient way to boost leg power and athletic performance.

APPLICABLE REMARKS

- This study demonstrates that alternate leg-bound exercises effectively enhance leg muscle explosive power, making them a valuable addition to training regimens for athletes in sports requiring explosive strength, such as sprinting and football.
- Coaches should incorporate these exercises 2-3 times per week, adjusting intensity and volume to suit individual fitness levels.
- Proper technique is essential to avoid injury, and athletes should progress gradually to ensure continued improvement.

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AUTHORS' CONTRIBUTIONS

Ely Yuliawan contributed to the study design, data analysis, and manuscript writing. Sukendro assisted in data collection, analysis, and reviewing the manuscript. Ilham was involved in data collection and interpretation of results. Yusradinafi contributed to the methodology, data analysis, and manuscript revision. Bangkit Yudho Prabowo assisted with the study design data collection and reviewed the manuscript. Muhammad Galih Gusti Sidik contributed to the analysis and interpretation of the data. Ely Yuliawan was responsible for the statistical analysis and manuscript editing. Ely Yuliawan assisted in data collection, interpretation of results, and manuscript preparation.

CONFLICT OF INTEREST

The authors mention no "Conflict of Interest" in this study.

ETHICAL CONSIDERATION

This research has met the standards of research ethics and has received approval to be a sample of all respondents.

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FINANCIAL DISCLOSURE

The authors have no financial interests related to the material in the manuscript.

ARTIFICIAL INTELLIGENCE (AI)

Use There was NO use of artificial intelligence (AI) for

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Table 1. Liliefors Test Analysis Results

Source of Variation	Lcount	Ltable	Criteria
<i>Prel-test</i>	0.09145	0.22	Normal
<i>Post-test</i>	0.198786		Normal

Table 2. Results of f-Test Analysis

	Prel-test	Post-test
Standart Delviation	0.25378	0.384441
F count	1.514877982	
Degrees of Freedom	14	14
Alpha	0.05	0.05
Ftable	2.48373	2.483726

Table 3. Results of t-Test Analysis

No	Name	Prel test	Post-test	D	D	d ²
1	Bintang	1.51	1.62	0.11	-0.2175	0.047306
2	Riski	1.86	1.97	0.11	-0.2175	0.047306
3	Arielf	1.97	2.05	0.08	-0.2475	0.061256
4	Aldi	2.02	2.11	0.09	-0.2375	0.056406
5	Sultrisno	2.04	2.15	0.11	-0.2175	0.047306
6	Relno	2.06	2.24	0.18	-0.1475	0.021756
7	Fikri	2.12	2.17	0.05	-0.2775	0.077006
8	Kaiselr	2.17	2.2	0.03	-0.2975	0.088506
9	Bayul	2.18	2.33	0.15	-0.1775	0.031506
10	Relyhan	2.22	2.3	0.08	-0.2475	0.061256
11	Dika	2.26	2.35	0.09	-0.2375	0.056406
12	Abiyul	2.37	2.49	0.12	-0.2075	0.043056
13	David	2.42	2.63	0.21	-0.1175	0.013806
14	Fahlull	2.45	2.98	0.53	0.2025	0.041006
15	Ardi	2.48	3.16	0.68	0.3525	0.124256
Total		32.13	34.75	2.62	-2.2925	0.818144
Average		4.01625	4.34375	0.3275		
						N
						15
						N(N-1)
						210
						$\bar{x}_D$
						0.3275
						$\sum d^2$
						0.818144
						$\sum d^2/N(N-1)$
						0.003896
						$\sqrt{\sim}$
						0.062417
						T _{count}
						5.246941
						T _{tab:e}
						2.145

The Teams Games Tournament Type Cooperative Model on the Basic Motor Skills of Students with Mild Intellectual Disabilities in Special Needs Schools

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ABSTRACT

Background. This study was motivated by the fact that during the initial observation of students with mild intellectual disabilities, the scores of more than 30% of students were not good in the indicators of balance, walking, running, jumping, and object manipulation. Hence, there needs to be a solution to this problem by developing a learning model to help and improve the latest innovations in physical education learning for students with intellectual disabilities. **Objectives.** This study aims to determine the effect of the cooperative learning model of the team games tournament type on the basic motor skills of students with mild intellectual disabilities who are under the needs of students with intellectual disabilities in special schools. **Methods.** This study is an experimental study with a Quasi-experimental design with design (posttest-only control design). The population in this study were students with intellectual disabilities in special schools in Dharmasraya Regency. The sample of this study was students with low intellectual disabilities in phases B&C who were in the age range of 8 to 13 years at SLBN Pulau Punjung as a control class and at SLB Koto Agung as an experimental class in Dharmasraya Regency. The research instrument was the Scott Motor Ability movement ability test. **Results.** Based on the hypothesis test results using the independent sample t-test, a significance of <0.05 was obtained. **Conclusions.** The cooperative model of the team's games tournaments (TGT) type influences the basic motor skills of students with mild intellectual disabilities.

KEYWORDS: *Teams Games Tournaments, Basic Motor Skills, Intellectual Disabilities*

INTRODUCTION

Students with disabilities present conditions that differentiate individuals under ability/function physique and their mentality, as well as show characteristic features that are very specific. They are good in physique, mental, social, and emotional (1). The types of disabled students, in general terms, both nationally and internationally, are grouped into intellectual disabilities, mental disabilities, physical disabilities, and multiple disabilities (2).

This is the same as the problem researchers found in the field during initial observations, which showed that the scores of more than 70% of students were inferior and not good in the indicators of balance, walking, running, jumping, and object manipulation (3–5).

Observations and interviews with the principals of teachers at Special Schools revealed that the difficulty in developing and implementing physical education learning is due to the lack of facilities and infrastructure (6). Learning

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models to help teachers improve students' learning experiences are also lacking. In addition, Special Schools in Dharmasraya Regency do not have physical education teachers who can facilitate students with intellectual disabilities in learning movement.

MATERIALS AND METHODS

The method is experimental research, the only one that can adequately test the hypothesis concerning causal relationships (cause and effect) (10). The design used is a pre-experimental design with one group pretest -post-test. Samples were taken from schools with the most significant number of students, taking into account students in the low intellectual disability category who are in the age range of 8 to 13 years, then all data was collected into one according to student characteristics. The analysis of this study uses prerequisite tests, namely the normality test and the homogeneity test, for data analysis using the t-test (paired *t-test*) using SPSS version 23.

RESULTS

The proposed hypothesis can be tested if it passes the prerequisite test for data analysis, namely the normality test, as shown in Table 1.

The table above shows that the normality test in the control class is $0.478 > 0.05$, so the data is normally distributed. In the experimental class, the value is $0.500 > 0.05$, so the data can be stated to be normally distributed. So, it is concluded that the basic motor skills data of students with intellectual disabilities from the posttest results come from a normally distributed population.

A homogeneity test is submitted in the research using a variance test. For more details, see the the table 2.

Based on the results of the calculation of the homogeneity test of the research variables above, it was found that the value of $0.006 > 0.05$, so it can be stated that all data groups in this study were taken from a homogeneous population.

After conducting data testing using data normality tests and data homogeneity tests, the data results were tested using a *t-test* (paired *t-test*), the details of which are shown in Table 3.

Based on the results of the hypothesis test using the independent sample t-test, a value of $0.003 < 0.05$ was obtained, so it can be concluded that there is an influence of the cooperative model of the teams' games tournaments (TGT) type on the basic motor skills of students with mild intellectual disabilities.

DISCUSSION

The cause of the low learning outcomes of students with disabilities in PE learning is based on internal factors, namely the lack of motivation in carrying out movement activities, the lack of interest of students with disabilities due to the lack of variation in the delivery of learning in physical education, sports, and health learning. This is reinforced by previous research entitled " Development of Physical Education Text Book Based on Direct Instructions for Children with Special Needs," which found low learning outcomes for students with disabilities and the lack of textbooks in Special Schools (7–9). Furthermore, the results of the cooperative model study of the team games tournaments (TGT) type can also improve the creativity, cooperation, and soccer-playing skills of deaf students (10,11).

CONCLUSION

In conclusion, the results of this study indicate that the cooperative learning model of the Team Games Tournament (TGT) type significantly improves the basic motor skills of students with mild intellectual disabilities. The findings, supported by statistical analysis using normality tests, homogeneity tests, and paired t-tests, demonstrate that the TGT model effectively enhances the students' abilities in balance, walking, running, jumping, and object manipulation. This suggests that implementing the TGT model can effectively address the challenges faced by students with intellectual disabilities in physical education, improving both their motor skills and overall learning experience.

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APPLICABLE REMARKS

- The results of this study are essential for teachers as a design for a cooperative model of the Teams Games Tournaments (TGT) type, aimed at developing fundamental movement skills in students with intellectual disabilities to enhance fundamental motor skills.

AUTHORS' CONTRIBUTIONS

Study concept and design: Alchonity Harika Fitri, Nurul Ihsan. Acquisition of data: Alnedral, Syafruddin. Analysis and interpretation of data: Nurhastuti, Gusril. Drafting the manuscript: Alchonity. Critical revision of the manuscript for important intellectual content: Ilham. Statistical analysis: Alchonity.

CONFLICT OF INTEREST

The authors mention no "Conflict of Interest" in this study.

ETHICAL CONSIDERATION

The members participating in the meeting unanimously decided to use the Universitas Negeri Padang and Publication Ethics Directive as the "Ethics Committee Approval Document" for the research.

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Table 1. Summary of Normality Test

Class	Test	df	Sig.
Control	Kolmogorov-Smirnov	7	0,1388889
	Shapiro-Wilk	7	0,3319444
Experiment	Kolmogorov-Smirnov	9	0,1388889
	Shapiro-Wilk	9	0,3472222

Table 2. Summary of Normality Test

df1	df2	Sig.
10.574	1	0.006

Table 3. Data from the results of the *t*-test (*paired t*-test)

t	df	Sig.	95% Confidence Interval
-3.561	14	0.003	(-63.30, -15.71)
-4.037	8.628	0.003	(-61.78, -17.22)

Design of Cooperative Learning Model of Teams Games Tournaments Type to Improve Basic Movement Skills of Students with Mild Intellectual Disabilities in Special Schools

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ABSTRACT

Background. Students with intellectual disabilities have limitations in cognitive function, so they have a level of intelligence below the average of typical students. Limitations in developing their intelligence are not optimal, hindering their growth and development, such as low thinking skills, less ability to think abstractly, and lack of vocabulary. **Objectives.** So, this research aims to design a cooperative learning model of the Team Games Tournament (TGT) type for basic motor skills of mentally disabled students. **Methods.** The developed model, a model book, teacher's guidebook, and parent's guidebook, was studied using the ADDIE research design, a theory from Robert Maribe Branch. ADDIE is an abbreviation for Analysis, Design, Development, Implementation, and Evaluation. **Results.** Based on the results of the validation test of the teacher's guidebook on the design of a cooperative model of the teams' games tournaments (TGT) type for basic motor skills of students with mild mental retardation, it was declared valid with a very valid category at an average value of 91%. **Conclusions.** The validation results of the parent's guidebook on the cooperative model of the teams' games tournaments (TGT) type for basic motor skills of students with low mental retardation were declared valid with a valid category at an average value of 78%.

KEYWORDS: *Cooperative Model, Basic Motor Skills, Intellectual Disability*

INTRODUCTION

Special schools are educational institutions that play an essential role in providing inclusive and special education for students with various types of disabilities, including students with intellectual disabilities (1–3). Students with intellectual disabilities have limitations in cognitive function, so they have a level of intelligence below the average of typical students. Limitations in developing their intelligence are not optimal, hindering growth and development, such as low thinking skills, less ability to think abstractly, and lack of vocabulary (4). Intellectual disabilities can be classified into three parts: debil (educable), embryonic (trainable), and idle (needs care). In the field of special education, the classification of intellectual disabilities is classified into needing care (severely and profoundly), educable, and trainable.

Intellectual disability is a condition that can affect a person's intellectual ability, causing limitations in understanding, learning, and adapting to everyday life. Mental disabilities caused by imperfect brain and nerve development in students with intellectual disabilities hinder their physical development and experience problems with their motor skills. This is proven based on a basic motor ability test with five indicators, namely balance,

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walking, running, jumping, and object manipulation, with an average score of basic motor abilities for students with intellectual disabilities in the low intellectual category of more than 70% of students being very poor and poor.

The problem found in the field is that the basic motor abilities of students with intellectual disabilities do not develop optimally. This occurs due to the lack of stimulation of motor exercises for students with intellectual disabilities. Therefore, more intensive efforts are needed, and effective learning methods should be focused on to improve their basic motor abilities. One of the methods that can be applied is implementing a cooperative learning model, such as the Teams Games Tournament (TGT), which has been proven effective in facilitating collaboration, social interaction, and active learning in various educational settings (5). Although many studies have shown the success of this learning model in regular schools, few studies have explored its implementation in special schools, especially in the context of improving basic motor skills in students with intellectual disabilities (6).

One of the important aspects of children's development, including that of children with intellectual disabilities, is basic motor skills (7). Fundamental motor skills involve physical activities such as walking, running, jumping, and playing, which are essential for their physical, social, and emotional development. Good basic motor skills can also help improve the quality of life of students with intellectual disabilities, help them participate in physical activities, increase independence, and enable them to interact socially with peers. In this context, this study aims to bridge the knowledge gap by investigating and analyzing the effectiveness of implementing the TGT Type Cooperative Learning Model in Special Schools (8). The results of this study are expected to provide valuable insights into the potential of this method in improving the basic motor skills of students with intellectual disabilities so that it can improve the adaptive physical education approach in special schools and provide benefits for the physical and social development of the students concerned (9).

MATERIALS AND METHOD

This research is a developmental study known as research and development, which validates and develops a product. The product developed is a cooperative model of the teams' games tournaments (TGT) type. The scope of the research is to design a cooperative model. This cooperative model was developed in physical education, sports, and health learning for students with intellectual disabilities in the mild intellectual category based on the ADDIE research model, a theory by Robert Maribe Branch. ADDIE stands for Analysis, Design, Development, Implementation, and Evaluation (9). Analyzing what is related to the activity of analyzing environmental situations so that a product can be found to be developed. Design is an activity where a product is designed according to needs. Development, product manufacturing testing, and evaluation activities, evaluating products and proof of concept (9). Furthermore, this research stage can be seen in the following fishbone,

RESULTS

This learning model is also equipped with a parent's guidebook as a step so that intellectually disabled students continue to move at home. This parent's book explains the development of intellectually disabled children, socio-emotional attitudes, the role of parents, learning conditions for intellectually disabled children, and movement games to improve the fundamental movement skills of intellectually disabled students. The cover design of the cooperative model book, team games tournaments type for mild intellectually disabled students, can be seen in Figure 1.

The quality of a learning model is determined by how valid and practical the product of the development is (10). The model is arranged based on syntax, reaction principles, social systems, support systems, instructional impacts, and accompanying effects. The results of the validation of the TGT (teams' games tournaments) type cooperative learning model on the basic motor skills of students with intellectual disabilities in the low intellectual category can be seen in Table 1.

From the validity test above, we can see that the cooperative model book of the team's games tournaments (TGT) type on the fundamental movement skills of students with intellectual disabilities in the low category obtained valid results, which were stated as very valid with an average value of 85%. The validation results of the teacher's guidebook of the cooperative model of the team's games tournaments (TGT) type on the fundamental movement skills of students with intellectual disabilities in the mild category can be seen in Table 1.

Based on the results of the validation test of the teacher's guidebook on the design of a cooperative model of the teams' games tournaments (TGT) type for basic motor skills of students with mild mental retardation, it was declared valid with a very valid category at an average value of 91%. The validation results of the parent's guidebook on the cooperative model of the teams' games tournaments (TGT) type for basic motor skills of students with low mental retardation were declared valid with a valid category at an average value of 78%.

DISCUSSION

Movement problems generally occur in children with intellectual disabilities due to weaknesses in gross and fine motor skills, motor coordination skills, lack of self-awareness towards the situation and the surrounding environment, and lack of physical health (10). In physical education learning that involves much physical activity, below-average mental abilities affect physical abilities to a greater or lesser extent, such as Basic movements that seem awkward, disproportionate, and inflexible (stiff), especially in basic movements such as walking, running, jumping, and running (11,12). Furthermore, in the research that has been conducted, the results showed that the scores of children with intellectual disabilities were significantly lower on all items of motor skills and object control skills compared to normal children, and intellectual disabilities in children cause children with intellectual disabilities to have difficulty in carrying out movements that are very important for carrying out their daily lives (13). Considering the various problems found, a solution is needed for fundamental movement problems for students with intellectual disabilities in sports education learning by providing innovations in physical education learning.

CONCLUSION

Based on the discussion above about the design of a cooperative model of the Teams Games Tournaments (TGT) type for basic movement skills of students with intellectual disabilities, it can be concluded in several points, namely. The first point is that teachers can use the design of this learning model as a reference in physical education learning on basic movement material. The second point is that the design of this learning model is a guideline for parents of students in providing essential movement stimulation at home, and the third point is that the design of this learning model is a solution so that students with intellectual disabilities can use it in improving their fundamental movement skills.

APPLICABLE REMARKS

- The results of this study are essential for teachers as a design for a cooperative model of the Teams Games Tournaments (TGT) type, aimed at developing fundamental movement skills in students with intellectual disabilities to enhance fundamental motor skills.

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AUTHORS' CONTRIBUTIONS

Study concept and design: Alchonity Harika Fitri, Nurul Ihsan. Acquisition of data: Alnedral, Syafruddin. Analysis and interpretation of data: Nurhastuti, Gusril. Drafting the manuscript: Alchonity Harika Fitri. Critical revision of the manuscript for important intellectual content: Nurul Ihsan. Statistical analysis: Alchonity Harika Fitri

CONFLICT OF INTEREST

The authors mention no "Conflict of Interest" in this study.

ETHICAL CONSIDERATION

The members participating in the meeting unanimously decided to use the Universitas Negeri Padang and Publication Ethics Directive as the "Ethics Committee Approval Document" for the research.

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ARTIFICIAL INTELLIGENCE (AI) USE

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Figure 1. Cooperative Product Type Teams Games Tournament (TGT).

Table 1. Validation results of teacher's manual

Components	Research Results	
	Quantitative	Qualitative
Layout	87,50%	Very Valid
Language	87,50%	Very Valid
Model Aspects	98%	Very Valid

Hybridized Teaching: Through Personal Social Responsibility and Sport Education in Physical Education

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ABSTRACT

Background. Currently, schools are facing severe challenges with the increasing phenomenon of moral and social crises from students, such as fights, bullying, and disrespectful acts. **Objectives.** This study analyzes hybridized teaching through personal social responsibility and sport education in physical education. **Methods.** This research method is quasi-experimental with a pretest-posttest control group design. The sample of this study is 72 high school students. The instruments used are adapting the Tool for Assessing Responsibility Based Education (TARE), questionnaires, observation sheets, and football, volleyball, and basketball knowledge tests. Data analysis uses paired sample t-tests and independent sample t-tests. **Results.** The results of the study show that (1) the hybridization model of the Teaching Personal, Social, Responsibility, and sports education hybrid model has a significant and effective influence in improving the affective domain (responsibility and respect), psychomotor domain (football, volleyball, and basketball playing skills), cognitive domain (knowledge of the characteristics of football, volleyball, and basketball) of students with a significance value of <0.05 . (2) the hybrid model of Teaching Personal, Social, Responsibility, and Sport Education had a significant and practical difference in influence between the experimental and control groups in improving the affective domain (responsibility and respect), psychomotor domain (football, volleyball, and basketball playing skills), cognitive domain (knowledge of the characteristics of football, volleyball, and basketball) students with higher average scores of the experimental group compared to the control group. **Conclusions.** Therefore, it can be concluded that the experimental group is better than the control group in every physical education learning in schools.

KEYWORDS: *Teaching Personal, Social, Responsibility, Sport Education, Physical Education*

INTRODUCTION

The success of achieving learning objectives is determined by the teacher's ability to plan, implement, and assess learning (1). The role of teachers is vital; teachers are the spearhead in facilitating students in the learning process to develop student potential (2,3) Physical Education as a learning process is a conscious and planned effort to develop students' potential to be physically healthy and have character (sportsmanship) through various physical activities. The learning implementation plan provides benefits as a guideline in implementing learning to achieve the goals by preparing a learning plan to carry out active, creative, effective, innovative, and fun learning activities.

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However, based on the results of observations at Sleman Regency Senior High School in June 2024 with sports teachers, it was stated that currently, the school is facing severe challenges with the growing phenomenon of moral and social crises from students, such as fights, bullying, and disrespectful acts. This problem is often occurring in the context of learning at school. Empirical facts support this Simonton & Shiver, (2021); Utomo et al., (2023) In his research, he stated that social problems such as responsibility and respect among students are currently considered unsatisfactory. Of course, this needs to be a concern for teachers and resolved immediately so that it does not negatively affect students in the future.

Based on the above problems, there are several solutions that teachers can implement to improve students' affective, psychomotor, and cognitive domains in physical education learning, namely through the use of the right learning model. Teaching Personal, Social, Responsibility and Sport Education are the learning models that can be used. The hybridization of the Teaching Personal and Social Responsibility and Sport Education models is a student-centered learning model so that students become more active in the learning process (6). The hybrid learning model is expected to provide real experience for students in the physical education learning process. This study aims to analyze the influence and effectiveness of the Hybrid Teaching Personal, Social Responsibility, and Sport Education models in improving the affective domain, psychomotor domain, and cognitive domain of students. This research can be one of the alternatives or references that can help teachers improve the affective domain (responsibility and respect), the psychomotor domain (skills to play football, volleyball, and basketball), and the cognitive domain (understanding the characteristics of sports) of students through physical education learning that is fun for students.

MATERIALS AND METHODS

This study uses a quasi-experimental research method with a non-equivalent control group design. Some groups will be given treatment, namely the experimental group and the control group. The subjects in this study are students of Sleman Regency Senior High School. The population in this study is 180 students, consisting of 60 male students and 120 female students. Sampling was carried out randomly (Random Sampling). The selected class has a total sample of 72 students, with 36 students each. This research has received ethical approval from the Research Ethics Committee of Yogyakarta State University. The instruments in this study are divided into four. The first is the Tool for Assessing Responsibility Based Education (TARE), which is used to measure the level of responsibility of students; the second instrument is a questionnaire used to measure the level of respect of students; the third is an observation sheet to find out the level of playing skills of students, and a knowledge test to find out students' knowledge about the game of football. Volleyball and basketball data analysis used in this study using SPSS 26 is done using an independent sample t-test.

RESULTS

Table 1 shows the results of the independent sample t-test on the pre-test data comparing the experimental group with the control group.

In the experimental group and control group, the average score of the pre-test and post-test was obtained with a significance value of <0.05 . So, there is a significant influence and increase on students' scores of responsibility, respect, playing skills, and knowledge of the big ball game.

DISCUSSION

Based on the study's results, this study's discussion can be described as follows: a) there is a positive influence of the Teaching Personal and Social Responsibility and sports education learning models applied in the physical education learning process. This is supported by the results of previous research, which explained that the Teaching Personal and Social Responsibility learning model significantly increases students' responsibility, respect, and social behavior (7). The Teaching Personal and Social Responsibility learning model can improve students' social skills, discipline, responsibility, respect, and care (8). b) The sports education learning model also positively influences physical education learning. The sports education model has been proven to improve the psychomotor domain through students' playing skills through exercises and sports competitions in physical education learning (9–11). Furthermore, the Sport Education Model has also been proven to improve students' cognitive domains, such as knowing the rules of the game, scoring scores, and roles as players, coaches, referees, and others (12,13). In addition, through the sports education model, students highlight a good attitude, such as respecting each other and taking responsibility for the role they get (14,15).

CONCLUSION

Based on the results of the study, it can be concluded that (1) the hybridization model of Teaching Personal, Social, Responsibility, and Sport Education has a significant and effective influence in improving the affective

domain (responsibility and respect), psychomotor domain (football, volleyball, and basketball playing skills), cognitive domain (knowledge of the characteristics of football, volleyball, and basketball) students (2). The experimental group is better than the control group in every physical education learning in school. That way, the model is feasible and recommended for use in every physical education learning in schools.

APPLICABLE REMARKS

- The hybridization model of Teaching Personal, Social, Responsibility, and Sport Education is one of the learning models used to develop students' affective domain (responsibility and respect), psychomotor domain (football, volleyball, and basketball playing skills), cognitive domain (knowledge of football, volleyball, and basketball characteristics).

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AUTHORS' CONTRIBUTIONS

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The authors mention no "Conflict of Interest" in this study.

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This research has met the standards of research ethics and has received approval to be a sample of all respondents.

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Table 1. Test Results Independent t Test Analysis

Variable	Average	t count	t table	P
Responsibility				
Pretest Experimental Group	75,7	12.190	2.028	0.000
Posttest Experimental Group	91,8			
Pretest Control Group	70,4	3.238	2.028	0.001
Posttest Control Group	75,0			
Rasa Hormat				
Pretest Experimental Group	72,1	10.156	2.028	0.000
Posttest Experimental Group	84,5			
Pretest Control Group	69,6	4.093	2.028	0.001
Posttest Control Group	73,1			
Keterampilan bermain				
Pretest Experimental Group	23,0	14.677	2.028	0.000
Posttest Experimental Group	31,0			
Pretest Control Group	24,5	2.600	2.028	0.003
Posttest Control Group	26,9			
Pengetahuan Permainan Bola besar				
Pretest Experimental Group	33,2	9.158	2.028	0.000
Posttest Experimental Group	42,8			
Pretest Control Group	34,4	3.870	2.028	0.001
Posttest Control Group	37,6			

Early Childhood Gross Motor Improvement: Through Demonstration and Conventional Learning Methods

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ABSTRACT

Background. Physical growth has a significant influence on children's motor skills development. **Objectives.** This research aims to analyze (1) the influence of learning methods on the improvement of early childhood gross motor skills and (2) the difference in the influence of demonstration and conventional learning methods on the improvement of early childhood gross motor skills. **Methods.** This type of research is an experiment with two groups: pre-test and post-test. The sample in this study is 20 early childhoods. Gross motor instruments were tested consisting of: (1) a test of walking on a straight line of 5 meters, (2) a test of running to avoid five obstacles as far as 15 meters, (3) a test of standing on one foot for 10 seconds, (4) a test of jumping from a 15 cm high beam, (5) a test of jumping from a 15 cm high beam. **Results.** The research results prove that: 1) There is a significant influence of learning methods on early childhood gross motor skills by obtaining a significance value of less than 0.05 ($p < 0.05$). 2) There was a difference in the influence of demonstration and conventional learning methods on improving early childhood gross motor skills. It was tested that the average score of the gross motor post-test in the demonstration learning method group was 12.2. On the contrary, the average score in the conventional learning method group was 7.8, with an average difference in the post-test. **Conclusions.** With this, it can be concluded that the group given the treatment of the demonstration learning method has a more significant influence than the group of conventional learning methods.

KEYWORDS: *Demonstration, Conventional, Gross Motor*

INTRODUCTION

Physical education positively impacts student's physical organization and mental, intellectual, emotional, and social development. Physical education uses physical movement activities as a means of education (1,2) The physical activity in question is the activity of large muscles, not the activity of fine muscles only. Motion cannot be separated from students because, with movement, students meet the need to move. Meeting this need is significant because movement is the only stimulus for students' physical growth.

Physical growth has a significant influence on children's motor skills. The motor is the development of controlling body movements through coordinated activities between the arrangement of nerves, muscles, brain, and spinal cord (3,4). The motor physique is divided into two parts: the fine and gross motor (5,6). Early Childhood Education shows a rapid development that needs to be observed and fostered to clarify the future direction.

Based on the results of observations in June 2024 with kindergarten teachers, Dharma Yoga Santi explained that children's gross motor skills are still relatively low. This is proven when initial data collection obtained a gross motor score of 4, which was considered lacking. The researchers observed that improper learning

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methods caused the lack of early childhood gross motor skills training. The ongoing learning process here is still centered on the teacher; during the teaching and learning process, the teacher is the one who talks a lot and conveys information. This means that the methods used have not varied, and almost all learning activities are controlled by teachers.

The description above shows that a teacher is required to be highly professional. Because a teacher is the foundation of the success or failure of a teaching and learning process and will subsequently produce the output of a good and quality education (7,8), it is inevitable that the more qualified the teacher is, the better it is for the development of his students and society. Therefore, an active, innovative, creative, effective, and fun learning model is needed to overcome learning difficulties experienced by students. The ability of teachers to choose and use the proper teaching method is a demand for teachers' professional skills so that the teaching and learning activities carried out can be maximally successful, one of which is by using the demonstration method. The demonstration learning method is a teaching method that demonstrates objects, events, rules, and the order of carrying out activities, either directly or through teaching methods that are relevant to the subject or material being presented (8,9). Based on the problems described, this study aims to analyze the difference in the influence of conventional demonstration and learning methods on children's gross motor skills.

MATERIALS AND METHODS

This research method uses a quantitative and quasi-experimental approach through a two-group pre-test and post-test design. The population in this research is all PRA children of Dharma Yoga Santi Kindergarten, totaling 38 children. The sample in this study is 20 children, and it was taken using purposive sampling criteria. Then, it was divided into two groups. Ten children were given demonstration learning methods, and 10 were given conventional ones. The process of collecting information in this research is test and measurement. The instrument used to measure the child's gross motor skills is a test consisting of (1) a test of walking on a straight line of 5 meters, (2) a test of running, avoiding five obstacles of 15 meters, (3) a test of standing on one foot for 10 seconds, (4) a test of jumping from a 15 cm high block, (5) a test of jumping from a 15 cm high block. The overall validity of the early childhood gross motor test is 0.779, and the reliability of the early childhood test is 0.888 (10). This is a reasonably high category. After that, the treatment of demonstration and conventional learning methods was distributed 3 times a week for 4 weeks. The data analysis method used in this study is using a paired sample t-test with SPSS 24.

RESULTS

Based on the results of the analysis of the Paired Sample test of gross motor data, a significance value of 0.000 was obtained less than 0.05 ($p < 0.05$); it can be concluded that there is a significant difference in gross motor skills during the pre-test and post-test in the demonstration learning group. This means there is a significant increase in gross motor skills before and after the treatment.

Based on the results of the analysis of the data of the Paired Sample t-test scale, a significance value of 0.157 was obtained greater than 0.05 ($p > 0.05$), so it can be concluded that there was no significant difference in the gross motor during the pre-test and post-test in the conventional learning group of children.

DISCUSSION

Based on hypothesis testing, it is known that there is a significant difference in the influence of demonstration and conventional learning methods on the improvement of gross motor skills in early childhood. The demonstration learning method group was higher (good) than the traditional group in improving gross motor skills. These results are in accordance with the research (11), which states that the demonstrative learning model significantly influences students' psychomotor ability. This is supported by previous research by (12), who said that the demonstrative learning model significantly affects students' fundamental motor skills. The democratic learning model improves students' motor skills because when carrying out the demonstration learning model, students can hone their psychomotor skills and actively carry out learning activities. This is supported by research (13). Proving that a demonstrative learning model can help students practice gymnastics movements in penjas.

According to (14,15), the demonstration method is an excellent learning model for students to develop basic motor skills, cognition, and learning outcomes. Motor development plays a role in supporting students' skills in various ways. The demonstration learning model can be used to help students develop motor skills.

CONCLUSION

This study concludes that demonstration and conventional learning methods influence early childhood gross

motor skills. The group given the demonstration learning method had better gross motor skills than the children given the conventional learning method. Based on these results, it is recommended that teachers or teaching staff apply demonstration learning methods for early childhood to improve children's gross motor skills.

APPLICABLE REMARKS

- The demonstrative model is one of the learning models that can be used to develop gross motor skills in early childhood.

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CONFLICT OF INTEREST

The authors mention no "Conflict of Interest" in this study.

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This research has met the standards of research ethics and has received approval to be a sample of all respondents.

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Table 1. Results of the Paired Sample t test of the demonstration learning group

Data	Group	Mean	t count	p	Information
Gross Motor	Pre test	7,8	3,960	0,000	Significant
	Post test	12,2			

Table 2. Results of Paired Sample t test conventional learning group

Data	Group	Mean	t count	P	Information
Gross Motor	Pre test	7,2	1,650	0,157	Significant
	Post test	7,8			

Plyometric Training on Strength and Agility of Badminton Athletes: A Systematic Review

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ABSTRACT

Background. Systematic observation is essential to gain a more comprehensive understanding of the impact of this plyometric training on badminton athletes. **Objectives.** The purpose of this study was to conduct a systematic reflection on the effectiveness of plyometric training in increasing the strength and agility of badminton athletes. **Methods.** This study used a systematic observation design by collecting data from relevant research articles through primary data such as PubMed, Google Scholar, and others. This review found that plyometric training significantly improved badminton athletes' muscular strength and agility. **Results.** Most studies showed significant improvements in vertical strength testing and reaction speed after a plyometric training program. Variations in response to training were also observed, depending on factors such as training intensity and athlete skill level. Plyometric training has significantly enhanced badminton athletes' strength and agility. **Conclusions.** These findings provide a solid foundation for coaches and practitioners to incorporate plyometric exercises into their badminton training programs. Furthermore, this study suggests the need for further research to explore additional factors that could influence training outcomes.

KEYWORDS: *Plyometric, Training Program, Badminton, Strength, Agility*

INTRODUCTION

Strength and agility are two crucial components in the performance of badminton athletes. Badminton games involve fast and explosive movements such as jumps, short runs, and changes of direction that require good muscle explosiveness as well as the ability to move quickly and efficiently in the muscle field, especially in the neck muscles, allowing athletes to achieve more optimal height and reach when performing overhead shots. In contrast, agility will enable them to adjust body position quickly and effectively in response to an opponent's attack. According to (1,2), strength and agility are core elements in developing successful badminton game performance.

Plyometric training is one of the most effective methods for improving strength and agility in various sports. The plyometric exercise combines eccentric (muscle lengthening) and concentric (muscle shortening) muscle contractions to produce considerable explosive power, usually in jumps, bounce movements, and other exercises that focus on increasing explosivity. Studies by (Shedge et al., 2024) state that plyometric training significantly increases strength and agility in athletes, making this method increasingly popular among badminton coaches.

In addition, in badminton, plyometric training can increase athletes' resilience in the face of stressful and fast game dynamics. A literature review by (3) revealed that plyometric training increases explosive power and improves

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overall body biomechanical performance, such as coordination and speed of movement. This is especially relevant in badminton, where any efficient movement can reduce the risk of injury due to sudden movements.

However, despite the proven effectiveness of plyometric training in various sports, there are still significant research gaps that urgently need to be addressed, particularly in the context of badminton. Numerous studies have underscored that the response to plyometric training can be variable, contingent on the intensity, duration, and type of training administered. Therefore, systematic observations are imperative to gain a more comprehensive understanding of the impact of this training on badminton athletes. As (4) As the article points out, age, fitness level, and physical condition can also influence the effectiveness of plyometric training, making this a compelling area for further exploration in the literature review.

This study aims to systematically examine the effect of training on the strength and agility of badminton athletes. By considering various factors affecting training results and collecting and analyzing relevant literature, we hope to provide a comprehensive understanding of the benefits of plyometric training for badminton athletes. More importantly, this study will provide practical guidelines for coaches in designing more effective and safe training programs, thereby enhancing their athletes' performance.

MATERIALS AND METHODS

Research Design. The research design in this systematic review follows the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines. This study employed a rigorous and systematic approach to collect and synthesize evidence from various studies relevant to Plyometric training on the Strength and Agility of Badminton Athletes. Inclusion criteria included experimental and observational studies that addressed the effect of plyometric training on the Strength and Agility of Badminton Athletes. Data analysis procedures involved data collection from the selected studies, qualitative and/or quantitative analysis depending on the characteristics of the included studies, and synthesis of findings tailored to the research objectives.

Study Selection Process. Searches were conducted through credible databases such as PubMed, Scopus, and Web of Science using relevant keywords such as "Plyometric," "badminton," "training program," and the like.

Data Analysis. The authors used PRISMA or the Cochrane Risk of Bias Tool to improve the quality of the included studies. With the right analytical approach, valid and meaningful findings on the effectiveness of plyometric training are expected.

RESULTS

A total of 450 studies were analyzed in this systematic review. A rigorous study selection process was conducted based on the pre-defined inclusion criteria to ensure the accuracy and precision of the results. A thorough literature search was conducted through various databases related to teaching games for understanding, badminton, and physical education, using relevant keywords to obtain a comprehensive range of literature. After eliminating duplicates and applying the inclusion criteria, 31 studies were eligible for inclusion in the analysis. This presentation of the number of studies analyzed provides context for the depth and breadth of empirical evidence considered in this systematic review and demonstrates the diversity of literature sources used to support the findings and conclusions.

The results of these studies provide a clear picture of the methodology and population involved in the analysis regarding the effect of plyometric training on the performance of badminton athletes.

DISCUSSION

Plyometric exercises have proven to improve athletes' strength and agility, especially in sports that require quick movements and precise reactions, such as badminton. Based on the results of the following systematic observations, it was found that plyometric training can improve athlete performance in various aspects. Research by (10) demonstrated that plyometric training increases explosive power, a key component in dynamic and fast-paced sports, including badminton. According to (3,11), The effectiveness of plyometric training can vary greatly depending on the athlete's experience and age, thus requiring a customized training program. In addition, a study by (12) also affirms that increased muscle strength can contribute to increased agility. However, the effectiveness of plyometric training depends not only on the type of exercise performed but also on factors such as the intensity and frequency of the exercise. As expressed by (13), Higher plyometric training frequencies can provide better results in increased strength and agility. Therefore, coaches should design a training program that considers these factors to maximize the desired results. Other research by (14,15) emphasizes that the duration and intensity of training also play an essential role in achieving performance improvement.

This study suggests that plyometric exercises can effectively improve strength and agility in badminton athletes. However, to achieve optimal results, coaches must consider various factors, including the proper design of the training program and the individual characteristics of the athlete. Further research is needed to

explore the effectiveness of this method in the broader context of the sport of badminton and to develop practical guidelines for coaches and athletes.

CONCLUSION

This systematic review reveals that plyometric training significantly improves the strength and agility of badminton athletes. Various studies show that plyometric training can increase muscle strength, especially in the muscles most frequently used in badminton games, such as leg and core muscles. In addition, the results showed increased agility, which is essential for making quick and responsive movements on the court. These improvements impact individual performance and contribute to a competitive advantage in matches. Recommendations for future research include further exploration of factors that influence the effectiveness of plyometric training, such as age, gender, and skill level of athletes. Longitudinal studies involving more participants with diverse backgrounds are also needed to gain a deeper understanding of the long-term impact of these exercises. Thus, it is hoped that future research can refine the training program to meet the specific needs of badminton athletes.

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APPLICABLE REMARKS

- Increased muscle strength and agility in badminton can be done with programmatic plyometric exercises.

AUTHORS' CONTRIBUTIONS

Concept and design of the study: Ardhika Falaahudin. Data acquisition: Suharjana. Data analysis and interpretation: Sumarjo. Compiled the script: Padli. Critical revision of the manuscript for important intellectual content: Rezha Arzhan Hidayat. Statistical analysis: Muhamad Ichsan Sabillah. Administrative, technical, and material support: Ardhika Falaahudin. Study supervisor: Muhamad Ichsan Sabillah.

CONFLICT OF INTEREST

The authors mention no "Conflict of Interest" in this study.

ETHICAL CONSIDERATION

This is a systematic review of research, so the implementation does not involve humans directly.

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FINANCIAL DISCLOSURE

The authors have no financial interests related to the material in the manuscript.

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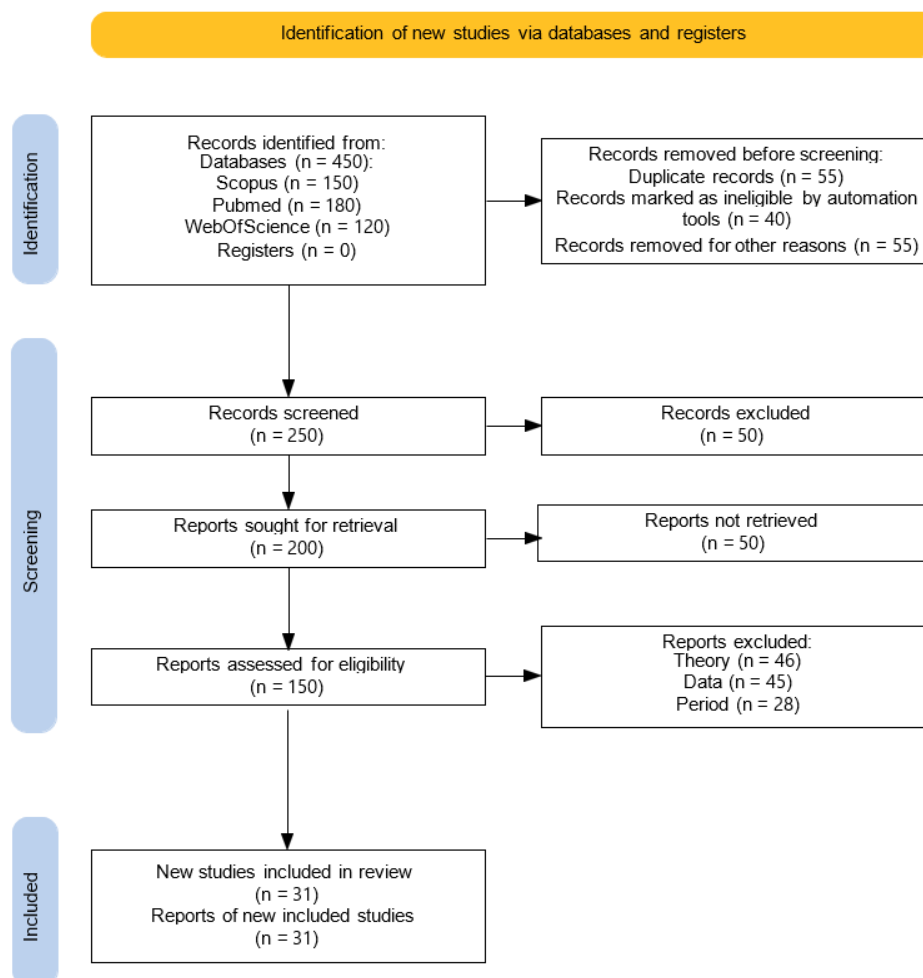


Figure. 1. Selection process using PRISMA guidelines

Table 1. Inclusion and Exclusion Criteria.

Inclusion Criteria	Exclusion Criteria
Experimental, observational, and meta-analysis studies	Studies that do not have a clear research design
Badminton athletes, both beginner and professional level	Studies that did not include badminton athletes
Structurally applied plyometric exercises	Exercises that were not plyometric related or not measured
Studies describing strength and agility measurements	Studies that did not report strength or agility measurements
Studies published in English or a language the authors can understand	Studies in a language that the authors could not understand
Studies published within the last 10 years	Studies that were published outside the specified timeframe

Table 2. Key Findings from Systematic Review

Findings	Explanation	One of the supporting Journals of Systematic Review
Increased Muscle Strength	Plyometric exercises significantly increase muscle strength, especially in the muscles used in the specific movements of badminton.	(5,6)
Increased Rarity	Athletes who participated in a plyometric training program showed significant improvements in reaction time and the ability to move quickly.	(7)
Variability of Response to Exercise	The response to plyometric training varies based on factors such as skill level and age of the athlete, which requires adjustments in the training program.	(8)
The Impact of Different Types of Plyometric Exercises	The combination of different types of plyometric exercises, such as vertical and horizontal, has a different impact on athlete performance, maximizing gains in strength and agility.	(9)

Improving Volleyball Athlete's Arm Muscle Power: Through Medicine Ball Throw and Bench Press Exercises

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ABSTRACT

Background. Explosiveness in volleyball smash skills is crucial because maximum power is needed when making a smash shot, and the arm muscles are maximized. **Objectives.** This study aims to analyze (1) the effect of medicine ball throw and bench press exercises on increasing the arm muscle power of volleyball athletes and (2) the difference in the effect of medicine ball throw and bench press exercises on the increase of arm muscle power of volleyball athletes. **Methods.** This type of research is an experiment with one group pre-test and post-test design. The sample in this study amounted to 80 athletes who were taken using random sampling techniques. The instrument used measures the arm muscles' power, namely the test medicine ball put. **Results.** The study's results showed that: 1) medicine ball throw training and bench press training significantly increased arm muscle power with a significance value of less than 0.05 ($p < 0.05$). 2) There was a significant difference in the influence between the group given medicine ball slam training and bench press training on increased arm muscle power. It was proven that the average value of arm muscle power in the group of athletes who were given medicine ball throw training was 6.80, while the average value of arm muscle power in the bench press exercise group was 2.70 with an average difference of 4.10 post-test. **Conclusions.** The volleyball athletes given medicine ball throw training had better arm muscle power than the bench press training group.

KEYWORDS: *Medicine Ball Throw, Bench Press, Volleyball, Arm Muscle Power*

INTRODUCTION

An important part that volleyball athletes must have when facing a tournament is maximum physical quality (1,2). A volleyball athlete must have optimal physical skills to improve performance in a match. The physical components needed in volleyball include arm muscle power, leg muscle power, hand muscle strength, muscle endurance, hand-eye coordination, and agility (3). In volleyball, one of the most needed aspects of the physical component is the power of the arm muscles in order to be able to smash optimally (4,5).

Based on previous literature (6) shows that physical ability, primarily arm muscle power in volleyball athletes, is still relatively low. The physical exercise program to train arm muscle power has been poorly organized. Other research (7) also revealed that the top passing ability in volleyball is still relatively lacking.

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This is due to the lack of innovative physical exercises, so the exercises provided are not under the needs of physical components, especially the power of the arm muscles in volleyball. To make a perfect smash or pass, volleyball players must have excellent arm muscle power.

However, the reality is that the power ability of the arm muscles is still not optimal in volleyball athletes in Sleman Regency. Based on the results of observations made by researchers on June 11, 2024, at a volleyball sports club with volleyball coaches, it was revealed that volleyball athletes' arm muscle power ability is still lacking. This is because exercises to increase arm muscle power are not effective and are still not on target according to the characteristics of volleyball. Other factors that affect the low power ability of volleyball athletes' arm muscles include: 1) The smash hit that is done is not strong so that it is easy to receive and return by the opposing player, 2) Every smash of the ball often involves the net, and 3) Smashes made by students often go out of the court or are not on target.

Based on the results of the previous literature, there have been several physical exercise methods to increase arm muscle power. Some exercises to maximize arm muscle power are medicine ball throws and bench press exercises. Medicine Ball is a form of plyometrics exercise that aims to increase muscle power (8,9). In addition, bench press exercises are one of weight exercises that train the upper body and aim to stimulate the chest and arms (10).

Explosiveness in volleyball smash skills is very important because maximum power is needed when making a smash shot, and the arm muscles are maximized (11,12). Based on the problems raised previously, the researcher aims to analyze the effectiveness of medicine ball throw and bench press exercises on increasing the arm muscle power of volleyball athletes.

MATERIALS AND METHODS

This study uses quasi-experimental research with a pre-test design and a post-test two-group design. The population in this study is all volleyball athletes in Sleman Regency, totaling 100 people. The sample in this study is 80 volleyball athletes taken using random sampling techniques. The subjects were divided into two groups: a group of athletes who were given medicine ball throw training for as many as 40 people and a group of volleyball athletes who were given bench press training for as many as 40 people. The data collection technique in this study is test and measurement. The instrument used to measure arm muscle power is the medicine ball. After that, they were given treatment or practiced as many as 18 meetings with a frequency of 3 times a week. Moreover, it ends with taking the final test score or post-test to measure the power of the arm muscles after the treatment. The data analysis technique used in this study using SPSS 24 is a paired sample t-test.

RESULTS

Based on the results of the analysis of the Paired Sample t-test for arm muscle power data, a significance value of 0.002 was obtained less than 0.05 ($p < 0.05$), so it can be concluded that there is a significant difference in arm muscle power during the pre-test and post-test in the medicine ball throw group. This means there is a significant increase in arm muscle power before and after treatment.

Based on the results of the analysis of the Paired Sample t-test in arm muscle power data, a significance value of 0.045 was obtained less than 0.05 ($p < 0.05$), so it can be concluded that there is a significant difference in arm muscle power during the pre-test and post-test in the bench press exercise group.

DISCUSSION

Based on hypothesis testing, it is known that there is a difference in the effect of medicine ball throw and bench press exercises on increasing the arm muscle power of volleyball athletes. Medicine ball throw exercise is a more effective training method to develop physical component variables, including arm muscle power. These findings align with several previous studies (12) that found that the Medicine Ball Throw exercise can improve the ability of the power component of the arm muscles with a large population. These findings are consistent with some previous evidence (13) explaining that the Medicine Ball Throw practice for 6 weeks with a frequency of 3 times A week is an effective method to increase the muscle power of athletes. Increased muscle power may be due to the intensity of exercise.

CONCLUSION

The conclusions of this study were: a) there was a significant increase between medicine ball throw and bench press exercises on the increase in arm muscle power before and after treatment, b) the group of athletes who were given the treatment of medicine ball throw exercise had better arm muscle power compared to the group of volleyball athletes who were given bench press exercises.

APPLICABLE REMARKS

- Athletes can be trained Through Medicine Ball Throw and Bench Press Exercises to develop arm muscle strength in volleyball.

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AUTHORS' CONTRIBUTIONS

Concept and design of the study: Thadius Yambedoan. Data acquisition: Bernadeta Suhartini. Data analysis and interpretation: Padli. Compiled the script: Muhamad Ichsan Sabillah. Critical revision of the manuscript for important intellectual content: Cerika Rismayanthi. Statistical analysis: Afif Khoirul Hidayat. Administrative, technical, and material support: Anas Ardiansyah. Study supervisor: Thadius Yambedoan.

CONFLICT OF INTEREST

The authors mention no "Conflict of Interest" in this study.

ETHICAL CONSIDERATION

This research has met the standards of research ethics and has received approval to be a sample of all respondents.

FUNDING/SUPPORT

No institution, organization, or person supported this study. **ROLE OF THE SPONSOR** The funding organizations are public institutions and have no role in the design and conduct of the study, collection, management, and analysis of the data or preparation, review, and approval of the manuscript.

FINANCIAL DISCLOSURE

The authors have no financial interests related to the material in the manuscript.

ARTIFICIAL INTELLIGENCE (AI)

USE There was NO use of artificial intelligence (AI) for preparation, writing, or editing this manuscript.

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Table 1. Results of Paired Sample T Test Medicine Ball thro Exercise Groupw

Data	Group	Mean	t count	p	Information
Power arm muscles	Pre-test	2,50	8,887	0,002	Significant
	Post-test	6,80			

Table 2. Results of Paired Sample t-Test Bench Press Training Group

Data	Group	Mean	t count	P	Information
Power arm muscles	Pre-test	1,30	0,759	0,045	Signifikan
	Post-test	2,70			

The Effect of Dryland Training Using the Circuit Training Method on 50-Meter Breaststroke Swimming Speed in Padang City Swimmers

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ABSTRACT

Background. Addressing the need for adequate training methods to boost swimmer performance, the research focuses on enhancing speed and movement efficiency. **Objectives.** This study evaluates the impact of circuit-based strength training on the 50-meter breaststroke speed of athletes in Padang City. **Methods.** Twenty-five athletes aged 13-14 were selected through purposive sampling, ensuring consistency in developmental stages. These athletes engaged in a Dryland training program, employing circuit training to strengthen muscles critical for swimming, improving stroke techniques and propulsion. Swimming speed was measured before (pre-test) and after (post-test) the training intervention. Paired t-tests were applied to assess speed changes, revealing a significant improvement. **Results.** The t-value was 22.962, surpassing the critical value of 2.797 at a 0.000 significance level. The average time dropped from 41.21 seconds in the pre-test to 36.98 seconds in the post-test, indicating an effective increase in speed. This supports the utility of Dryland circuit training in enhancing young swimmers' performance, particularly for competitive preparation. **Conclusions.** The findings provide insights into structured training approaches that enhance swimmers' athletic capacity, helping them achieve more incredible speed and efficiency essential for higher-level.

KEYWORDS: *Dryland Training; Circuit Training; Swimming Speed; Strength Training, Athletic Performance, Breaststroke*

INTRODUCTION

Sports have been an essential aspect of human life, evolving from primitive activities for survival, like swimming and hunting, to modern competitive and fitness-oriented practices (1,2). This transformation has been driven by advancements in science and technology, which have influenced various dimensions of sports, including economic, social, and performance aspects(3). Through Law No. 11 of 2022 on Sports, Indonesia highlights the role of competitive sports in enhancing athletes' abilities to raise national dignity (4,5).

Swimming, a prominent sport in Indonesia, holds significance at local, national, and international levels. The breaststroke, known for its technical precision, demands strength and agility, with speed often measured by the time taken to complete 50 meters(6). Supervised by skilled coaches, practical training is vital to refine techniques and boost performance(7). In Padang City, swimming has flourished, producing talented athletes through clubs like Tirta Kaluang and Women SC. However, challenges such as limited facilities and inadequate training programs persist.

Dryland training, conducted off-water, is increasingly utilized to enhance swimmers' physical performance. Circuit training, a popular method, involves exercises at multiple stations designed to build endurance, strength, and speed(8). These exercises are tailored with specific durations and rest intervals to optimize

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performance. In Padang, addressing issues like poor physical conditioning and a lack of motivation is crucial to unlocking athletes' potential (9,10).

This study investigates the effectiveness of dryland circuit training in improving 50-meter breaststroke swimming speed among Padang City swimmers. The findings are expected to offer practical solutions for optimizing training programs, emphasizing physical conditioning alongside technical and tactical preparation, to improve athlete performance and competitiveness.

MATERIALS AND METHODS

This study used a quasi-experimental method to evaluate the effect of strength training with the circuit training method on the 50-meter breaststroke swimming speed of athletes in Padang City. The research sample consisted of 25 athletes, selected using purposive sampling to ensure participants were appropriate for the study's objectives. All participants were active competitive swimmers between 13-14 years old and were members of swimming clubs in Padang City. The study took place at the indoor swimming pool of Universitas Negeri Padang from May to July 2024, under approval from the institution's ethical review board.

Data were collected by recording each athlete's time during the pre-test and post-test sessions. Statistical analysis was conducted using a paired t-test to determine the significance of changes in swimming speed before and after the intervention. The paired t-test was chosen as it is suitable for comparing two related samples, ensuring the analysis accurately reflected changes within the same group of participants. The t-value obtained was compared to the critical t-table value at a significance level of 0.05 to establish if there was a significant improvement. Statistical analyses were performed using SPSS software, providing a comprehensive assessment of the training program's impact on swimming performance.

RESULTS

The Kolmogorov-Smirnov Test results in Table 5 show that the pre-test and post-test data for 50-meter breaststroke swimming speed among Padang City swimmers follow a normal distribution. The pre-test mean is 482.020 with a standard deviation of 245.368, and the post-test mean is 469.280 with a standard deviation of 275.564. The "Most Extreme Differences" values are 0.322 for the pre-test and 0.165 for the post-test, with test statistics matching these values. The asymptotic significance values are 0.197 for the pre-test and 0.200 for the post-test, both greater than 0.05, confirming normality at a 95% confidence level. These results validate the use of parametric statistical analysis for further evaluation.

The paired samples t-test results in Table 6 indicate a statistically significant improvement in the 50-meter breaststroke swimming speed of Padang City swimmers after the training program. The mean difference between pre-test and post-test results was 127.400, with a standard deviation of 143.206 and a 95% confidence interval ranging from 0.52897 to 307.697. The t-value was 2.797 with 24 degrees of freedom, and the significance level (Sig. 2-tailed) was 0.000, less than 0.05. These findings confirm that the training program had a significant positive impact on the athletes' performance.

DISCUSSION

This study highlights the effectiveness of Dryland circuit training in improving 50-meter breaststroke swimming speed among swimmers in Padang City. Analyzing pre-test and post-test results showed a significant improvement, with many athletes achieving "Very Fast" and "Fast" times. This land-based training method is practical for coaches, especially with limited pool access, offering a viable alternative to traditional water-based training(11).

Circuit training combines sequential exercises with minimal rest, targeting cardiovascular endurance and muscular strength(12). While swimming traditionally develops in-water skills, Dryland training focuses on strengthening specific muscle groups critical for swimming, like the core, legs, and arms, without water resistance constraints(13). Research confirms that such training enhances strength and endurance, improving swimming performance when integrated correctly(13).

Breaststroke requires a balance of power and agility, emphasizing leg and core strength for synchronized arm-leg movements and efficient glides. Targeted Dryland training improves these muscle groups, as evidenced by decreased completion times post-training, supporting its effectiveness(14). Moreover, this approach aligns with findings that cross-training enhances performance in various sports(15).

An observed variability in post-test results suggests individual differences in adaptation, influenced by factors like fitness levels or genetics. This underscores the importance of tailoring training intensity to individual capacities for optimized outcomes. Additionally, combining Dryland and water-based training fosters well-rounded development, especially during off-seasons or pool closures.

This study suggests that Dryland circuit training complements traditional swimming practices, improving

key attributes like strength and endurance. It also provides insights for future research, such as exploring psychological factors or their effects on other strokes. By incorporating structured Dryland exercises, coaches can enhance performance, reduce injury risks, and address resource limitations, contributing to the growing innovation in competitive swimming training.

CONCLUSIONS

This study confirms that Dryland circuit training effectively enhances the 50-meter breaststroke speed of young athletes in Padang City, significantly improving speed and movement efficiency. These findings provide a practical training method that can benefit coaches, athletes, and sports organizations by offering an effective alternative to traditional water-based training. This research contributes to sports science by validating a structured, land-based approach that can improve competitive readiness and overall performance in swimming.

APPLICABLE REMARKS

- This study demonstrates the effectiveness of Dryland circuit training in enhancing the swimming speed of young athletes, particularly for the 50-meter breaststroke.
- The significant improvement in performance highlights the importance of integrating strength and conditioning exercises into training regimens.
- Coaches can use this approach to complement water-based sessions, especially during off-season periods or when pool access is limited.
- This research supports using structured land-based training programs to improve both technique and overall athletic performance in swimming.

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AUTHORS' CONTRIBUTIONS

Argantos developed the research concept and design. Data acquisition was conducted, and Jannatul Khairoh performed the statistical analysis and interpretation of data: manuscript drafting and critical revision for important intellectual content by Tri Irfa Indrayani.

CONFLICT OF INTEREST

The authors mention no "Conflict of Interest" in this study.

ETHICAL CONSIDERATION

This research has met the standards of research ethics and has received approval to be a sample of all respondents.

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ARTIFICIAL INTELLIGENCE (AI)

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Table 1. Normality Test Results

One-Sample Kolmogorov-Smirnov Test			
		Pre Test	Post Test
	N	25	25
Normal Parameters ^b	Mean	482.020	469.280
	Std. Deviation	245.368	275.564
Most Extreme Differences	Absolute	.322	.165
	Positive	.241	.165
	Negative	-.322	-.137
Test Statistic		.322	.165
Asymp. Sig. (2-tailed)		.197 ^c	.200 ^{c,d}
a. Test distribution is Normal.			
b. Calculated from data.			
c. Lilliefors Significance Correction.			
d. This is a lower bound of the true significance.			

Table 2. Hypothesis Testing Results

Paired Differences							
Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference		t	df	Sig. (2-tailed)
			Lower	Upper			
127.400	143.206	.64938	.52897	307.697	2.797	24	.000

Badminton Learning Media Innovation Based on Virtual Reality to Improve Physical Education Student Learning Outcomes

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ABSTRACT

Background. The integration of advanced technologies, such as Artificial Intelligence (AI) and Virtual Reality (VR), into educational media is crucial in modernizing the learning process, particularly in Physical Education (PE) courses. In the context of badminton, there is a need for innovative learning media that combines both practical and theoretical aspects, providing an engaging, interactive experience for students in the 21st century. **Objectives.** This study aims to develop android-based interactive learning media utilizing AI and VR technologies to enhance the teaching and learning process for badminton courses in the Physical Education Study Programme at a university in Bengkulu. **Methods.** The research follows the Research and Development (R&D) method, specifically the 4D model, which includes four stages: defining, designing, developing, and disseminating. Data was collected through questionnaires and tests distributed to material experts, media experts, and students. The developed learning media was tested on students enrolled in the badminton course, and their responses were used to assess its feasibility and effectiveness. **Results.** The combined validation from material experts, media experts, and user assessments yielded a total score of 138.5, with an average score of 4.1. This indicates that the AI-based VR learning media for badminton is categorized as "feasible" for learning activities. **Conclusion.** The android-based interactive learning media, incorporating AI and VR technologies, is considered practical and feasible for badminton courses. The innovation provides a useful and engaging approach to learning, aligning with the needs of 21st-century education in physical education.

KEYWORDS: *Badminton Learning, Innovation, Physical Education, Virtual Reality*

INTRODUCTION

The techniques used in playing badminton are grip techniques, body position, basic strokes, service strokes, foot movements, strategies, and tactics (1). In this era, innovation is essential for managing practical and theoretical learning. (2–7). Badminton is closely tied to its practical aspects, but it also requires theoretical support to enhance the quality of learning outcomes in the subjects being taught. The learning materials offered should not only aim to improve the quality of education but will also be more effective if they are relevant and accessible to students. Learners today belong to Generation Z, having grown up in a rapidly evolving digital world, making them highly proficient in technology. The close relationship between learners and technological devices, like gadgets, prompts educators to explore educational opportunities, such as creating learning materials that utilize Artificial Intelligence applications. (8). Classroom teaching and learning interactions are closely influenced by the media teachers use to

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present instructional materials. (9–11). The more engaging the media used and the more communicative the teacher's delivery, the greater the students' interest in participating in classroom lessons. Learning media offers numerous benefits, including sparking new desires and interests, boosting motivation, stimulating learning activities, and psychologically impacting students. (12–14).

MATERIALS AND METHODS

This research employs the Research & Development (R&D) method, specifically the 4D (four-D) model, which includes four main stages: defining, designing, developing, and disseminating (15). The study focuses on developing an Artificial Intelligence Virtual Reality (VR)-based learning media for badminton within the Physical Education Study Programme at the University level in Bengkulu, using a purposive sampling technique to select students enrolled in the Badminton course. Data collection involved questionnaires distributed to material experts, media experts, and students and objective and essay questions to assess student understanding. The research process began with the Defining stage, which involved preliminary analysis, student analysis, material analysis, task analysis, and specification of learning objectives.

RESULTS

The stage of testing Artificial Intelligence Virtual Reality (VR) learning media that media experts and material experts have validated is carried out on 3rd-semester class A students who take Badminton courses where the number is 34 students. Before being tested, researchers discussed Zoom and the procedures for using learning media. After that, the researcher sent a simulation link to make it easier for students to learn what this artificial intelligence virtual reality (VR) learning media operated like. Researchers also ask students to register via a Gmail account or any social media account to be connected to the application-assisted Artificial Intelligence Virtual Reality (VR) learning media. This is due to the limited time required to collect trial results. However, these 4 Artificial Intelligence Virtual Reality (VR) questions represent Badminton material. The four materials are 1) the History of the Badminton Game, 2) the basic techniques of the Badminton game, 3) the facilities and infrastructure of the Badminton game, and 4) the rules of the Badminton game. The following are the results of the trial use of Artificial Intelligence Virtual Reality (VR) Badminton learning media on students.

Table 1 describes the results of implementing trials on 32 students who took Badminton courses. Each material transformed into Artificial Intelligence Virtual Reality (VR) as a learning media consists of 20 questions of Artificial Intelligence Virtual Reality (VR). It can be seen that the material History of Badminton games obtained by students amounted to 81.44. The material presented in the learning media in the form of Artificial Intelligence Virtual Reality (VR) is material with a medium level of difficulty because this material is quite familiar to students. The existence of closeness and characteristics known by students makes this material have moderate difficulty. Of course, this has implications for the trial results obtained by students, namely the Worthy category.

DISCUSSION

Research shows that the development of artificial intelligence virtual reality (VR) Badminton learning media based on android-assisted applications is feasible to use as a learning medium in Badminton courses. This research and development adapts the learning model consisting of 4 main stages. However, based on the research objectives mentioned earlier, it should be underlined that the research that adapts the 4D model is only carried out up to the development stage. At that stage, there is only a product trial that material and media experts for students have validated. This research procedure consists of defining, designing, and developing stages. The defining stage is a stage carried out to analyze the needs related to users, namely lecturers who teach courses and also students who take Badminton courses. In addition to analyzing needs, this stage aims to determine the tendency to use learning media in the Physical Education Study Program literature courses. Data from this needs analysis is obtained from questionnaires from prospective users of Artificial Intelligence Virtual Reality (VR) learning media distributed using Google Forms. The results showed that it received a scale of 4.7 and 3.4 from an average interval of at least 3. This means developing learning media, such as artificial intelligence virtual reality (VR) based on Android, is feasible.

CONCLUSION

The conclusions that researchers can formulate from the development of badminton learning media based on artificial intelligence (VR) to improve the learning outcomes of physical education students are as follows: This research and development adapts the learning model consisting of 4 main stages. However, it should be underlined that the research that adapts the 4D model is only carried out up to the development stage. At that stage, there are only product trials that material and media experts for students have validated. This research procedure consists of the defining stage (define), the design stage (design), and the development stage

(develop). Overall, the total score obtained from the combined validation of material, media, and user experts is 138.5, or an average score of 4.1, which means that the Development of Badminton Learning Media Based on Artificial Intelligence Virtual Instructor System to Improve Learning Outcomes of Physical Education Students that researchers develop falls into the category worthy of use in learning activities.

APPLICABLE REMARKS

- Integrating AI and VR technology in badminton learning media represents a cutting-edge approach, providing students with an interactive and engaging platform for mastering physical education skills.

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AUTHORS' CONTRIBUTIONS

Study concept and design: Bogy Restu Ilahi. Acquisition of data: Septian Raibowo and Oddie Bananda Rizki. Analysis and interpretation of data: Fina Hiasa. Drafting the manuscript: Andika Prabowo. Critical revision of the manuscript for important intellectual content: Andes Permadi.

CONFLICT OF INTEREST

The authors mention no "Conflict of Interest" in this study.

CONFLICT OF INTEREST

The members participating in the meeting unanimously decided to use the Universitas Negeri Padang and Publication Ethics Directive as the "Ethics Committee Approval Document" for the research.

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ROLE OF THE SPONSOR

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FINANCIAL DISCLOSURE

The authors have no financial interests related to the material in the manuscript.

ARTIFICIAL INTELLIGENCE (AI) USE

There was NO use of artificial intelligence (AI) for preparation, writing, or editing this manuscript.

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Table 1. The results of the trial use of Artificial Intelligence Virtual Reality (VR) Badminton

Type of Material	Average Score	Assessment Aspect	Total Score	Average Score	Category
History of Badminton Game	81.44.00	Material Expert Assessment	64	04.06	Feasible
Badminton Development	83.02.00	Media Expert Assessment	23	03.08	Feasible
Badminton Game Techniques	79	User Assessment	51.05.00	04.29	Very Feasible
Badminton Game Tactics	76.01.00				
Average	79.89	TOTAL	138.05.00	04.01	Feasible

Prototype of Ball Launcher Sepaktakraw

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ABSTRACT

Background. In Sepaktakraw, the ball velocity during serves (75–80 km/h) makes defense challenging, highlighting the need for practical training tools. Current ball-throwing devices are often impractical, with poor design specifications that hinder their usability in training. **Objectives.** This study aims to develop and validate a ball launcher prototype capable of replicating real-match ball velocities for Sepaktakraw defense training. Additionally, it investigates the device's effectiveness in improving players' defensive skills compared to traditional methods. **Methods.** The research is conducted in three phases: 1) developing the ball launcher prototype using parametric modeling and real-world ball kinematics, 2) validating the prototype's speed using a 1,000 FPS camera and a speed gun, and 3) conducting an experimental study to assess the training effectiveness on athletes. **Results.** The prototype successfully generated ball velocities consistent with competitive play, and preliminary findings suggest it improves defensive performance. **Conclusion.** The ball launcher prototype effectively enhances Sepaktakraw defense training, offering practical advantages over traditional methods.

KEYWORDS: *Ball Launcher, Sepaktakraw, Defence Training, Training Effectiveness*

INTRODUCTION

Robotics has become an essential aspect of contemporary human life, with extensive applications across industry, healthcare, and entertainment sectors (1). Robots have supplanted numerous manual tasks in the manufacturing industry, enhancing production efficiency and precision (2–5). Similarly, in the healthcare sector, robots facilitate complex surgical procedures with high accuracy and assist in patient rehabilitation. Additionally, robots are utilized in the entertainment and household sectors for various functions, ranging from interactive toys to automated house cleaning. Advances in robotics technology are transforming our work and daily life practices, creating new opportunities for innovation and enhancing the quality of life (6–8).

The application of robotics has also expanded into the world of sports. In recent years, using robots in sports has become increasingly popular, with research and development being undertaken to integrate robots into various aspects of the sport. Previous studies have focused on developing robot-assisted sports training devices in football, table tennis, and badminton. Specifically, robot-assisted sports training devices are currently deployed to aid athletes during training sessions, furnishing precise feedback and enabling more rigorous and focused training regimes.

The development of ball launchers as robot-based training tools is currently experiencing notable advancement. Moreover, there is a growing demand for ball launchers, particularly in sports where heightened levels of speed and precision are essential. Integrating robots in sports enhances the development of athlete

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skills by replicating realistic competition scenarios.

MATERIAL & METHODS

The ball-launcher research and development model in this research was adopted from Borg and Gall, 1983. This research methodology is quite systematic, and there have been several tests and revisions in the research's progress. The research design explained that Study I and Study II will focus on research and development, then optimizing the ball launcher. The third study will conduct an experiment to be tested in two groups, with and without a ball launcher. Modeling of the ball launcher using Parametric Analysis will be conducted. This is to identify the forces acting on each part of the machine. This stage will involve several experts in Sepaktakraw, sports engineering, and electrical engineering, as well as academics and practitioners. The judgment carried out is to evaluate the performance of the ball launcher. In addition, it also aims to find out information regarding the feasibility of each component developed by researchers. In this experiment, the objectives include (1) finding out whether the ball-launcher can be appropriately applied and correctly by the trainer and (2) determining how effective the results of applying the model are in meeting the objectives of this study. Thus, a quantitative approach is used to find this effectiveness with a pre-experimental research design in a two-group pre-test-post-test design. The steps taken in this trial include (1) determining groups of research subjects, (2) carrying out a pre-test (O1), (3) dividing into two groups, (P1) doing the training process using a ball launcher while (P2) doing the training process without using a ball launcher (traditional method); (4) carry out post-test (O2); (5) find the average pre-test and post-test scores and compare between them whether there is a significant improvement or not.

RESULTS

The results of research on measurement data and kinematics in actual conditions show athletes can experience high-speed, consistent, and accurate ball throws, enhancing their training efficiency. The device's adjustable settings and automatic features allow for realistic practice scenarios, improving players' reactions and technique in various match conditions. Its portability and mobile control make it convenient and adaptable for different training environments.

From the explanation above, it can be concluded that the table outlines the specification features of a Sepaktakraw ball launcher, emphasizing automation, high-speed throwing (over 60 km/h), and portability (under 30 kg). and in-car portability (under 30 kg). This launcher uses a double spoon roller system with adjustable height and angle, powered by electricity. The launcher ensures accuracy and stability for training, supports mobile app control for angle settings, and offers a top-spin throw for realistic practice.

DISCUSSION

In the early stages of conducting research, the researcher conducts two activities during literature studies (literature review and previous research results). The literature study process consists of reviewing the literature, especially theories and conditions in the actual Sepaktakraw game, what happens in the game process, and what is needed to support the performance of Sepaktakraw, especially in the defensive quality of athletes. The literature review results will be used to support research studies in the field. This research aims to develop a ball launcher prototype with verified ball speed capabilities that align with the demands of real competitive Sepaktakraw matches. Our findings indicate that the prototype Sepaktakraw ball launcher we developed generally meets the performance criteria effectively, demonstrating high functionality and reliability. However, the experimental results reveal that the prototype does not fully achieve our models' theoretical ball launch speeds.

CONCLUSION

The conclusion of this study indicates that the developed ball launcher prototype exhibits variability in its capacity to generate ball velocities congruent with theoretical projections. Operating at 70% motor capacity minimizes the discrepancy between the anticipated and actual ball launch speeds, registering a 34.6 km/h difference. This suggests the ball launcher performs relatively accurately and consistently at this particular velocity threshold. Conversely, the most significant disparity between theoretical and actual launch velocities is observed at 100% motor capacity, with a 40.6 km/h discrepancy. This disparity suggests that ball launchers encounter challenges in sustaining precision and uniformity in launch velocities at maximal capacities. These observations underscore the necessity for additional refinements to the launcher's design and mechanisms to enhance its efficacy across varying motor speed capacities, intending to attain heightened accuracy across diverse training scenarios.

APPLICABLE REMARKS

- The study emphasizes the importance of refining the launcher's mechanisms to improve its accuracy and reliability across varying motor speeds, ensuring its adaptability for diverse training purposes.
- Despite current limitations, the prototype shows promise as a training tool, particularly at moderate speeds, with potential for broader applications following design optimizations.

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AUTHORS' CONTRIBUTIONS

Study concept and design: Burhan Basyiruddin. Acquisition of data: Shariman Ismadi. Analysis and interpretation of data: Mohad Anizu Mohd Nor. Drafting the manuscript: Johansyah Lubis and Hernawan. Critical manuscript revision for important intellectual content: Sukiri and Mochammad Azqilla Ahdalazim. Dadan Resmana.

CONFLICT OF INTEREST

The authors mention no "Conflict of Interest" in this study.

CONFLICT OF INTEREST

Universitas Negeri Padang and Publication Ethics Directive were unanimously decided by the members participating in the meeting to give this document as the "Ethics Committee Approval Document" for the research.

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Figure 1. Prototype of Ball Launcher Sepaktakraw

Table 1. Prototipe ball launcher sepaktakraw

Aspect	Specification
Performance	Using a Spon Roller system with automatic height adjustment, use horizontal (direction) and vertical (angle) shafts for throwing the ball according to the Sepaktakraw game aspect to every field corner.
Throw wheel	2 Spons Roller, diameter 15 cm, width 11.5 cm
Size	Very Simple and Portable, Consultation with Design Engineering
Throwing ability	>100 ball throws/hour
Throw speed	> 60 km km/h
Throw point	can function accurately for training Sepaktakraw, angle hard, and stability
Type of throw	<i>Top spin can be directed in various directions according to the conditions of the match.</i>
Timing	Automatic
Feeding Ball	Feeding ball on the top
Signal Throw	-
Energy Source	Electric
Price	Rp. 25.000.000 - 30.000.000
Function	Automatic
Heavy	< 30kg
Frame	Steel
Angle	Can setting with mobile apps
Controller	Automatic with Android apps

Boosting Taekwondo Performance: The Impact of Modified Goal and Pyongyo Training on Dollyo Chagi Skills

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ABSTRACT

Background. In Taekwondo, mastering the dollyo chagi (roundhouse kick) is crucial for performance, yet many novice athletes struggle with technique. **Objectives.** This study aims to investigate the impact of dollyo chagi training using modified goals and pyongyo on athletes' skills. **Methods.** This study employs an experimental approach to examine the skills involved in executing the dollyo chagi kick. The research design follows a "Pretest-Posttest Control Group Design," where a pretest is conducted prior to the intervention, and a posttest is administered afterward. This design enables an accurate comparison between the experimental group, which undergoes training with modified goals and pyongyo, and the control group, which does not receive the intervention. **Results.** The improvement in skills in the experimental group reached 57.47% (Mean Difference 10), while the control group was only 23.17% (Mean Difference 3.8). Data analysis showed a change in the percentage of posttest results compared to pretest in two groups. For the experimental group, a significant increase was recorded at 57.47%, with a posttest score of 27.40 and pretest score of 17.40. On the other hand, the control group experienced a lower increase, namely 23.17%, with a posttest score of 20.20 and pretest score of 16.40. These results indicate that the intervention applied to the experimental group had a greater impact compared to the control group. **Conclusion.** The research results indicate that dollyo chagi training using modified and pyongyo-based goals has a significant impact on improving dollyo chagi kicking skills in Taekwondo athletes. The superiority of the training method applied in the experimental group can be attributed to a more specific and targeted approach to enhancing dollyo chagi techniques.

KEYWORDS: *Dollyo Chagi; Taekwondo; Kicking Technique; Targeted Training ; Athlete Performance*

INTRODUCTION

In the world of martial arts, particularly Taekwondo, mastering technique is essential for achieving optimal performance (1,2). One vital technical aspect is kicking, with dollyo chagi, or the roundhouse kick, being a fundamental technique that every athlete must learn. Although kicking offers greater power compared to striking, many novice athletes still struggle to execute it correctly (3–5). At the university level, we have observed that many athletes are unable to perform dollyo chagi effectively, as reflected in their training sessions. This significantly affects the athletes' ability to score points in competitions, especially when using modern scoring systems like PSS (Protector Scoring System).

Common problems such as inadequate knee lift when performing kicks and improper foot contact with the target result in ineffective technique (6). These mistakes not only hinder their ability to execute kicks correctly, but also affect their potential to score points in matches, especially when using modern scoring systems such

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as PSS. Without targeted training intervention, these technical deficiencies can continue, preventing athletes from reaching their full potential and competing effectively at higher levels (7–9). To overcome this problem, this study aims to explore the influence of dollyo chagi exercises using modified goals and pyongyo. This method is expected to provide proper stimulation, so that athletes are able to improve their technique and improve their skills. Through this research, we want to make a meaningful contribution to the development of athletes' technical abilities, as well as emphasize the importance of systematic training in achieving excellence in Taekwondo.

MATERIALS AND METHODS

This study employs an experimental approach to examine the skills involved in executing the dollyo chagi kick. The research design follows a "Pretest-Posttest Control Group Design," where a pretest is conducted prior to the intervention, and a posttest is administered afterward. This design enables an accurate comparison between the experimental group, which undergoes training with modified goals and pyongyo, and the control group, which does not receive the intervention. The training sessions are held three times a week over 16 meetings, each lasting 90 to 100 minutes. Analyses will be conducted to evaluate the impact of the training on dollyo chagi skills, focusing on aspects such as posture, strength, and speed. The results of the pretest and posttest will provide valuable insights into the effectiveness of the applied training methods.

RESULTS

An assumption test or analysis requirements test must be performed before conducting a statistical analysis. Assumption tests or analysis requirements tests include normality tests and homogeneity tests. The normality test is used to determine whether the data obtained is normal or not, while the use of homogeneity test is used to find out whether the research sample comes from a homogeneous population. The data normality test in this study uses the Kolmogorov Smirnov method. The results of the data normality test carried out in each analysis group were carried out using the SPSS 23.0 program with a significance level of 5% or 0.05.

The results of the calculation of the two tables above for both the experimental group and the control group using the Kolmogorov-Smirnov test on the results of the dollyo chagi exercise using modified and pyongyo goals showed that the Asymp.Sig of both variables > 0.05 so it can be concluded that both the experimental group and the control group are normal.

This test will test the hypothesis that the variance of the variables is the same, to accept or reject the hypothesis by comparing significant values > 0.05 . If the significance value > 0.05 , it means homogeneous, while if the significance result < 0.05 , it means that it is not homogeneous. The results of the homogeneity test can be seen in the table below:

The results of the calculation with the statistical levene above show that the data is homogeneous, where the results for the pretest data are 0.881 and for the posttest data 0.122 which means that the Sig value of the data is > 0.05 so that the data is homogeneous. The analysis of the data used to answer the hypothesis proposed is whether or not there is an influence of dollyo chagi training using modified goals and pyongyo on the dollyo chagi kicking skills of Taekwondo athletes. Whether or not there is an influence on this study, a t-test is carried out.

The t-test table shows that the posttest results of the experimental and control groups have a significance value of < 0.05 . The experimental group recorded a value of 0.008 and the control group 0.021, so H_0 was rejected and H_a was accepted, indicating the influence of dollyo chagi training with the aim of modification and pyongyo on the dollyo chagi kicking skills of Taekwondo athletes. The improvement in skills in the experimental group reached 57.47% (Mean Difference 10), while the control group was only 23.17% (Mean Difference 3.8). Data analysis showed a change in the percentage of posttest results compared to pretest in two groups. For the experimental group, a significant increase was recorded at 57.47%, with a posttest score of 27.40 and pretest score of 17.40. On the other hand, the control group experienced a lower increase, namely 23.17%, with a posttest score of 20.20 and pretest score of 16.40. These results indicate that the intervention applied to the experimental group had a greater impact compared to the control group.

DISCUSSION

The research results indicate that dollyo chagi training using modified and pyongyo-based goals has a significant impact on improving dollyo chagi kicking skills in Taekwondo athletes. The superiority of the training method applied in the experimental group can be attributed to a more specific and targeted approach to enhancing dollyo chagi techniques. Modifications in training allow athletes to focus more on developing coordination, accuracy, and kicking power (10,11). Meanwhile, the control group, which used conventional training methods, experienced a lower increase in skills, indicating that a more innovative training approach

can yield better results. Taekwondo coaches may consider implementing this method to enhance training effectiveness and optimize athletes' skill development (12,13).

CONCLUSION

This study shows that dollyo chagi training uses modified goals and pyongyo has a significant positive influence on the skills of Taekwondo athletes in executing these techniques. The results of the analysis showed that the experimental group experienced an increase in skills by 57.47%, while the control group only increased by 23.17%. A greater increase in the experimental group showed the effectiveness of the training methods applied. The interventions carried out, including the use of appropriate exercise tools, provide direct feedback to participants and encourage them to focus on technique and accuracy when performing kicks. The research process that includes pretest, exercise treatment, and posttest proves that structured exercises with the right media can significantly improve the ability of the dollyo chagi technique. Overall, these findings emphasize the importance of an innovative and systematic training approach to developing Taekwondo athletes' technical abilities, so that they can compete more effectively in competitions.

APPLICABLE REMARKS

This study highlights the effectiveness of innovative training methods, such as using modified goals and pyongyo, to improve the dollyo chagi technique in Taekwondo athletes. The significant improvements observed in the experimental group emphasize the importance of targeted, structured training approaches. Coaches and trainers should consider incorporating these methods into their programs to enhance athletes' technical skills, ultimately improving performance in competitions. Additionally, further research with larger sample sizes and longer intervention periods would be valuable to confirm and expand on these findings.

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AUTHORS' CONTRIBUTIONS

Yogi Setiawan was responsible for the conceptualization, methodology, data analysis, and writing of the original draft. He also supervised the project and managed its administration. Yogi Arnaldo Putra contributed to data collection and analysis, and played a key role in writing the review and editing of the manuscript, as well as providing visualizations. Berto Apriyano assisted with data collection and contributed to the review and editing of the manuscript, along with providing software support. All authors played a significant role in the design of the study, data analysis, and manuscript preparation.

CONFLICT OF INTEREST

The authors mention no "Conflict of Interest" in this study.

ETHICAL CONSIDERATION

This study ensured ethical integrity by obtaining informed consent from all participants, guaranteeing their right to withdraw at any time. Participants' confidentiality and anonymity were maintained, and data was securely stored. The study adhered to ethical guidelines, ensuring respectful interaction with participants and approval from the relevant institutional review board.

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Table 1. Results of Calculation of the Normality Test of the Experimental Group

Categori	t	df	Sig. (2-tailed)	Mean Difference
Pretest	3.472	8	.008	7.20000
Posttest	3.472	4.513	.021	7.20000

Table 2. Results of the Normality Test of the Control Group

Variabel	Asymp.Sig	Conclusion
Pretest	0,200	Normal
Posttest	0,110	Normal

Table 3. Results of Calculation of Homogeneity Test of Experimental Groups

Test	Equal Variances Assumed	Equal Variances Not Assumed	F	Sig.
Pretest	Yes	No	0.024	0,811
Posttest	Yes	No	3.000	0,122

Table 4. Experimental and Control Group t-Test

Test	Asymp.Sig	Conclusion
Pretest	0,056	Normal
Posttest	0,200	Normal

How Explosive Arm and Leg Training Elevates Climbers?

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ABSTRACT

Background. Improving climbing performance in rock climbing athletes requires targeted training, especially in explosive muscle power. This study focuses on the impact of arm and leg muscle explosive power training on climbing ability. **Objectives.** This study aims to assess the effect of explosive power training on the climbing performance of rock climbing athletes in Padang City, specifically in the Speed World Record and Lead categories. **Methods.** An experimental design with pre-test and post-test was used, involving control and experimental groups. The sample consisted of rock climbing athletes from FPTI Padang City, selected via purposive sampling. The intervention included an 8-week explosive power training program (3 sessions per week). Climbing ability was measured using the international standard speed climbing test. Data were analyzed using t-test statistics. **Results.** The study found that leg muscle explosive power training significantly improved climbing ability in the Lead category. However, arm muscle explosive power training did not significantly affect Speed World Record climbing ability. **Conclusion.** Explosive power training, particularly for leg muscles, significantly improves climbing performance, confirming the effectiveness of specific training programs for enhancing rock climbing skills.

KEYWORDS: *Training Modes, Arm Muscle Explosive Power, Limb Muscle Explosive Power, Speed World Record, Climbing*

INTRODUCTION

Science and technology are the basis of the sports coaching aspect and are already an integral part of the sports coaching process (1). Forming reliable athletes can no longer be done in traditional ways, and it is time to change the pattern of coaching by using the latest science and technology (the latest) with the concept of modernization (2,3). Scientific sports coaching should be the foundation for breeding and coaching athletes from a program to achieve maximum performance (4,5). Improved physical condition can only be achieved by training properly, programmed, and measured based on scientific principles. Therefore, the physical training process must be planned and carried out systematically based on the training principles.

The description above explains that the achievement of sports achievements can be obtained when supported by coaching and developing achievements from sports-related research. One of the sports that is significantly developed in Indonesian sports achievement is rock climbing or wall climbing. Rock climbing sport is a physical ability, technique, and human way to get to a higher position at the top of the cliff (Top). Three types of rock climbing competition categories are lead climbing, speed climbing, and bouldering. In this lead climbing category, the climber climbs a climbing route where the climber installs safety equipment and is secured by a belayer or a safety from below to safeguard a climber against a fall. Belaying is arranging ropes to protect a climber when falling (6–11). For the speed climbing category, the characteristics of this type of rock climbing competition are that two climbers compete quickly to reach the top or peak with a rope attached

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to an anchor or safety. Bouldering is a climbing sport done on a wall that is relatively not too high, with a height of 2-5 meters, without using a safety rope or harness. This type of rock climbing competition only uses a mattress placed below to anticipate the climber's fall.

MATERIALS AND METHODS

This study uses a pseudo-experimental design to evaluate the effect of arm and leg muscle explosive power training on the ability to climb the Speed World Record category in rock climbing athletes in Padang City. The study population involved all male rock climbing athletes of FPTI Padang City who had mastered the basics of rock climbing in the Speed World Record category, with a total of 10 people. The sample was determined through the Purposive Sampling technique, focusing on male athletes due to considerations of differences in physical abilities between male and female athletes. The research was conducted at Wall Climbing at UIN Imam Bonjol campus from December 2023 to January 2024. Data was collected by testing the ability to climb the Speed World Record category, using time as the primary variable. The research instruments included artificial rock climbing boards, climbing ropes, carabiners, climbing shoes, magnesium, a harness, a belayer, and an electric mechanical timer (starting pad).

RESULTS

Normality test analysis for the pre-test and post-test data groups shows that both data groups are normally distributed. In the normality test, the Lo (Lilliefors) value determines whether a data distribution follows a normal distribution.

The Lo value obtained for the Pre-test Data group was 0.130, while the Lo value for the Post-test Data was 0.079. These two values are compared with L Table (critical value for $n=10$), which is 0.258. Both Lo values are below the critical value of the L Table, indicating insufficient evidence to reject the null hypothesis that the data follows a normal distribution. In other words, the Pre and post-test Data show a normal distribution. This is important in statistical analysis because many advanced analysis techniques assume that data follows a normal distribution.

A test was carried out on the explosive power training data for arm and leg muscles to analyze the homogeneity of variance, and a calculated F value of 0.811 was obtained. This value is then compared with the F table (critical value at a certain level of significance), which has a value of 3.179. The criterion for determining homogeneity of variance is that if the calculated F value is lower than the F table, the variance between groups is considered homogeneous. Based on the results obtained, the calculated F value is lower than the F table, indicating that the variance between the test groups, namely the groups before and after training, is homogeneous.

These results have important implications in research. The homogeneity between groups suggests that variability in athlete performance before and after the training program has a similar degree of dispersion.

Data collected from the *pre-test and post-test results will be processed using the t-test statistical analysis technique* to prove whether the hypothesis proposed in this research can be accepted or rejected.

Based on the t-test results for hypothesis 1 presented, the calculated t-value is 2.66, which is lower than the t-table value of 2.78. This table's t value represents the critical value required to determine statistical significance at a certain level of confidence, usually 95%.

Based on the table in the t-test results for hypothesis 3, the calculated t-value obtained is 4.35, which exceeds the t-table value of 2.78. This shows a significant difference between the group that was given the leg muscle explosive power training intervention and the group that was not, at the level of statistical confidence that is generally used.

The t-test results for hypothesis 3 show that the calculated t-value is 4.33, far exceeding the t-table value of 2.78. This indicates a significant difference between the effect of explosive power training for arm and leg muscles on the ability to climb in the Speed World Record category in Padang City rock climbing athletes. With the calculated t value significantly exceeding the t table, we can conclude that the two training methods for arm and leg muscles have different impacts on athlete performance(14). Statistically, this confirms that the effect of training on one muscle group is not the same as on another muscle group in the context of increasing climbing speed. In this case, exercises focused on the leg muscles may contribute more to improving speed climbing ability than exercises focused on the arm muscles, or vice versa, depending on the context and design of the exercises implemented.

CONCLUSION

In conclusion, the study examined the impact of explosive power training on the climbing ability of rock climbing athletes in Padang City, focusing on the Speed World Record category. The results demonstrated

significant improvements in climbing performance following specific training interventions targeting arm and leg muscles. While arm muscle explosive power training did not show a statistically significant influence on climbing ability, leg muscle explosive power training significantly enhanced climbing performance in the lead climbing category.

APPLICABLE REMARKS

- Explosive strength training of leg muscles can significantly improve rock climbing performance in the main rock climbing category.

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AUTHORS' CONTRIBUTIONS

Concept and design of the study: Nuridin Widya Pranoto. Data acquisition: Nuridin Widya Pranoto. Data analysis and interpretation: Bayu Putra. Compiled the script: Nuridin Widya Pranoto. Critical revision of the manuscript for important intellectual content: Nuridin Widya Pranoto. Statistical analysis: Bayu Putra. Administrative, technical, and material support: Nuridin Widya Pranoto. Study supervisor: Bayu Putra.

CONFLICT OF INTEREST

The authors mention no "Conflict of Interest" in this study.

ETHICAL CONSIDERATION

This research has met the standards of research ethics and has received approval to be a sample of all respondents.

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Table 1. Data Normality Test

Data Group	Lol	L Table (n=10)	Information
Pre-test data	0.130	0.258	Normally distributed
Post-test data	0.079	0.258	Normally distributed

Table 2. Data Homogeneity Test

F count	F table	Information
0.811	3,179	Homogeneous Variance

Table 3. Hypothesis 1 testing results

t count	t table	Information
2.66	2.78	There is no significant difference.

Table 4. Hypothesis 2 testing results

t count	t table	Information
4.35	2.78	There are significant differences.

Table 5. Hypothesis 3 testing results

t count	t table	Information
4.33	2.78	There are significant differences between the two training methods.

The Physical Literacy Profile of Regional Athletes in Men's Football

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ABSTRACT

Background. Physical literacy plays an important role in the world of football, and it encourages people to continue to do physical activities to improve their sports achievements. **Objectives.** This study aims to determine how the physical literacy profile of regional athletes in men's football is concerned. **Methods.** This type of research is quantitative descriptive with an instrument in the form of a questionnaire adopted from the International Physical Literacy Association (IPLA) draft instrument. The research sample in this study was taken using a purposive sampling technique with male gender criteria and was selected to participate in the national qualification round of 24 samples. The data analysis technique uses quantitative descriptive analysis presented in percentages. **Results.** The results showed that the physical literacy profile of regional athletes in men's football was in the category of not realizing/ignoring potential by 8.3%, the category of exploring potential by 12.5%, the category of developing potential by 37.5%, the category of consolidating potential by 41.7% and the category of maximizing potential by 0%. The category dominant, with a result of 41.7 %, namely the physical literacy profile of regional athletes in men's football, consolidates potential. **Conclusion.** Regional athletes in men's football need to continue to improve and develop their potential, and athletes need to understand the meaning and ultimate goal of physical literacy. Understanding physical literacy will help athletes develop rapidly.

KEYWORDS: *Physical Literacy, Realizing Potential, Ignoring Potential, Exploring Potential, Maximizing Potential, Football*

INTRODUCTION

Physical literacy is the ability to perform physical activity for a lifetime. This is reinforced by Edwards et al. (2018), who say that physical literacy is required to adopt a physically active lifestyle. Activity experiences, in turn, can nurture an individual's physical literacy and ideally culminate in a good cycle (2,3). Physical literacy can be described as a multifaceted concept consisting of interconnected domains of influence, physical and cognitive (4). Physical literacy interacts with other physical components to influence children's physical activity patterns (5). The importance of physical literacy is that it contributes not only to the improvement of physical activity but also to the outcome of physical participation (6).

Physical literacy plays an important role in the world of sports to continue to do physical activity for a lifetime. Bahtra & Putra (2024) explained the LTAD (Long Term Athlete Development) model, a seven-stage

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framework to guide training, competition and recovery in physical activities and sports from infancy to adulthood. The seven stages that are planned are as follows: 1) Active Start Stage, in the range between 0-6 years, Children must continue to be active; 2) Fundamental Stage, the age at this stage is 6-9 years for men while 6-8 years for women. Fundamental motor skills include running, jumping, spinning, throwing, kicking, and catching. 3) In the Learning to Train stage, the chronological age for males is 9-12 years, while females are 8-11 years old. This phase begins to integrate physical, mental, cognitive, and emotional components in a structured program; 4) Training to Train Stage aims to develop endurance, strength, speed, special skills, and sports fitness. The chronological age for males is 12-16 years while females are 11-15 years old; 5) In the Learning to Compete stage, males are in the age range of 16-18+ while females are in the age range of 15-17+. Aim to develop more specific physical preparations. Aerobic speed, strength, capacity, and endurance training are optimized as needed; 6) Training to Win Stage: this stage aims to maximize preparation specifically for optimal performance results. The age at this stage for men and women $\pm$ 20-23 years. At this stage, the athlete becomes a full-time athlete, and all energy and resources are directed to support the athlete who excels at the highest level. 7) The Active for Life stage aims to prepare them to join society. At this stage, sports values and the urgency of sports have been embedded so that they are able and willing to exercise and be active throughout their lives.

Individuals who have good physical literacy are expected to have cognitive knowledge, be physically competent, and be mentally motivated in a physically active life for life (8). Children with greater physical literacy are likelier to meet daily physical activity guidelines (9). Often, these elements are seen as being concerning to each other. Based on some of the literature above, which shows the importance of physical literacy, athletes should have good physical literacy. Athletes from the men's football region of the Special Region of Yogyakarta do not know their physical literacy profile. Therefore, it is necessary to research the physical literacy profile of regional athletes in men's football.

MATERIALS AND METHODS

This study uses quantitative descriptive research. The population in this study is all regional athletes in the football branch of the Special Region of Yogyakarta, which is as many as 60 athletes. Meanwhile, the samples in this study amounted to 24 using the purposive sampling technique. The instrument in this study is a questionnaire adopted from the International Physical Literacy Association (IPLA) draft instrument that all ages can use with four aspects, namely motivation, confidence, physical competence, knowledge, and understanding; with each aspect there are three items of statements, namely 1) Motivation aspect, motivation to participate in physical activity, continuous application and involvement - motivated to apply oneself and motivated to taking steps to incorporate physical activity into the lifestyle, 2) Aspect of Confidence, 3) Aspect of Physical Competence, 4) Aspect of Knowledge and Understanding. This instrument allows all respondents to engage in constructive self-reflection to measure life's journey. The data analysis technique in this study uses a percentage data analysis technique.

RESULTS

The results of this study aim to describe the physical literacy profile data of regional athletes in men's football (Table 1).

Descriptive statistical data from the results of the physical literacy profile research of regional athletes in the men's football branch were obtained with the lowest score (minimum) 26, the highest score (maximum) 57, the average (mean) 47, and the standard deviation (SD) 7.

When displayed in a frequency distribution, the physical literacy profile of regional athletes in the DIY men's football branch is presented in table 2.

Based on the table above it shows that the physical literacy profile of regional athletes in the men's football branch is in the category of not realizing/ignoring potential by 8.3%, the category of exploring potential by 12.5%, the category of developing potential by 37.5%, the category of consolidating potential by 41.7% and the category of maximizing potential by 0%. The category dominant, with a result of 41.7%, namely the physical literacy profile of regional athletes in men's football, is consolidating potential.

DISCUSSION

Based on the study results, it was shown that the physical literacy profile of regional athletes in the DIY football branch was the most dominant category, with a consolidating potential of 41.7%—the category of consolidating potential shows that athletes already have good physical literacy. Athletes begin to strengthen and try to maximize their potential. Individuals with greater physical literacy are likelier to meet daily physical activity guidelines (10). Moreover, these elements are often seen as conflicting with each other. Engaging in

meaningful physical activity experiences will allow individuals to develop and nurture their physical literacy, whereas those with good physical literacy also contribute to developing physical activity habits (11).

In terms of motivation, athletes are motivated to take advantage of their motor potential and significantly contribute to their quality of life. Makransky et al. (2019) said motivation has a role or part that is quite important to be physically literate. In terms of confidence, athletes can move calmly and have confidence in various situations that may be physically challenging and manage their performance. This is in line with the opinion (13) which said that individuals who have physical literacy must move with calmness and confidence in various physically challenging situations and perceptively in reading all aspects of the physical environment, anticipating the need or possibility of movement and responding appropriately, with intelligence and imagination of movement. In terms of physical competence, athletes can develop skills and movement patterns as well as experience various intensities and durations of movement.

Knowledge and understanding aspects include the ability to identify and express important qualities that affect movement, understand the health benefits of an active lifestyle, and appreciate safety features appropriate to physical activity in a variety of settings and physical environments. The ultimate goal of physical literacy is lifelong involvement in physical activity. The International Physical Literacy Association says that lifelong involvement in physical activity refers to individuals taking personal responsibility for physical literacy by freely choosing to be active regularly.

CONCLUSION

Based on the results of the above study, regional athletes in the men's football branch already have good physical literacy, with the most dominant category consolidating a potential of 41.7%. Regional athletes in men's football need to continue to improve and develop their potential; athletes need to understand the meaning and ultimate goal of physical literacy. Understanding physical literacy will help athletes develop rapidly.

APPLICABLE REMARKS

- Regional athletes in men's football need to continue to develop their potential, and football athletes need to understand the meaning and ultimate goal of physical literacy.
- Understanding physical literacy will help athletes develop rapidly and improve their performance.

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Concept and design of the study: Dewi Kiani Cakrawati. Data acquisition: Wawan Sundawan Suherman. Data analysis and interpretation: Erwin Setyo Kriswanto. Compiled the script: Suryo Utomo. Critical revision of the manuscript for important intellectual content: Muahamd Ichsan Sabillah. Statistical analysis: Suryo Utomo. Administrative, technical, and material support: Muhamad Ichsan Sabillah. Study supervisor: Dewi Kiani Cakrawati.

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The authors mention no "Conflict of Interest" in this study.

ETHICAL CONSIDERATION

This research has met the standards of research ethics and has received approval to be a sample of all respondents.

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Table 1. Descriptive Physical Literacy Profile of Regional Athletes in Men's Football

Statistics	
N	24
Mean	47
Std. Deviasi	7
Max	57
Min	26

Table 2. Frequency Distribution of Physical Literacy Profiles of Regional Athletes in Men's Football

Interval	Category	Frequency	Percentage
< 36	Not Realizing / Ignoring Potential	2	8,3 %
36- 43	Exploring Potential	3	12,5 %
43 - 50	Developing Potential	9	37,5 %
50 - 57	Consolidating Potential	10	41, 7 %
> 57	Maximizing Potential	0	0 %

Volleyball Basic Abilities Improving With Technical Training Models in the Students

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ABSTRACT

Background. The problem in this study is that students who take volleyball courses do not yet have good basic volleyball technique skills. Objectives. Therefore, it is necessary to apply structured and systematic training models to ensure that students have optimal basic volleyball technique skills at the end of the semester. **Methods.** This study uses a research and development method by looking at the effectiveness of the training models, namely by providing exceptional treatment. Before the treatment was conducted to see the impact of applying the technique training model, an initial measurement was carried out on the basic volleyball technique skills consisting of underhand serve techniques, underhand passes, and overhand passes, totaling 58 students. **Results.** The average value of the initial test of essential volleyball technique ability was 50.00, and the average value of the final test was 66.85, meaning that there was an increase in essential volleyball technique ability based on the average value of 16.85. The results of the data analysis were obtained using the dependent sample t-test. Based on the study's results, $t_{count} = 11.24 > t_{table} = 2.01$. **Conclusion.** This means that the research hypothesis can be accepted empirically. Thus, the results of this study indicate that when students do systematic training from the volleyball technique training model, students' basic volleyball technique abilities will increase optimally.

KEYWORDS: Concentration, Eye-Hand Coordination, Arm Muscle Strength, Woodball

INTRODUCTION

The learning outcomes of volleyball courses are that students must master and be skilled in performing basic volleyball techniques systematically and effectively. Someone can own volleyball techniques if they are routinely practiced so that each technique has movement automation (1). The main goal of each sport is to develop the training model needed for each sport on an ongoing basis (2). The learning process using a systematic training model is one of the determining factors in how someone achieves satisfactory learning outcomes. Therefore, it is necessary to have a modern approach to teaching in order to obtain effective movement from the practice of teaching skills (3). In the sport of volleyball, for example, the physical conditions that have a significant influence are the explosive power of the leg muscles, the explosive power of the arm muscles, flexibility, agility, and endurance (4).

Furthermore, to achieve an optimal level of success, a structured and efficient physical condition training model is needed during its implementation (5). Then, there needs to be technical training that is arranged from simple to more complex movements. The training model in question is a training model that can improve the

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physical condition, technique, tactics, and mental or psychological state of students in volleyball lectures (6). Physical condition is the main program for coaching students to excel in a volleyball sport, which is compulsory for graduating with good grades (7).

MATERIAL AND METHODS

The proposed research uses a qualitative descriptive approach using the Research and Development method. The data collection technique used in this study is the ability tests of volleyball skills tests. The sample in this study was students who took volleyball courses, totaling 58 people. Data were analyzed using the dependent sample t-test.

RESULTS

Based on the measurement of students' basic volleyball technique skills, which consist of underhand passing, overhand passing, and underhand serving techniques, the initial test data obtained the highest score of 65 and the lowest score of 37, range (measurement distance) 29. The distribution of scores produced an arithmetic mean of 50, a median of 50.9, and a standard deviation of 6.93. Furthermore, for the results of the final test data, the highest score was 67, and the lowest score was 43, so the range (measurement distance) was 24, and the middle or median value was 54.9. While the average value was 56.85, the standard deviation was 5.66.

The increase in basic volleyball technique abilities was 16.85, with an average initial test score of 50.00 and a final test score of 66.85. Technical ability is the essential preparation for optimal volleyball learning outcomes.

DISCUSSION

The enhanced skills are underhand serve, underhand pass, and overhand pass, which are core components of volleyball (8). Mastering these basic techniques is critical, as they form the foundation for more advanced skills. Initially, students might gradually build up the level of the basic drills so that motor learning principles would occur (9). (10) also showed that learner ability combined with repeated, progressive practice optimizes motor learning outcomes given proper instruction. This is paralleled by the improvement in the final test results, where 27.59% of the students passed with an "excellent" compared to 10.34% in the initial test.

As pointed out by (10), athletes in good and optimal condition are likely to afford a high degree of control and cohesiveness in their movements, which helps them efficiently execute specific volleyball-related tasks such as passing and serving. They found that students tested during the preliminary test were likelier to be tired, have bad posture, and perform erratically and unsystematically throughout a specific rally, specifically during the underhand serve and pass. However, as students' physical fitness increased, those problems were negated, and they could execute techniques correctly and effectively (11).

The structured nature of the training model, which included regular assessments and feedback, likely positively affected the students' motivation and self-confidence. Motivation plays a crucial role in sports performance, and the sense of progression students experience as they improve their skills could have increased their engagement with the training (12). Furthermore, it is established that self-confidence is always related to sports skills (13,14). The psychological enhancements of self-efficacy and motivation should form part of future studies as they form critical variables in sustaining individuals in training for sporting activities.

This key finding highlights the potential for structured training models to reduce performance disparities among students with different initial skill levels. Such a model can be helpful in teaching environments, such as when learners enroll with different levels of experience in sports such as volleyball (15). Employed in this study, the approach that has been developed does this by catering to differences while adopting a more simplified and progressive skill learning methodology that guarantees all students attain a competent level.

CONCLUSIONS

As a result, the structured technical training model applied in this study was deemed successful in enhancing students' basic volleyball technical competence. The tremendous increase in underhand serve, underhand pass, and overhand pass skills establishes a need to employ a methodical training model that optimizes physical and technical efficacy. In this study, the model enhanced performance and maintained a positive attitude regarding future skills, implying that it may be important for educators or coaches in similar situations.

APPLICABLE REMARKS

- Technical training models are crucial in improving students' basic volleyball abilities, focusing on structured practice of fundamental skills such as passing, serving, and spiking.

- These models emphasize repetition, feedback, and gradual skill progression to enhance technique and performance.
- Students can develop better coordination, accuracy, and confidence by incorporating drills and game-like scenarios, laying a strong foundation for advanced gameplay.
- Well-designed technical training improves individual abilities and fosters teamwork and strategic understanding of the sport.

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AUTHORS' CONTRIBUTIONS

Concept and design of the study: Erianti. Data acquisition: Yuni Astuti. Data analysis and interpretation: Haripah Lawanis. Compiled the script: Bekir Erhan Orhan. Critical revision of the manuscript for important intellectual content: Karuppasamy. Statistical analysis: Yuni Astuti. Administrative, technical, and material support: Erianti. Study supervisor: Govindasamy.

CONFLICT OF INTEREST

The authors mention no "Conflict of Interest" in this study.

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This research has met the standards of research ethics and has received approval to be a sample of all respondents.

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Table 1. Frequency Distribution of Preliminary Test Data Results and Final Tests of Student Volleyball Fundamental Techniques Ability

Interval Class	Category	Preliminary Test		Final Test	
		Absolute Frequency	Relative Frequency	Absolute Frequency	Relative Frequency
60 – 65	Excellent	6	10,34	16	27,59
55 – 59	Good	9	15,52	25	43,10
49 – 54	Fair	16	27,59	12	20,69
43 – 48	Poor	18	31,03	5	8,62
37 – 42	Bad	9	15,52	0	0
Total		58	100	58	100

Table 2. Data Normality

Data	L _{observation}	L _{table}	Exp
Preliminary Test of Basic Volleyball Technique Ability	0,107	0,116	Normal
Preliminary Test of Basic Volleyball Technique Ability	0,110	0,116	Normal

Table 3. Summarizes The Results Of Hypothesis Testing

Implementation Of Physical Conditions	Mean	SD	t _{count}	t _{table}	Test Result	Exp
Preliminary Test	50	6,93	11,24	2,01	Significant	Ho was rejected, and Ha was accepted
Final Test	66,85	5,66				

Development of Karate Learning Media Based on Virtual Reality Digital Technology Applications

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ABSTRACT

Background. The development of technology in the era of ERI (Industrial Revolution Era) 4.0 and society 5.0, especially information and communication technology, offers many conveniences in learning. Therefore, the media is needed to help students remember basic karate techniques, especially in lectures. In this study, a learning media will be created using a karate movement guide based on virtual reality technology. **Objectives.** To develop karate learning media with a virtual reality (VR)-based technology application design that can help students learn. **Methods.** The type of research is development research with Research and Development research procedures. The design model developed will go through the following stages: an exploration of potential problems, data collection, product design, design validation, design revision, product trials, product revisions, usage trials, product revisions, and mass production. **Results.** This study shows validation by material experts at 86%, validation by media experts at 85%, validation by technology experts, and learning design at 88.5%, which is suitable for use. Data analysis from all experts on products with results of 86.5% valid category without improvement. **Conclusion.** Karate Learning Media Based on Virtual Reality Digital Technology Application is valid and feasible to be implemented in the Faculty of Sport Science, Padang State University. Implementing karate learning media based on virtual reality digital technology applications benefits teaching staff (lecturers), teachers, and trainers.

KEYWORDS: *Learning Media, Virtual Reality, Karate*

INTRODUCTION

Advances in information technology are integrated into the world of digital life, which can impact scientific disciplines (1). The industrial revolution has reached a higher stage, namely 4.0 and society 5.0 (2). Information and communication technology development provides many conveniences in the learning process (3). One of the trends in learning media in education is media with Virtual Reality-based technology. VR uses interactive simulations of real-world events as if they were present in the virtual world (4). Various challenges in the digital era can be overcome effectively, including the martial art of karate. Kinetics and kinematics are the most important biomechanical elements in karate martial arts techniques (5).

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The effectiveness and efficiency of karate technique movements can be increased (6,7). Technology plays an important role in the learning process at the higher education level. Based on a preliminary study at FIK UNP, the researcher's observations found several problems in learning media. This problem made the author consider changing how the material is presented using existing facilities. The researcher tried to apply digital technology learning media based on Virtual Reality (VR). This learning media can be studied by students anywhere, anytime, and there is no time limit to learning (8).

VR is a technology that allows users to interact with a virtual environment. The main advantage of virtual reality is the experience that makes users feel the sensation of the real world in the virtual world. Researchers continue to develop to facilitate karate training and teaching (3,9,10). Previous research on developing VR learning media in martial arts courses (9). From a series of studies that have been conducted, none have touched on the development of VR-based karate learning media. Supporting media is very important to accelerate understanding of the concept of movement during karate learning (11–13). Therefore, researchers are interested in conducting research aimed at developing Karate learning media with (VR)-based technology application design.

MATERIALS AND METHODS

Research design. The type of research used is Research and Development (R&D) development research, which consists of several steps, namely: exploration of potential and problems, data collection, product design, design validation, design revision, product trials, product revisions, usage trials, product revisions, and mass production.

Data analysis. The data obtained will be divided into two parts: qualitative and quantitative. Data analysis techniques are used to group information from qualitative data. The results of the data analysis are then used to revise the products being developed.

Instrument. *Product Evaluation Data by Material Experts.* The material expert who became the validator in this study was the lecturer in charge of the Karate course. Data was obtained by providing products. To make decisions using the criteria (Table 1). *Product Evaluation Data by Media Experts.* The media experts who were validators in this study were media experts and lecturers in Educational Technology at Padang State University. The data in this study were obtained by providing products—*product Evaluation Data by Technology and Learning Design Experts.* The technology expert who became the validator in this study was an Information Technology Expert and lecturer at the Faculty of Engineering, Padang State University. The data in this study were obtained by providing products.

Results of Validation Data Analysis by Material, Media, and Technology Experts. After the average value of each validator is known, the next step is to calculate the total average by adding up the average values of all validators and dividing it by the number of validators. The calculation can be formulated as follows:

Percentage: F/N

Information: $F = \text{Total Percentage of Subjects. } N = \text{Number of Subjects}$

Media Development Model. The structure of the media development model in this study can be seen in Figure 1. The researcher used the Luther-Sutopo version of the Multimedia Development Life Cycle (MDLC) in this study.

RESULTS

Karate Learning Media Product Development Based on Virtual Reality Technology. There are several menus in the development of karate learning media based on virtual reality technology, namely the main menu, karate textbook menu, instructions menu, VR menu, VR action menu, VR action video menu, VR Yan Nidan menu, VR Yan Sandang menu, VR Yan Sodang menu can be seen in table 2.

Research Results Process. It is necessary to go through a validation and trial process consisting of material and media validation by media experts. Then, the trial process is carried out on students of the Faculty of Sports Science, Universitas Negeri Padang.

Expert Validation Results. *Product Evaluation Results by Material Experts* (Table 3). *Data Evaluation Results by Media Experts* (Table 4). *Evaluation Data Results by Learning Design Technology Experts* (Table 5). *Data Analysis Results* (Table 6).

Data analysis shows that each validator's average is $(86\% + 85\% + 88.5\%) : 3 = 86.5\%$. The results obtained for the validity of audio-visual multimedia are determined based on the interval, determining the level of validity.

DISCUSSION

Based on the results of the validation of material experts, 86%; validation of media experts, 85%; validation of technology and learning design experts, 88.5%, it is concluded that it is perfect and suitable for use.

Furthermore, the results of data analysis from the three experts on karate learning media products based on (VR) at the Faculty of Sports Science, Padang State University, with a result of 86.5%, are included in the valid category without improvement. This research aligns with research (19) and (20), which state that VR training can improve athletes' actions in responding to virtual attacks from opponents.

CONCLUSION

Based on the results and discussion, it can be concluded that the Karate Learning Media Based on Virtual Reality Digital Technology Application is valid and feasible to implement in the Faculty of Sport Science, Padang State University. Implementing karate learning media based on virtual reality digital technology applications benefits teaching staff (lecturers), teachers, and trainers.

APPLICABLE REMARKS

- This research can be used as a recommendation for further research on solutions to improve the student learning process in developing karate learning media based on digital virtual reality technology applications.

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AUTHORS' CONTRIBUTIONS

Concept and design of the study: Septri, Syahrial Bachtiar, Khairuddin, Nurul Ihsan. Data acquisition: Ilham and Rully Effendi. Data analysis and interpretation: Hendra Afriwan and Arie Asnaldi. Manuscript preparation: Septri, Sonya Nelson, and Rully Effendi.

CONFLICT OF INTEREST

The author declares no "Conflict of Interest" in this research.

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The authors have no financial interests related to the material in the manuscript.

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There was NO use of artificial intelligence (AI) for preparation, writing, or editing this manuscript.

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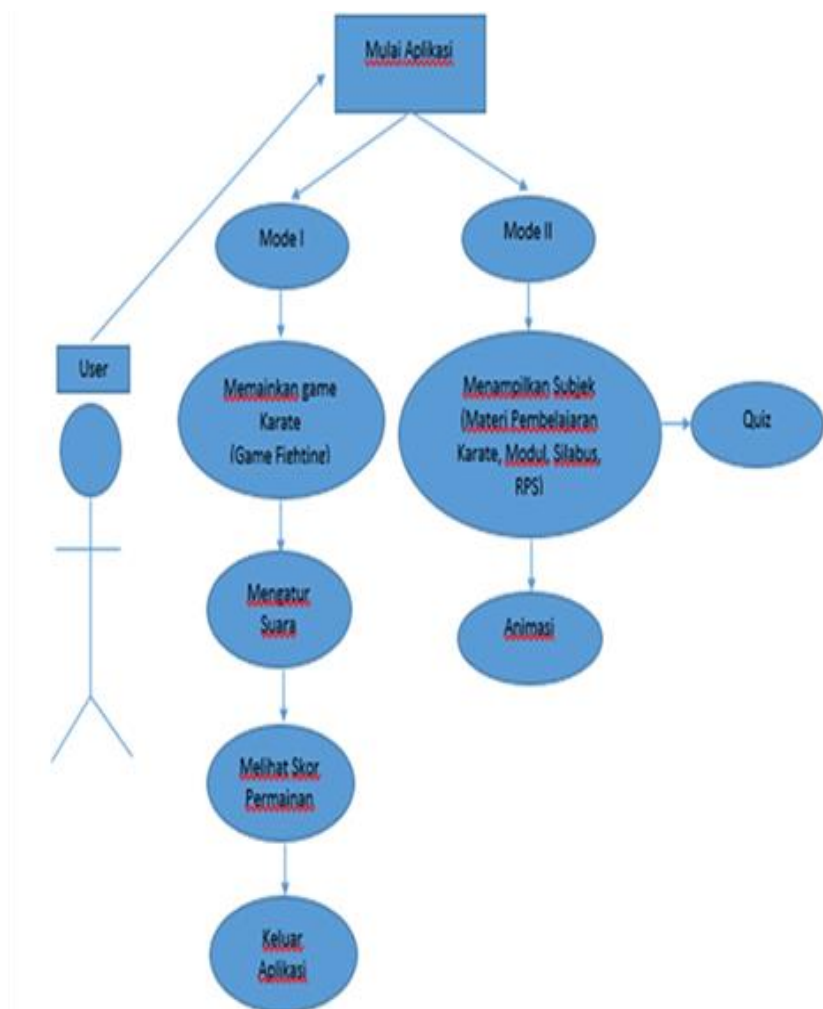


Figure 1. Structure of the media development model

Table 1. Percentage Determination Criteria

Sign	Rating Scale	Qualification
5	81-100%	Very good
4	61-80%	Good
3	41-60%	Enough
2	21-40%	Not good
1	0-20%	Very Poor

Table 2. Development of Karate Learning Media Based on Virtual Reality Technology



Table 3. Results of Material Expert Assessment

Variables	Maximum Score	Score	%	Information
Content aspects	20	17	85%	Very good
Material accuracy aspects	55	48	87%	Very good
Average score			86%	Very good

Table 4. Media Expert Validation Results

Variables	Maximum Score	Score	%	Information
Program quality aspects	30	26	86%	Very good
Media design aspects	15	13	86%	Very good
Material Presentation Aspects	30	25	83%	Very good
Average score			85%	Very good

Table 5. Results of the Learning Design Technology Expert Assessment

Varbel	Maximum Score	Score	%	Information
Media content quality	30	26	86%	Very good
Media view	45	41	91%	Very good
Average score			88.5%	Very good

Table 6. Audio Visual Multimedia Validity Level Based on Interval

Magnitude x (average)	Category	Information
80% < x < 100%	Legitimate	Used
66% < x < 84%	Quite valid	Used
56% < x < 66%	Less valid	Replaced
40% < x < 56%	Invalid	Replaced
0% < x < 40%	Invalid	Replaced

Fast Footwork Training in Youth Football Players: Promising Results with Four Directions Ladder Agility Drills

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ABSTRACT

Background. Coaches predominantly utilize standard training to improve the agility of youth football players. However, there are developments in models and training media on agility in soccer. **Objectives.** The study aimed to analyze the effect of fast footwork training (FFT) with four directions ladder agility (FDLA) drills on improving agility in youth football players. **Methods.** The sample of participants consisted of 40 youth football players who play soccer school from 13 to 15 years old. The experimental training program lasted six weeks and conducted tests using the Arrowhead Agility Test. Statistical analyses were performed using the IBM SPSS version. 27.0, and significance was set at $p < 0.05$. **Results.** The results showed that the experimental group had a significant analyzed improvement ($0.01 < 0.05$) and a larger effect size than the control. Based on the research results conducted for youth football players aged 13-15 years, it was found that the training given to the experimental group significantly improved agility skills compared to the control group. **Conclusion.** Therefore, providing FFT using the FDLA drills is very suitable and effective in improving the agility of youth football players.

KEYWORDS: *Agility, Fast Footwork Training, Football, Youth Players*

INTRODUCTION

Soccer sports coaching can effectively improve physical performance but requires additional components beyond the identified paths (1)(2). Soccer also emphasizes quick strength, agility, speed, strength, and power (3). Acceleration, maximal speed, and strength are believed to share standard specifications and muscle fibril types related to agility (4). In the modern era of football, games are fast-paced and high-tempo (5). Agility refers to the rapid change of direction in performance sports, a body's response to a stimulating phenomenon (6). Agility training will improve the physical condition of youth soccer players because it is practical, safe, effective, and efficient (7).

Training is a systematic, gradual, and individualized sports activity to develop human physiological and psychological functions to meet task demands (8)(9). Training aims to enhance athletes' skills and working capacity to enhance their performance (10). Creativity and innovation can be done by modifying the exercises used to improve agility, one of which is by providing FFT. FFT in soccer refers to a player's quick and efficient foot movement to maintain ball control, avoid defenders, and create scoring opportunities (11). The game involves swift changes in direction, acceleration, deceleration, and swift movements with the ball at the player's feet (12).

FFT is a time-efficient training program that aids in developing physical, sporting, technical, and tactical abilities in youth football players. Using training media with modified four directions ladder agility (FDLA) drills can improve the physical condition of soccer athletes, especially the agility component. The ladder tool in physical condition training is a training tool known as the modified FDLA drills. Training using this ladder efficiently develops physical

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attributes needed in football to improve speed, agility, and coordination (13).

Players with fast footwork can dribble through tight spaces, make quick turns, and perform intricate maneuvers to outwit opponents on the field. These fundamental skills are for players in all positions, from attackers trying to beat defenders to midfielders maintaining possession under pressure. Based on this, fast footwork improves agility, coordination, balance, and ball control. Thus, researchers are interested in utilizing FFT to improve the agility of youth soccer players in FDLA drills. The urgency of the findings of this study can be used as a reference and recommendation for academics, coaches, and football stakeholders, and FFT can be used as an alternative for training that can improve football agility.

MATERIAL AND METHODS

The sample of participants consisted of 40 youth football players who play soccer school from 13 to 15 years old. The experimental group consisted of 20 players, and the control group of 20 players from Muspan SS and Imam Bonjol SS. All players practiced thrice weekly (90 minutes per session), with one match played over the weekend during the training period. The experimental and control groups were required to participate in three weekly training sessions (during 6 weeks). The experimental group performed additional FFT in addition to FDLA drills (Figure 1), and the control group performed standard FFT agility training. The research instrument used was the Arrowhead Agility Test. Statistical analyses were performed using the IBM SPSS, and significance was set at $p < 0.05$.

RESULTS

The researcher used a research design using a pretest-posttest control group design, meaning that there were two groups involved in this study, namely the experimental group and the control group, where all groups in this effectiveness test used players from several Soccer Schools. The experimental group had 20 players, and the control group had 20. Each group was given different treatments, where the experimental group was given FFT with FDLA drills, while the control group used a standard FFT model, wherein the control group, the researcher, ultimately left the training process to the coach in that group.

Before the treatment was carried out in the experimental and control groups, the researcher conducted an initial test on all subjects using the Arrowhead Agility Test. After that, the treatment was given for sixteen meetings (for 6 weeks). After providing treatment, at the end of the meeting, researchers conducted a final test on all groups, including experimental and control groups, using the same instrument test as the initial test. The following are the results of the requirements of the independent sample t-test in Table 1 and Figure 2.

Based on the independent sample t-test above, the significance value (2-tailed) is $0.001 < 0.05$, then H_0 is rejected, and H_a is accepted. That is, there is a significant difference between the results of FFT using FDLA drills and FFT with standard training.

DISCUSSION

The research findings are derived from a test on the efficacy of exercises designed and implemented for youth football players and, based on the results of research on FFT for 13-15-year-old youth football players, revealed that experimental training significantly improved agility skills compared to the control group. This is indicated by the difference in the average post-test score in the two groups after being given different treatments. Youth football players should master agility, which involves running fast, accelerating, and slowing down while adapting to changes in direction (14).

The data also showed that the 6-week FFT program significantly improved agility performance with the FDLA drills. However, the fast footwork training improved the experimental group's performance compared to the control group. Therefore, FFT with FDLA drills can be recommended to improve agility and football performance. Based on the interpretation of the research data, it can be said that the provision of FFT using four directions ladder agility media has significantly improved the agility ability of young football players aged 13-15 years.

Agility is influenced by the athlete's perception, decision-making ability, and ability to change direction quickly (15). The theory is applied to FFT given to the experimental group for 6 weeks. So, the high increase in the agility ability of youth football players aged 13-15 years in the experimental group compared to the control group is thought to be the result of the influence of FFT, which has been adjusted to the relevant theory. Therefore, the correct FFT needs to be taught early so that youth football players have a strong foundation for agility and the development of further physical conditioning abilities.

Players' laterality may influence the difference in time performance between groups in the present study. For this reason, future studies should consider the effect of laterality when comparing different training groups. It should be noted that fast footwork ability is relevant to football performance. Training and testing agility is more relevant to football games because players have good stimulus when carrying out FFT with FDLA drills.

CONCLUSION

The present study showed that FFT using FDLA drills can significantly improve agility skills in youth football players aged 13-15. Including specific FFT using FDLA drills provides more significant benefits than standard agility training. Therefore, it is recommended for coaches and physical trainers to routinely include exercises that require fast footwork and reaction to specific stimuli in agility training sessions.

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AUTHORS' CONTRIBUTIONS

Concept and design of the study: Vega Soniawan. Data acquisition: Johansyah Lubis. Data analysis and interpretation: Hernawan. Compiled the script: Vega Soniawan. Critical revision of the manuscript for important intellectual content: Vega Soniawan. Statistical analysis: Vega Soniawan. Administrative, technical, and material support: Vega Soniawan. Study supervisor: Vega Soniawan.

CONFLICT OF INTEREST

The authors mention no “Conflict of Interest” in this study.

ETHICAL CONSIDERATION

This is a systematic review of research, so the implementation does not involve humans directly.

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FINANCIAL DISCLOSURE

The authors have no financial interests related to the material in the manuscript.

ARTIFICIAL INTELLIGENCE (AI)

USE There was NO use of artificial intelligence (AI) for preparation, writing, or editing this manuscript.

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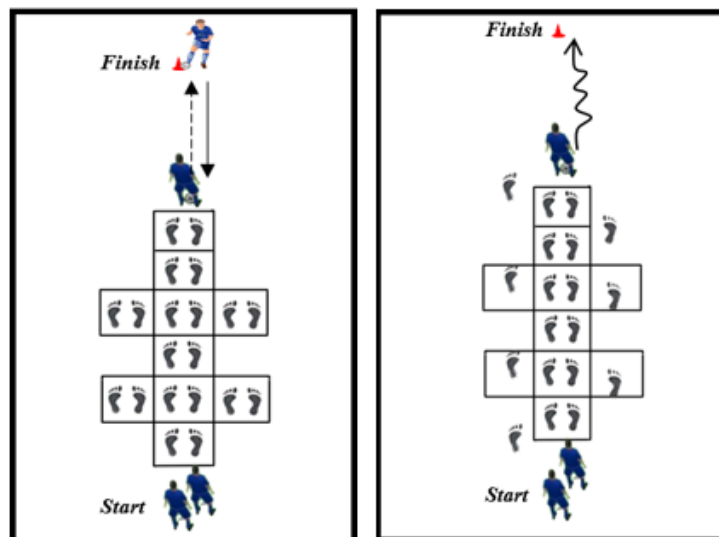


Figure 1. Four Directions Ladder Agility (FDLA) Drills

Table 1. Independent Samples Test for Agility Results

	Levene's Test for Equality of Variances		t-test for Equality of Means						
	F	Sig.	t	df	Sig. (2 tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Upper
Equal variances not assumed	20.575	<.001	-5.233	24.420	<.001	-.54000	.10320	-.75280	-.32720

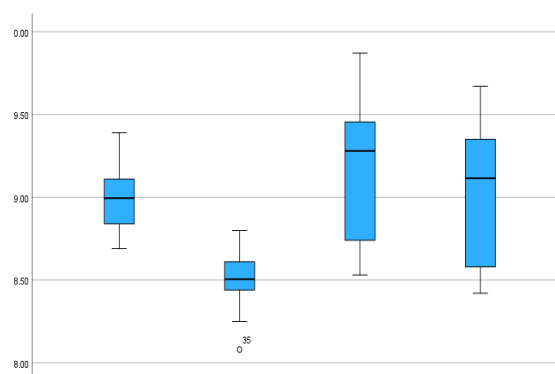


Figure 2. Increased Time Normal Plot of Agility

The Effect of Kawa Leaf Coffee Jelly Candy On Athletes' Performance After Running 400 Meters

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ABSTRACT

Background. Athletes favor many sports supplements as a support or performance enhancer after doing aerobic training activities. However, no supplement formulation has been developed in the form of coffee leaf kawa-based jelly candy that can support performance in running 400 meters. **Objectives.** This study aimed to analyze the effect of giving jelly candy based on coffee leaf kawa on the 400-meter run carried out by athletes. **Methods.** The research design is a two-group pretest and post-test design. A total of 18 petanque athletes were used as research samples and divided into two groups using the matching pairing method. The research procedure was that the treatment group was given coffee leaf kawa-based jelly candy 15 minutes before the athlete ran 400 meters, as much as 10 grams. **Results.** Statistical tests showed no difference in 400 m running performance in the control and treatment groups ($p > 0.05$). **Conclusion.** Giving jelly candy based on coffee leaf extract can be a potential supplementation product option to support the performance of 400-meter running athletes.

KEYWORDS: *Oxidative Stress, Aerobic, Kawa Leaf Coffee, Candy*

INTRODUCTION

Sports are activities humans need; by doing sports, people get physical fitness, fresh thinking, and achievement in their work to increase work productivity (1). On the other hand, sports can also be used as a competition to achieve achievements individually and in groups. Sports have become a necessity and a means of education and achievement.

Short-distance running of 100 m to 400 m requires speed and endurance. Elite sprinters need to develop an aerobic training regime similar to that of marathon runners and some of the mechanical properties of elite sprinters. While also having the anaerobic and tactical capabilities to maintain speed throughout the race. In addition to genetics, gender, age, physiological and psychological factors, training (2), metabolic variables (3), energy usage (4), and nutritional supplements (5) have a significant impact on 400 m running performance. Endurance can be defined as the ability to maintain speed for as long as possible (6).

One factor that affects performance in maintaining the ability to run 400 m is nutritional supplements. One of the supplements that can potentially maintain athlete performance is high-antioxidant jelly candy based on coffee leaf extract. It has been proven that young coffee leaves with Arabica and Robusta varieties have high total phenolic levels (7). Indonesians not only consume coffee from the beans but also consume the leaves known as kawa leaves or kawa coffee (8). Unsurprisingly, kawa leaf coffee is used as a traditional regional drink (9). The most widely cultivated

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coffee plant in Indonesia is robusta coffee (*coffea canephora*) (10). Coffee leaves contain many different phytochemicals with health benefits, including anti-inflammatory, antioxidant, antidiabetic, and controlling oxidative stress (8). Also, coffee leaf tea from the *Coffea Robusta* type can potentially prevent post-workout oxidative stress (11). Previous research reported that giving infusion and ethanol extract of robusta coffee leaves has antidiabetic properties that can reduce blood glucose levels. In addition, coffee leaves are also used as a functional food to prevent metabolic syndrome with biochemical content (such as caffeine, flavonoids, chlorogenic acid, and mangiferin) (12). This study aims to analyze the effect of high-antioxidant jelly candy based on coffee leaf extract on athlete performance after a 400-meter run.

MATERIALS AND METHODS

This type of research is quantitative with a quasi-experimental approach, using a two-group pretest and posttest design—a total of 18 petanque athletes. The sample was divided into two groups using the matching pairing method: nine in the treatment group and nine in the control group. The research procedure was that the treatment group was given 10 grams of coffee leaf jelly candy 15 minutes before the athlete ran 400 meters. In contrast, the control group was given 200 ml of mineral water before running 400 m. The average age of the athletes was 21 years, weight 59.10 kg, height 162.30 cm, BMI 22.4 kg/m², body fat percentage 22.6%, hemoglobin 13.0 mg/dL, and blood glucose 90.0 mg/dL.

RESULTS

Results of this study show that age, gender, weight, height, fat, hemoglobin, blood glucose, and BMI can be seen in table 1. Furthermore, the average results of the treatment and control groups in this study are presented in table 2. Judging from the results of the statistical test of the Mann-Whitney test, it shows that there was no significant difference in the provision of high-antioxidant jelly candy based on coffee leaf extract between the control group and the treatment group, but there is a tendency for a difference in the average time of the treatment group compared to the control group. This can be seen in Figure 1. After obtaining the results of the athlete's 400-meter running ability, the data analysis test was continued. The data analysis technique in this study used the Mann-Whitney test. The results of the Mann-Whitney test can be seen in Table 3.

DISCUSSION

The study's findings showed no significant effect of giving coffee leaf extract jelly candy on the performance of 400 m running. However, there was a tendency for differences in the average of each group; namely, in the treatment group, the average athlete's 400-meter running ability was 1 minute 66 seconds, while in the control group, it was 1 minute 67 seconds. The difference in the average indicates a tendency for giving high-antioxidant jelly candy based on coffee leaf extract to contribute to the performance of 400-meter runners.

Previous studies have reported that consuming caffeinated instant coffee drinks with antioxidant-rich non-caffeine supplements can reduce oxidative stress after heavy exercise. In addition, coffee drinks that are rich in nutrients can delay the fatigue factor in long-distance runners. Another study also reported that coffee drinking is thought to cause a decrease in systemic oxidative DNA damage through a decrease in iron stores in the body. Young coffee leaves of Arabica and Robusta varieties have high total phenolic content. In addition, robusta coffee has the potential to prevent post-exercise oxidative stress. Caffeine is an alkaloid compound in coffee that increases insulin release from pancreatic β cells and glucose tolerance (13).

Flavonoids prevent insulin resistance and increase insulin sensitivity; mangiferin can improve insulin sensitivity and glucose tolerance. Coffee leaf kawa drink contains a bioactive blend of coffee leaves with cell-strengthening properties. Flavonoids and all phenols contained in the leaves are cancer-prevention agents that can prevent increased oxidative stress that occurs during sports activities. Phenolic compounds are believed to effectively strengthen cell movement through redox properties, kill lipid free radicals, and prevent hydroperoxide damage to free radicals. In addition to flavonoids and phenols, the tannin content in robusta *coffea* leaves can also potentially strengthen cells.

According to Przeliorz and Regulska, athletes who perform intensive training should have the best way and can regularly regulate natural foods rich in antioxidants (e.g., fresh fruits, vegetables, and tea) to increase the neutralization of increased ROS (14). This study was conducted as closely as possible to avoid errors during treatment. Further research is needed to strengthen these findings.

CONCLUSION

This study concluded that the ability to run 400 meters needs to be considered by providing supplements rich in natural antioxidants, such as coffee leaf jelly candy. This study has not found significant results, but there is a tendency for the treatment group to have a better time interval than the control group. Further research

is needed involving a larger group of subjects.

APPLICABLE REMARKS

- This study concludes that the ability to run 400 meters should be enhanced by considering supplements rich in natural antioxidants, such as coffee leaf jelly candy.
- Although significant results were not observed, a noticeable trend indicates that the treatment group had improved time intervals compared to the control group.
- Therefore, further research is warranted, particularly with a larger sample size, to understand better the potential benefits of these supplements on athletic performance.

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AUTHORS' CONTRIBUTIONS

Study concept and design: Wilda Welis and Khairuddin. Acquisition of data: Rully Effendi. Analysis and interpretation of data: Darni. Drafting the manuscript: Khairuddin and Maidawilis

CONFLICT OF INTEREST

The authors mention no “Conflict of Interest” in this study.

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The authors have no financial interests related to the material in the manuscript.

ARTIFICIAL INTELLIGENCE (AI) USE

There was NO use of artificial intelligence (AI) for preparation, writing, or editing this manuscript.

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Table 1. Subject Characteristics

Variable	Sample (n = 18)
Sex	
Male	12
Female	6
Characteristics and mean $\pm$ SD.	
Age, y	21
Height, m	162.30 $\pm$ 4.36
Mass, kg	59.10 $\pm$ 8.18
Percentage of subcutaneous fat (%)	22.6 $\pm$ 6.51
Hemoglobin (mg/dL)	13.00 $\pm$ 2.00
Blood Glucose (mg/dL)	90.00 $\pm$ 13.00
Body Mass Index (kg/m ²)	22.4 $\pm$ 6.51

Table 2. Results of 400 meter running ability (minutes)

Group	n	Minimum	Maximum	M $\pm$ SD
Treatment	9	1.17	2.31	1.66 $\pm$ 0.47
Control	9	1.39	2.44	1.67 $\pm$ 0.36

Table 3. Mann-Whitney Test Results

Test Statistics	Results	Conclusion
Mann-Whitney U	31,000	
Wilcoxon W	76,000	
Z	-0.841	Not Significant
Asymp. Sig. (2-tailed)	0.400	
Exact Sig. [2*(1-tailed Sig.)]	0.436b	

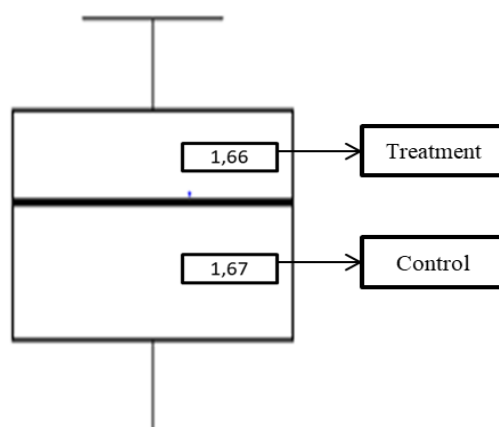


Figure 1. Difference in Mean of Treatment and Control Groups

Development of a Valid and Reliable Kinesthetic Movement Instrument for Identifying Talent in Youth Volleyball

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ABSTRACT

Background. Existing tools are not specific enough to assess young children's volleyball movement, and therefore, new tools targeting the early development stages are still needed. **Objectives.** This study aims to create a valid, reliable instrument for determining children's volleyball movements by their dominance in movement patterns. **Methods.** The research followed a development approach structured into four stages: A preliminary study, expert validation, acceptance testing, and utility testing. Volleyball experts, sports talent specialists, and coaches validated the product against suitability, accuracy, usability, and practicality. Acceptance testing applied the instrument to participants, and utility testing employed a retest method to evaluate reliability. Participants included 95 boys and 55 girls, all sixth-grade students aged 12 or younger. **Results.** Validation scores were 98 % from volleyball experts, 98 % from sports talent experts, and 97 % from coaches. Acceptance testing recommended 11 percent of boys and 24 percent of girls in the first test, with slight increases in the second. Reliability was 0.95 for boys and 0.98 for girls. **Conclusion:** This instrument aids educators and coaches in identifying children's kinesthetic abilities for volleyball.

KEYWORDS: *Kinesthetic Movement Instrument, Children, Volleyball, Validation, Reliability, Talent Identification*

INTRODUCTION

Funding for volleyball development in Indonesia is limited; there must be more coach education and scholarships for volleyball players (1). The country has a pyramid-shaped sports structure; only some athletes attain elite levels since development programs are limited, particularly in rural areas (2). However, despite these obstacles, because volleyball is still popular, athletes who wish to improve should continue developing their skills (3). Broadening Indonesia's talent pool can only be done by expanding volleyball skills among young players all over Indonesia.

Selecting talented young volleyball players involves various factors. Key anthropometric measures—such as weight, height, and age—are essential for talent identification and predicting future success in volleyball (4). Collaborative efforts from the sports and education sectors and volleyball's commercial appeal are crucial in attracting youth participation and addressing challenges in training reserve players. The relative age effect and attributes like height and jumping ability are significant in identifying youth volleyball talent. Training during developmental years had been crucial for those players to progress and become competitive. A volleyball-specific talent identification model is proposed to identify gifted students at the elementary level.

Tools to screen young volleyball athletes included aspects of self-efficacy, mental toughness, motor competence, and physical performance (5). The Volleyball Self-Efficacy Scale (VSES) is validated for high-

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performing Brazilian athletes, and an eight-item instrument measures cognitive, emotional, and behavioral responses in beach volleyball contexts (6). However, questions remain about the effectiveness of Neuromuscular Training (NMT) in enhancing motor skills and performance in young players (7). Conversely, integrative neuromuscular training (INT) shows promise, particularly in improving jump performance in youth with limited motor skills (8).

The pendular model has also been applied to evaluate tactical-technical skills in U18 male players, proving valuable for assessing tactical decision-making. However, existing tools are not specific enough to assess young children's volleyball movement, and therefore, new tools targeting the early development stages are still needed. Further research with youth athletes and input from coaches and sports experts is needed to develop validated, reliable instruments.

However, this study seeks to determine the validity and practicality of the current selection instruments for young volleyball athletes. It aims to enhance them through expert input to realize high reliability and all-encompassing developmental assessment. The key questions enquired here include evaluating the validity of existing young athlete selection tools under proper conditions.

MATERIALS AND METHODS

Study design. This study utilized Borg and Gall's theoretical framework, adapted into four stages: preliminary study, expert validation, acceptance testing, and utility testing. In the validation phase, three experts—a volleyball specialist, a sports talent identification expert, and a coach—evaluated the instrument for suitability, accuracy, usability, and practicality. During acceptance testing, the instrument was administered to participants, with results converted to a five-point scale; for the balance test, a minimum score of 1 was required for dynamic balance. Table 1 provides details on the score conversion process.

The maximum score achievable is 26, with recommendation criteria set at 20 or higher for females and 21 or higher for males. In the utility trial phase, participants completed the test twice, and the first and second data sets were analyzed using the retest method to assess the instrument's reliability.

Participants. The product trial included 55 male and 95 female participants, all elementary students aged 12 or younger (grades 2–6), selected as they were beginning sports involvement, consistent with Hastie's findings (9). The club where the study took place granted permission for data collection.

Product Design. The product focuses on kinesthetic movements, assessing strength, body coordination, agility, eye coordination, and balance. Strength is evaluated by throwing a mini volleyball, body coordination by catching it, agility through specific movements, eye coordination by bouncing the ball on the floor, and balance by moving the ball while standing on one foot.

Statistical Analysis. In the expert validation stage, expert evaluation data were analyzed as percentages. During the acceptance trial, descriptive percentage analysis determined recommendations for participants, with scores of at least 20 for females and 21 for males. The utility test assessed the instrument's reliability using the retest method.

RESULTS

Product Development. Six items were generated from this development to assess kinesthetic movements relevant to volleyball, which include throwing the ball with one hand, throwing the ball with two hands, catching the ball with two hands, bouncing the ball on the floor, agility, and balance. The product and its implementation are illustrated in Figure 1. Figure 1 illustrates the sequence for the kinesthetic movement identification test, beginning with a one-handed ball throw, then a two-handed throw, a two-handed catch, a floor bounce, and agility and balance assessments. After these steps, the child's kinesthetic abilities are scored, classified, and evaluated for recommendation. This battery test follows a specific sequence with no required rest between items. Table 2 outlines the procedures and necessary equipment.

Expert Validation. The validation results from volleyball experts, talent identification specialists, and volleyball coaches are presented in Table 3. Table 3 shows high validation ratings: the volleyball expert and talent expert both scored 98% (categorized as excellent), and the coach scored 97% (also excellent). Table 4 provides descriptive data for boys, while Table 5 presents data for girls based on participants' use of the kinesthetic movement talent identification instrument.

Table 4 shows the results of the kinesthetic movement testing for boys. Ten children, representing 11%, received a recommendation in the first test, while eleven children, or 12%, received a recommendation in the second.

Table 5 presents the results of the kinesthetic movement test for girls: 13 children (24%) received a recommendation in the first test, while 14 children (25%) received a recommendation in the second. According to Table 6, the instrument's reliability for boys was 0.95, which is classified as "very strong," while for girls,

it was 0.98, which is also classified as "very strong."

DISCUSSION

Measuring tools are essential for enhancing athletic performance. Electronic devices allow athletes to collect real-time data on physiological, performance, and environmental metrics, optimizing training and competition (10). Curve-measuring tools are also increasingly used, highlighting the importance of precision in sports training (11). Sports requiring complex motor skills, such as martial arts and team sports, have been linked to positive academic outcomes, research says, explaining that measuring tools help physical and cognitive performance (12). National sports policy documents recognize sports' role in well-being and academic success, further underscoring the need for measurement tools in implementing policies that support sports engagement (13).

For volleyball, measuring tools are valuable in assessing player performance. Research highlights the importance of accounting for age and maturity when grouping young players. Tools that evaluate techniques and tactics, as emphasized in beach volleyball studies, are critical for assessing performance in diverse environments (14). Additionally, validated tools for specific skills, such as the beach volleyball line-shot attack, are essential for accurate skill assessment (9). An instrument to identify youth volleyball children's kinesthetic movements has been developed and revealed high validity and reliability, proceeding through stages of expert validation, acceptance testing, and utility testing. Experts and coaches evaluated the instrument as robust, confirming its usability by identifying children with strong kinesthetic potential who do well in volleyball. This is a resource for physical education teachers and coaches to guide the growth of these younger athletes.

CONCLUSION

Measuring tools are vital for enhancing sports performance and evaluating their impact on volleyball players. The development of an instrument to identify children's movements has proven valuable, demonstrating high validity and reliability. This tool accurately identifies children's kinesthetic abilities, offering practical recommendations for young athletes with solid kinesthetic skills, making it well-suited for volleyball. The findings indicate that movement identification tools in volleyball boost athlete performance and training and contribute to a deeper understanding of the link between sports, overall well-being, and sports policy implementation.

APPLICABLE REMARKS

- Applying this research benefits coaches, physical education teachers, and academics to improve volleyball gameplay or performance.

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AUTHORS CONTRIBUTIONS

Study concept and design: Muhamad Sazeli Rifki, Ariando Ariston, and Liza. Acquisition of data: Hermanzoni, Raudhatul Hanifah, Alnedral. Analysis and interpretation data: Ilham and Vlad Adrian Geantă. English and AI control: Bekir Erhan Orhan.

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The authors declare no conflict of interest.

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ROLE OF SPONSOR

The funding organization is a public institution and has no role in the design and conduct of the study, the collection, management, and analysis of the data, or the manuscript's preparation, review, and approval.

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No artificial intelligence was used to prepare, write, or edit this manuscript.

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Table 1. Classification of Assessment and Score Conversion for Agility and Motor Skills

Criterion	Men (M)	Women (W)	Score (S)	Observation
Agility	10.4	11.6	5	Can perform
	10.5 - 14.5	11.7 - 16.7	4 - 7	Can perform
	14.6 - 18.6	16.8 - 18.8	3	Moderate
	18.7 - 22.7	18.9 - 20.9	2	Struggles
	22.8	21	1	Cannot perform
Standing Balance (S)	3	1		
Overhead Ball Throw (OHBT)	3.5	1		
Two-Handed Ball Throw (THBT)	4.5	3.6		
Total Coordination Balance (TCB)	3.7 - 6.7	6.8 - 9.8		
Performance Classification (M & W)	5			
Criterion	Men (M)	Women (W)	Score (S)	Observation
Agility	10.4	11.6	5	Can perform
	10.5 - 14.5	11.7 - 16.7	4 - 7	Can perform
	14.6 - 18.6	16.8 - 18.8	3	Moderate
	18.7 - 22.7	18.9 - 20.9	2	Struggles
	22.8	21	1	Cannot perform
Standing Balance (S)	3	1		
Overhead Ball Throw (OHBT)	3.5	1		
Two-Handed Ball Throw (THBT)	4.5	3.6		
Total Coordination Balance (TCB)	3.7 - 6.7	6.8 - 9.8		
Performance Classification (M & W)	5			

Notes: Scores = The scores reflect athletes' abilities in physical assessments, with lower scores indicating greater difficulty. "Can perform" denotes meeting the minimum threshold, while "Cannot perform" indicates falling below it. Agility and motor skill ranges reveal performance differences between men and women, highlighting gender variations. Additional assessments, like standing balance and overhead ball throw, help evaluate motor competence and identify areas for improvement.

Table 2. Kinesthetic Movement Instrument for Volleyball for Children Aged 12 and Under

Names	Equipment		Implementation	
One-Handed Ball Throw	a.	Mini Volleyball with a standard size 4	a.	The testee stands inside the circle to prepare for throwing the mini volleyball.
	b.	Measuring Tape	b.	The testee throws the mini volleyball as far as possible.
			c.	The testee's throw is measured.
			d.	The throw is repeated three times.
			e.	The furthest throw is recorded.
Two-Handed Ball Throw	a.	Mini Volleyball with a standard size 4	a.	The testee stands inside the circle to prepare for throwing the mini volleyball.
	b.	Measuring Tape	b.	The testee throws the mini volleyball as far as possible with both hands overhead.
			c.	The testee's throw is measured.
			d.	The throw is repeated three times.
			e.	The furthest throw is recorded.
Two-Handed Ball Catch	a.	Mini Volleyball with a standard size 4	a.	The distance between the young child and the tester is 2.5 meters.
	b.	Measuring Tape	b.	The tester is positioned to throw the mini volleyball.
			c.	The testee is positioned to catch.
			d.	The tester throws the mini volleyball towards the testee in a parabolic throw.
			e.	The tester catches the volleyball above the head with both hands.
			f.	Five mini volleyballs are thrown.
			g.	Points are awarded for each caught mini volleyball.
Bounce the Ball on the Floor	a.	Mini Volleyball with a standard size 4	a.	Distance from tester to the wall $\pm$ 2.5 meters
	b.	Stopwatch	b.	The testee is inside the starting circle. The testee hits the ball to the floor and the wall on the start signal.
	c.	Measuring Tape	c.	The ball rebound from the wall is caught
	d.	Whistle	d.	Then, another hit on the floor is performed
			e.	Each time it is hit by the hand, one count is made
			f.	The activity is carried out within a time limit of 30 seconds
Agility	a.	11 Big cones	a.	Distance between each Cone: 1 meter
	b.	Stopwatch	b.	Testee 1 gets ready in the starting position
	c.	Whistle	c.	Upon the start signal, Testee 1 starts running around the cones until the finish line.
			d.	This is done in 2 trials, and the fastest time is recorded.
Balance	a.	Mini Volleyball with standard size 4	a.	The testee is in the start position, with a distance of 50 cm between cones from the starting position.
	b.	8 small cones	b.	On the cue "Go," the testee begins jumping, using one foot on the available path.
	c.	Measuring Tape	c.	The testee moves forward using one foot while alternately transferring the ball from cone A to cone B with both hands.
			d.	Assessment is conducted by determining the participant's ability to perform the task without dropping either foot or hand, with success marked as "Able."
			e.	If either foot or hand touches the ground, the participant is deemed "Unable." The participant must complete the task until the finish.

Table 3. Questionnaire scores for the validity of kinesthetic movement by expert

Indicator	Expert		
	Volleyball	Talent	Coaches
Suitability	25	25	25
Accuracy	24	24	25
Convenience	24	24	24
Practicality	25	25	23
Amount	98	98	97
Percentage	98%	98%	97%
Eligibility Level	Excellent	Excellent	Excellent

Table 4. Kinesthetic Movement for Males in Test 1 and Test 2.

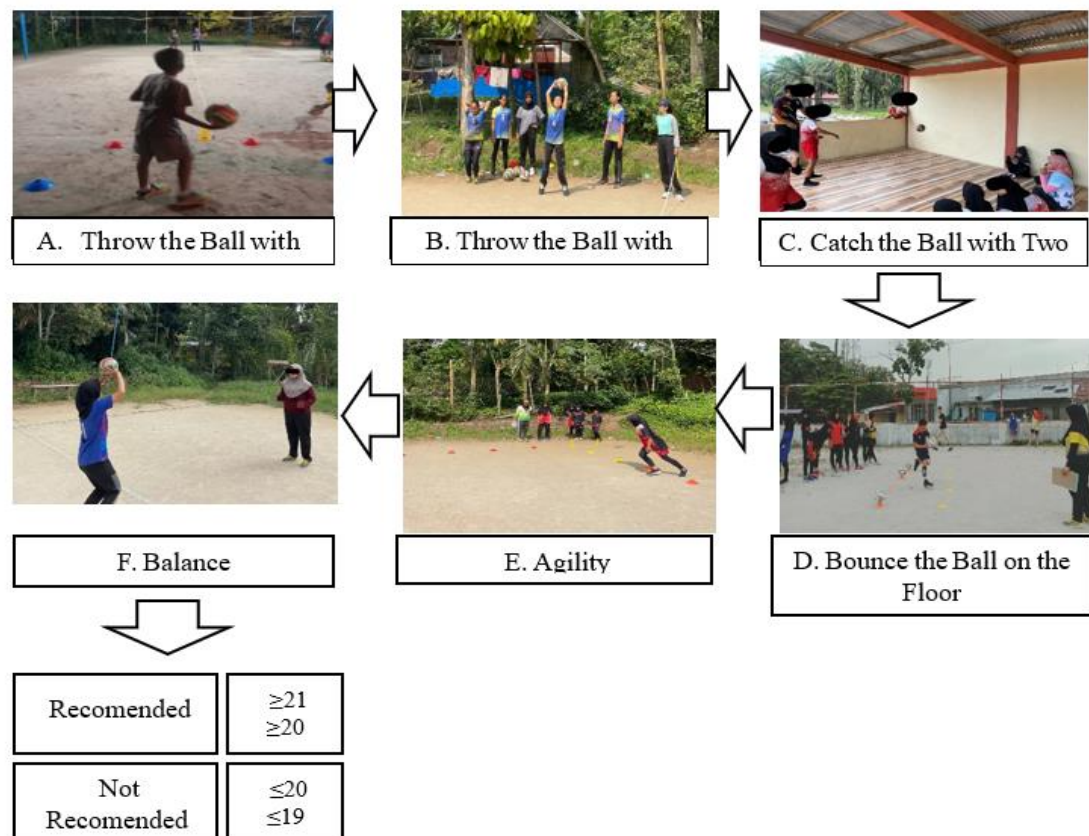
Classification	Test 1			Test 2		
	Frequency	Percentage	Information	Frequency	Percentage	Information
≥21	10	11%	Recommendation	11	12%	Recommendation
≤20	85	89%	Not	84	88%	Not
Total	95	100%		95	100%	

Table 5. Kinesthetic Movement for Females in Test 1 and Test 2

Classification	Test 1			Test 2		
	Frequency	Percentage	Information	Frequency	Percentage	Information
≥20	13	24%	Recommendation	14	25%	Recommendation
≤19	42	76%	Not	41	75%	Not
Total	55	100%		55	100%	

Table 6. Analysis of the test-retest for male and female

	Male		Female	
	Test 1	Test 2	Test 1	Test2
Min	11	11	13	13
Max	23	23	22	22
Mean	18,147	18,232	17,618	17,745
Standard Deviation	2,000	1,949	2,446	2,343
Variance	3,999	3,797	5,981	5,490
Reliability	0,95		0,98	

**Figure 1. The sequence of the Kinesthetic Movement Test Instrument Implementation for Volleyball**

Development of Physical Condition Training Model Based on Indonesian Football Philosophy

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ABSTRACT

Background. Physical condition is one of the important elements in improving performance. Poor physical condition makes players unable to play fight for 90 minutes and will make it difficult for players to compete in competitive football matches. **Objectives.** This study aims to produce a physical condition training model based on Indonesian football philosophy (Filanesia). **Methods.** The method in this study is research and development (R&D), with a sample size of 125 people divided into two groups, namely small-group trials and large-group trials. Data collection techniques in this study were through observation and interviews. Data collection instruments in this study were a list of questions and questionnaires. **Results.** Based on the research that has been carried out, a physical condition training model based on Filanesia with 28 exercise variations was produced. **Conclusion.** The physical condition training model based on Indonesian football philosophy (Filanesia) is feasible.

KEYWORDS: *Model Development, Physical Condition, Filanesia, Football, Young Players*

INTRODUCTION

Physical condition is an essential part of a sport because the physical condition aspect greatly influences game performance (1). Physical condition in football is a fundamental thing that the coach must prepare. Physical condition plays an important role in creating an effective playing pattern (2). These days' football players are characterized by physical and intellectual abilities (3). Physical condition is one of the most important things for football players. Football players must maintain their physical condition because it is part of a strategy to improve their technique, tactics, or strategy (4).

Physical condition is critical in training and developing players at a young age. Physical condition training is a challenging thing to do as a soccer player. Physical condition training is sometimes long or intense, so players feel too heavy to do it. Another problem we often see is that the existing training methods are isolated (separately) and do not use balls. Training methods like this make players bored and tired of training, so improving the player's physical condition is not optimal. One way is to implement the Indonesian Football Philosophy (Filanesia) in physical condition training.

Filanesia is designed based on the characteristics and culture of Indonesian football itself (5). The Indonesian Football philosophy is carried out in a playing practice format so that this can simultaneously improve technical and physical skills with open game intelligence (6). The Filanesia method is a training method that focuses on players getting used to real football game situations or when players are competing (7). Filanesia is an integrated or holistic training. Holistic training improves physical condition and the athlete's technical, tactical, and psychological skills (8,9).

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This developed training method is not isolated into technical-tactical-physical-mental training but holistically integrated. Every football training session always creates a series of communication-decision-executions. The characteristic of this developed physical condition training is that it is carried out with a ball and is not isolated (separately). In addition to improving physical condition, this model can improve football players' technical, tactical, and mental skills together (holistic).

MATERIALS AND METHODS

Participant. The participants in this study were 125 football players U-18. For small group trials at the IFA Academy club with a sample size of 25 people, large group trials were conducted at SSB PSTS Tabbung, Ripan's Soccer School, Tirta Soccer School, PSG Gadut, and Padang United; each club took a sample of 20 people.

Procedure. The research approach used in this study is research and development (R&D), which includes 10 steps (10). The data collection technique in this study is through observation and interviews. Observations were conducted at the subject's training location, while interviews were conducted with players and coaches. The data collection instruments in this study were a list of questions and a questionnaire. Data analysis includes all activities of clarifying, analyzing, using, and drawing conclusions from all data that has been collected.

RESULTS

This study aims to develop a physical condition training model based on Indonesian football philosophy (Filanesia). After conducting a needs analysis and literature study, a training model consisting of 34 models was compiled. After that, experts, including lecturers and football experts, carried out validation. Six models were declared invalid based on the experts' validation, so the remaining training models were 28. Based on the results of expert validation, the next step is model testing. In this trial, six aspects are assessed to determine the validity and feasibility of the designed model. From all aspects assessed, all designed training models are declared valid and feasible to use. The following are the results of the model trials, namely small-group trials and large-group trials. Based on the entire research series, the filanesia-based physical condition training model is valid and feasible to implement in football physical condition training.

DISCUSSION

Based on the research results presented above, the physical condition training model based on Filanesia is suitable for use. In Filanesia, one form of training will be integrated with all components of football (physical, technical, tactical, and mental) (8). Football players must possess physical condition because the match time is very long and there is much physical activity. In one match, football players cover a distance of 10-13 km and do around 1,350 activities (every 4-6 seconds), such as acceleration/deceleration, changes of direction, and jumps, all of which are interspersed with short recovery periods (11). Physical condition will support the application of techniques and tactics on the field (3).

Physical condition in soccer is a function of aerobic fitness, anaerobic fitness, speed, muscle strength, power, and agility (12). The average oxygen uptake for international soccer teams ranges from 55–68 ml/kg/min (13). In addition to endurance, speed also plays an important role. Professional athletes regularly cover a total distance of 10–13 km, of which approximately 900 m and 250–300 m are covered by high-speed running and sprinting (speed ≥ 25 km h⁻¹) (14). The next component of physical condition that supports sports performance is strength. The basis of most soccer movements is muscle strength (e.g., kicking, vertical jumping, and speed). The study of the strength profile of soccer players can provide benefits for soccer teams in interpreting strength results and asymmetries across field positions (15).

Physical conditioning training at a young age will affect players' physical condition later. Structured, systematic, and continuous physical conditioning training will improve players' physical condition. However, a training method is needed to motivate players and prevent them from being burdened because physical conditioning training is considered difficult for players. A physical conditioning training model based on Melanesia can solve physical conditioning training. The form of training in this model, which is more varied and uses balls, will eliminate player boredom in the training process.

CONCLUSION

Based on the research results above, it can be concluded that the physical condition training model based on Indonesian football philosophy (Filanesia) is valid and suitable for use in football physical condition training.

APPLICABLE REMARKS

- Based on the research results above, it can be concluded that the physical condition training model grounded in Indonesian football philosophy (Filanesia) is both valid and appropriate for implementation in football physical conditioning programs.

- This model aligns with the unique cultural aspects of Indonesian football and provides a structured approach to enhance players' physical performance.
- Further exploration and application of this model could lead to improved training outcomes in the sport.

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Table 1. Small Group Trial and Large Group Trial Results

No	Training Models	Eligible
1	Training Models 1	Worthy
2	Training Models 2	Worthy
3	Training Models 3	Worthy
4	Training Models 4	Worthy
5	Training Models 5	Worthy
6	Training Models 6	Worthy
7	Training Models 7	Worthy
8	Training Models 8	Worthy
9	Training Models 9	Worthy
10	Training Models 10	Worthy
11	Training Models 11	Worthy
12	Training Models 12	Worthy
13	Training Models 13	Worthy
14	Training Models 14	Worthy
15	Training Models 15	Worthy
16	Training Models 16	Worthy
17	Training Models 17	Worthy
18	Training Models 18	Worthy
19	Training Models 19	Worthy
20	Training Models 20	Worthy
21	Training Models 21	Worthy
22	Training Models 22	Worthy
23	Training Models 23	Worthy
24	Training Models 24	Worthy
25	Training Models 25	Worthy
26	Training Models 26	Worthy
27	Training Models 27	Worthy
28	Training Models 28	Worthy

Target Games: Can It Improve The Shooting Skills of Athletes Aged 16-19 Years?

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ABSTRACT

Background. This study focuses on the instability of petanque athletes' shooting performance during training and matches. **Objectives.** This study aims to determine the effect of single and team target game training on improving pétanque shooting ability. **Methods.** Participants in this study were 38 athletes aged 16-19 years. This study used an experimental method. The instrument used to test shooting ability was a pétanque shooting test from stations 1-5 with a distance of 6-9 meters. **Results.** Based on the results of the pretest and posttest data calculation from petanque athletes' shots who participated in the target game training program, a p-value of 0.011 was obtained. **Conclusions.** The target game training program significantly affects shooting results in petanque athletes aged 16-19.

KEYWORDS: *Target Game, Shooting, Petanque, Age 16-19 Years*

INTRODUCTION

Pétanque is a sport that requires manipulative movement skills (throwing) and visual object control, where athletes must throw a boule to approach or eliminate points (1). The main mechanical goal of the sport of pétanque is to achieve the highest level of accuracy by showing that to get a winning point, a throw must be done correctly on a specific target (2). Petanque has two types of throws: pointing and shooting (3). The difficulty in shooting is higher when compared to pointing (4). Based on this, it is essential to create a special type of training for shooting techniques so that junior athletes like it and can master this technique well.

The researchers created a series of games aimed at helping athletes improve their shooting skills in the sport of pétanque. The game is designed to provide an experience and help athletes achieve their training goals (5). Target games are intended to improve hand-eye coordination, balance, concentration, and the ability to listen to instructions to achieve a specific goal (6). The size of the target, the distance, and the type of movement used to reach the target are some of the variables that can be used in the target game (7). Whether played individually or in teams, target games aim to improve the player's hand-eye coordination and fine motor skills and improve their accuracy in achieving the goal (8).

MATERIALS AND METHODS

This study uses an experimental method with a "Two Group Pretest-Posttest Design" (9). Both groups underwent a pretest to obtain baseline data, followed by the intervention, and then a posttest to see changes in each group (10). The research participants were selected using Purposive Sampling (11). This sampling

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technique sorted the athlete population into 38 petanque.

The instrument in this study is the shooting pétanque test (12). The statistical test in this study is included in parametric statistics (13).

RESULTS

Before starting a statistical analysis, especially a parametric one, we must ensure that our data meets certain assumptions. Homogeneity and normality are two of the most frequently tested assumptions. The following is the data from the normality and hegemony test results, as shown in Tables 1 and 2 below.

The results of the normality and homogeneity tests show that the data is usually distributed and homogeneous. Because the data is homogeneous, the data analysis can be continued.

Based on the calculation of pretest and post-test data, the shooting results of pétanque athletes show that the target game significantly influences the shooting results of petanque athletes in this age range, as shown in Table 3.

Based on the description of independent test statistics, the difference in average results between the single target game group and the target game team was obtained. The single-target game scored 32.95, and the average team target game score was 29.37. Thus, the single-target game significantly influenced the shooting results of athletes aged 16-19, as shown in Table 4 below.

DISCUSSION

Many factors can affect the basic technical abilities in the game of Petanque, especially when it comes to shooting (14). Therefore, to improve athletes' shooting abilities, coaches must create innovative and varied training methods that will improve athletes' techniques and reduce fatigue and boredom (15). With more dynamic and innovative training methods, coaches can maintain athletes' enthusiasm and involvement in training so that their shooting skills can continue to develop.

The study's results, based on a comparison of pretest and posttest results, showed that target game training significantly improved the shooting results of athletes aged 16-19 years. Athletes' shooting abilities were improved by practicing single and team target games, but this study specifically found that both methods improved athletes' shooting performance and accuracy after training.

CONCLUSION

This study provides several suggestions for coaches and researchers. First, coaches should choose a valuable training program for improving petanque athletes' shooting ability. Second, coaches should monitor other aspects, such as athletes' physical, psychological, and rest conditions. Finally, athletes are expected to follow the training program strictly to get the best results from the training. In addition, this study paves the way for additional research that will study additional elements that can improve the shooting ability of petanque athletes.

APPLICABLE REMARKS

This study offers several recommendations for coaches and researchers. First, coaches are encouraged to select training programs designed to enhance petanque athletes' shooting ability. Second, coaches must monitor various aspects of the athletes' well-being, including physical, psychological, and rest conditions. Lastly, athletes are urged to adhere closely to the training regimen to maximize the effectiveness of their practice. Additionally, this study lays the groundwork for future research to explore other factors contributing to improving shooting skills in petanque athletes.

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Table 1. Normality Test

	Target_game	Kolmogorov-Smirnova		
		Statistics	Df	Sig.
Result_shooting	Post-single target game	.129	19	.200*
	Post-team target game	.148	19	.200*

Table 2. Results of Homogeneity Test Calculation

		Levene Statistic	df1	DF2	Sig.
Result shooting	Based on Mean	.122	1	36	.729
	Based on Median	.141	1	36	.709
	Based on the Median and with adjusted df	.141	1	35.832	.709
	Based on trimmed mean	.142	1	36	.708

Table 3. Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Result_shooting	Equal variances assumed	.122	.729	2.681	36	.011	3.579	1.335	.872	6.286
	Equal variances are not assumed.			2.681	35.985	.011	3.579	1.335	.872	6.286

Table 4. Group Statistics

	Target_game	N	Mean	Std. Deviation	Std. Error Mean
Result_shooting	Post-single target game	19	32.95	4.156	.954
	Post-team target game	19	29.37	4.072	.934

Development of an Android-Based Athletic Competition Rules Application as a Learning Media for Students

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ABSTRACT

Background. The rapid advancement of digital technology has significantly impacted physical education, especially in providing accessible, up-to-date athletic competition rules, which are often challenging to access through conventional resources. **Objectives.** This study aimed to develop an Android-based application offering comprehensive, regularly updated rule information to support students' understanding and practical application of athletic rules. **Methods.** Following a Research and Development (R&D) approach using the ADDIE model (Analysis, Design, Development, Implementation, and Evaluation), the app was designed, developed in Android Studio, and refined based on expert and student feedback. **Results.** Initial validity scores were 75% for content, 83% for language, and 67% for media, which improved to 97%, 98%, and 96% following revisions. In trials involving 20 and 40 students, the application scored up to 100% in media usability, confirming its effectiveness. **Conclusion.** This tool presents a practical solution for students learning competition rules and holds potential for further features, such as augmented reality, to enhance interactive learning experiences.

KEYWORDS: *Android, Application, Athletic, Physical Education, Digital, Learning*

INTRODUCTION

Digital technology has evolved rapidly and has a significant influence on life. It significantly impacts education, including physical education, where it can enhance learning quality in sports like athletics (1). One key challenge in this field is the dynamic nature of competition rules, which are frequently updated and require continuous learning to stay current (2,3). Traditionally, information about athletic competition rules has been conveyed through books, articles, and websites; however, these resources often lack timely updates and convenient access, making it challenging for students to stay informed and prepared to apply these rules in practice (4,5). This gap in accessible, updated information disadvantages students, particularly when preparing for roles such as referees, judges, or officials in class or competitive settings (6,7).

Given these challenges, digital solutions like Android-based applications offer a flexible, accessible alternative that could benefit students by providing instant, up-to-date information anytime and anywhere, fostering more effective learning (8). This study aims to develop an Android-based application tailored to deliver comprehensive and regularly updated athletic competition rules, making it easier for students to grasp and apply them in practice. The application is designed as a self-learning tool that encourages students' active engagement, thereby enhancing their readiness and understanding of frequently changing competition rules.

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MATERIALS AND METHODS

Study Design: This study utilized a Research and Development (R&D) approach to create an Android-based application aimed at helping students learn athletic competition rules. The ADDIE model, comprising Analysis, Design, Development, Implementation, and Evaluation guided the application's development.

Participants: 120 students enrolled in the Sports Education Program at Universitas Negeri Padang for the 2023–2024 academic year. Selection was based on purposive sampling to ensure all participants had a basic understanding of athletic competition rules. Informed consent was obtained from each participant according to ethical research standards.

Procedure: The study was divided into two main phases: development and testing.

1. In the development phase, the ADDIE model stages were implemented as follows:

a. **Analysis:** Researchers interviewed subject matter experts (coaches and lecturers) to assess learning needs.

b. **Design:** Wireframes and user interface prototypes were created, prioritizing ease of use.

c. **Development:** The application was developed using Java programming in Android Studio (Android Studio, Google LLC, Mountain View, CA), ensuring the inclusion of the latest athletic competition rules.

d. **Implementation:** The application was tested by the participating students.

e. **Evaluation:** Qualitative and quantitative feedback was gathered to assess the application's usability and effectiveness.

2. In the testing phase, a pre-test and post-test design was used to measure the application's effectiveness in improving students' understanding of athletic competition rules. The application underwent a Validity Test by three experts—a subject matter expert, a language expert, and a media expert—to evaluate its content, language clarity, and media quality. Revisions were made based on feedback before small-scale (20 students) and large-scale (40 students) trials were conducted to assess effectiveness and usability.

Tools: The application was developed in Android Studio using Java. Questionnaires evaluated ease of use, content clarity, and visual quality, while pre- and post-test knowledge tests assessed students' understanding.

Data Collection: Data included pre-test and post-test results, questionnaire feedback, and application usage logs. Descriptive and inferential statistics, processed with SPSS, were used to analyze demographic data and compare pre-and post-test results to evaluate the application's impact.

Ethics: Approved by Universitas Negeri Padang's Research Ethics Committee (Approval No. 2023-UNP-EDU-00123), participants were informed of the study's purpose, procedures, and rights.

This methodology confirmed the application's validity, effectiveness, and usability, supporting its role as a digital tool for advancing learning in sports education.

RESULTS

The application showed notable improvements in validity and user acceptance after extensive testing. Future recommendations include addressing minor issues as they arise and ensuring the application remains updated to meet evolving user needs, especially in dynamic content and media presentation. Adding interactive features or media elements, such as videos, could enhance user engagement and be considered for further development.

In the initial round of Expert Validity Testing, the application's content scored 45 out of 60 (75%), indicating it was reasonably valid but could benefit from further enhancements. The language aspect scored 43 out of 52 (83%), deemed valid yet needing refinement for greater clarity and communicativeness. The media aspect, with a score of 32 out of 48 (67%), also rated as reasonably valid, pointed to a need for improved visuals and navigation. Recommendations at this stage include enhancing the content with more comprehensive materials and making the media presentation more interactive and engaging for users.

After revisions, the second round of Expert Validity Testing showed marked improvements: content scored 58/60 (97%), language 51/52 (98%), and media 46/48 (96%). The application now performs at a high level, with only minor enhancements suggested, such as adding interactive features to enhance user experience further.

This application offers a user-friendly experience with an attractive, structured design relevant to the theme of athletic competitions. The use of transparent colors and icons aids navigation, while the content presented is comprehensive and detailed. Overall, the application is reasonably practical as a learning medium for students who want to understand the rules of athletic competitions.

In the Small-Scale Test, the content scored 1100/1200 (92%), showing high-quality and comprehensible material. The language aspect scored 980/1040 (94%), indicating clear and communicative language, while the media scored 900/960 (94%), reflecting well-suited media elements that meet user needs. These results suggest that the application demonstrates strong quality across all aspects.

In the Large-Scale Test, the content aspect scored 2320 out of 2400 (97%), indicating that the content is of excellent quality and well-understood by users. The language aspect scored 2040 out of 2080 (98%), further demonstrating that the language is highly effective and communicative. The media aspect achieved a perfect score of 1920 out of 1920 (100%), showing that the media is fully optimized for users. This confirms that the application exhibits excellent quality in all aspects.

DISCUSSION

This study highlights the importance of digital technology in enhancing the achievement of educational goals (12)(13), particularly in physical education and sports, where athletic competition rules frequently change. By developing an Android-based application, this research addresses the need for accessible, up-to-date information that conventional resources often lack. Unlike printed materials, this application provides instant access to rule updates, enabling students to apply them effectively in practical settings.

The results of the validity tests reveal that initial expert feedback led to significant improvements, enhancing content accuracy, language clarity, and user experience through better navigation and visual design. Small- and large-scale testing with students further confirmed the application's effectiveness in improving understanding, as evidenced by high post-test scores across content, language, and media aspects, that this application can be used in learning to improve students' understanding in learning so that student learning outcomes are better (13,14, 15).

These findings align with previous studies on mobile learning (m-learning), demonstrating that mobile applications provide a flexible, interactive learning experience suitable for disciplines requiring current, accurate knowledge (9,10,11,12). The study supports constructivist and cognitive multimedia theories, where interactive elements and multimedia enhance comprehension and knowledge retention.

In conclusion, this Android-based application successfully meets educational needs in sports by offering a flexible, up-to-date learning tool. Future developments may incorporate features like tutorial videos, virtual simulations, or augmented reality to deepen the learning experience. This study underscores the value of m-learning in sports education, providing a practical, scalable solution for students and practitioners alike.

CONCLUSIONS

This study successfully developed an Android-based application to provide up-to-date athletic competition rules in an accessible format, significantly enhancing students' understanding and readiness for roles in sports settings. Beyond benefiting students, the application is a valuable resource for educators, coaches, and practitioners. This research highlights the importance of integrating innovative educational technology in sports education to meet the evolving needs of the digital era.

APPLICABLE REMARKS

- An Android-based athletic rules app offers an innovative, interactive way for students to learn competition regulations.
- It enhances understanding, supports traditional teaching, and effectively integrates modern technology into education.

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AUTHORS' CONTRIBUTIONS

Concept and design of the study: Arsil. Data acquisition: Deswandi. Data analysis and interpretation: Syamsuar. Compiled the script: Rezli Oktaviani. Critical revision of the manuscript for important intellectual content: Despita Antoni. Statistical analysis: Jannatul Khairoh. Administrative, technical, and material support: Arsil. Study supervisor: Syamsuar.

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ETHICAL CONSIDERATION

This research has met the standards of research ethics and has received approval to be a sample of all respondents.

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FINANCIAL DISCLOSURE

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ARTIFICIAL INTELLIGENCE (AI)

USE There was NO use of artificial intelligence (AI) for preparation, writing, or editing this manuscript.

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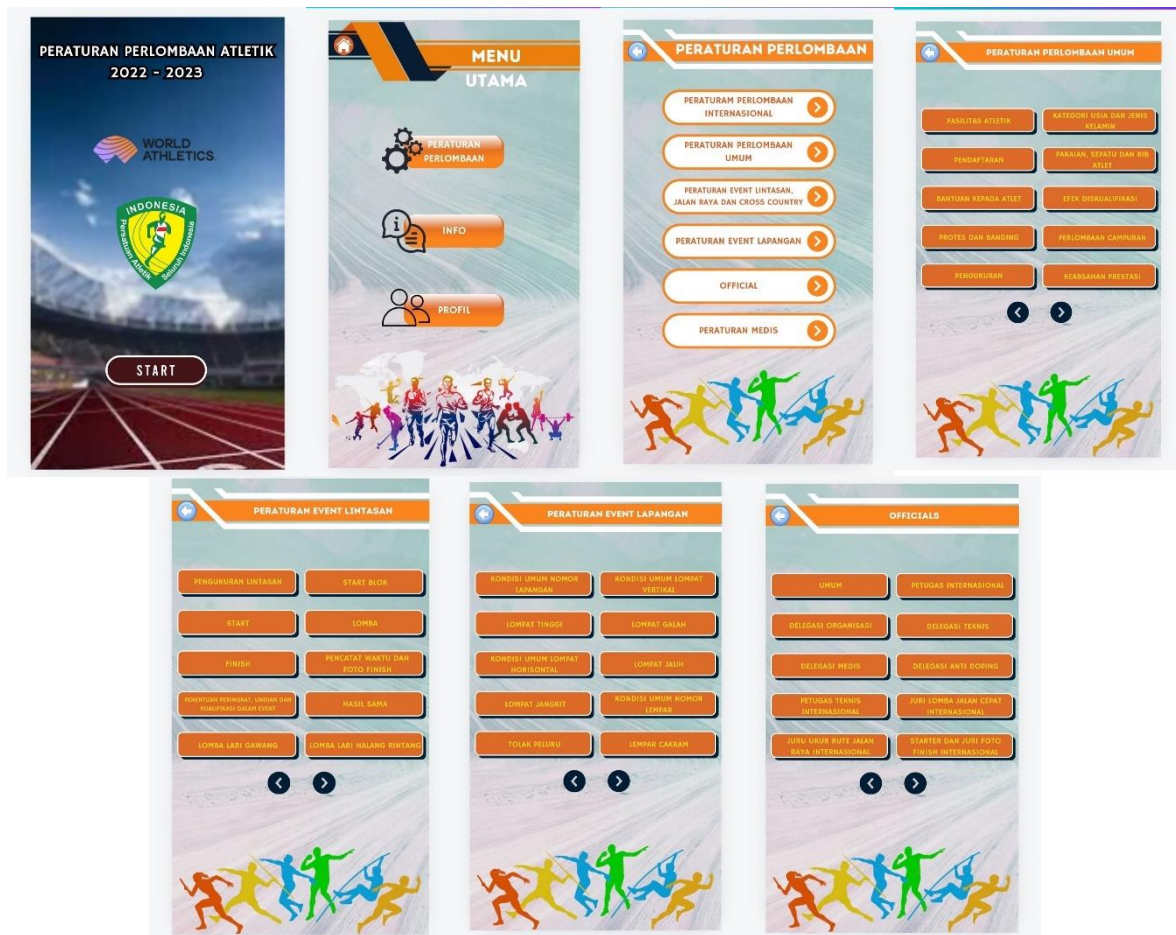


Figure 1. Application Screenshot

Table 1. Expert Validity Test Data Stage 1

No	Aspect Assessed	Score Obtained	Maximum Score	Percentage	Category
1	Content	45	60	75%	Fairly Valid
2	Language	43	52	83%	Valid
3	Media	32	48	67%	Fairly Valid

Table 2. Expert Validity Test Data Stage 2

No	Aspect Assessed	Score Obtained	Maximum Score	Percentage	Category
1	Content	58	60	97%	Valid
2	Language	51	52	98%	Valid
3	Media	46	48	96%	Valid

Table 3. Small-Scale Test Data

No	Aspect Assessed	Score Obtained	Maximum Score	Percentage	Category
1	Content	1100	1200	92%	Good
2	Language	980	1040	94%	Good
3	Media	900	960	94%	Good

Table 4. Large-Scale Test Data

No	Aspect Assessed	Score Obtained	Maximum Score	Percentage	Category
1	Content	2320	2400	97%	Good
2	Language	2040	2080	98%	Good
3	Media	1920	1920	100%	Good

Evaluation of Golden Age, Height, and Racket Grip Factors in Determining the Success of Badminton Athletes in the Olympics

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ABSTRACT

Background. Research shows that Several essential factors, including optimal age, height, and racket grip, influence the success of badminton athletes at the Olympics. These factors are the main components in achieving the highest achievement in the event. **Objectives.** This study aims to analyze the influence of optimal age, height, and racket grip on the success of badminton athletes in the Olympics. **Methods.** The method used in this study is a quantitative descriptive approach; data from gold medalists in the categories of men's singles, women's singles, men's doubles, women's doubles, and mixed doubles are collected from the official Olympic reports, BWF database, and IOC website. The variables described included age when winning the gold medal, height, racket grip (right or left hand), and number of matches. **Results.** The optimal age to win a gold medal varied according to the competition category: an average of 26.73 years for men's singles, 24.6 years for women's singles, 27.81 years for men's doubles, 25.04 years for women's doubles, and 25.68 years for mixed doubles. Height also varies, the highest in men's singles (average 183.78 cm) and the lowest in women's doubles (167.17 cm). Most athletes use their right hands, but some athletes have achieved optimally. **Conclusion.** The combination of optimal age, height, and racket grip plays a vital role in the success of badminton athletes at the Olympics, becoming a guide for coaches in designing effective training programs.

KEYWORDS: *Golden Age, Height, Racket Handle, Olympics, Gold Medals*

INTRODUCTION

Badminton began to be played at the 1992 Olympics in Barcelona, captivated spectators, and added to its competitiveness and prestige after it was officially played in the Olympics (1). Understanding the physical, technical, tactical, and psychological characteristics distinguishing successful Olympic badminton athletes from other elite athletes can provide valuable insight into the specific dynamics underlying performance excellence. The concept of "Golden Age" in badminton is a term that has been the subject of quite a lot of research (2). This refers to a period when the sport featured an incredible leap in game quality and the emergence of dominating players, setting a new standard of excellence and elevating the sport to unprecedented levels of competitive intensity and worldwide popularity (3). While excellent physical skill and performance are important factors, also what often goes unnoticed by casual observers is the profound impact of a player's choice of racket grip on their performance at the highest level of competition. Interestingly, the often overlooked racket grip choice can also significantly impact a player's ability to smash forehand (4) effectively. The study aims to build on this existing knowledge by conducting a comprehensive analysis of the interaction between the "Golden Age" factors, athlete height, and dominant racket grip, collectively contributing to the success of badminton athletes at the Olympics.

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MATERIALS AND METHODS

This study uses a quantitative descriptive approach to evaluate the influence of Golden Age (optimal age), height, and racket grip factors in determining the success of badminton athletes in the Olympics. This research data is secondary data obtained from various reliable sources, including official Olympic reports, the Badminton World Federation (BWF) database, the International Olympic Committee (IOC) website, scientific publications, and relevant sports articles. The data covers the period of the Olympics from the time badminton was first competed in 1992 to the 2024 Olympics in Paris.

The data collection process is carried out through documentation studies by collecting and selecting information per the research criteria. The data collection process involves carefully reviewing the documentation and collecting and selecting information that matches the pre-established research criteria. Data analysis was carried out using descriptive statistics, such as the mean, range, and percentage (%) calculation, determining the average age and height of the champion athletes in each match number.

RESULTS

Data analysis shows that the ideal age, or Golden Age, for badminton athletes to win a gold medal at the Olympics varies depending on the number of matches. In the men's singles match number, the optimal age ranges from 22.7 to 30.9 years, with an average age of 26.73 years, while in the women's singles match number, the average age is 24.6 years. In the men's doubles match, the average age reached 27.81 years, while in the women's doubles, it was 25.04. The mixed doubles match number shows an average age of 25.68 years. This age range suggests that the optimal age for athletes to achieve peak achievement is their mid to late 20s, with slightly more significant variation in men's doubles match numbers.

Data shows that for men's singles, the average height is 183.78 cm, ranging from 175 cm to 194 cm. In the women's singles, the average height is slightly lower, 170.56 cm. In the doubles match, the average height is 179.31 cm, and in the women's doubles, it is 167.17 cm, while in the mixed doubles, it is 174.31 cm.

The variables analyzed in this study were the racket grip, right-handed (R), and left-handed (L). Of the 18 athletes analyzed, 14 used their right hand in the men's doubles match number. Meanwhile, in the mixed doubles, only 2 out of 16 athletes used their left hand, but their achievements were dominant.

DISCUSSION

This analysis shows that for the men's singles number, the ideal age to achieve peak achievement and win an Olympic gold medal tends to be in the range of 22.7 to 30.9 years, with the average age of gold medalists being 26.73 years old, which shows that men's singles athletes usually reach their best physical and mental abilities in their mid to late 20s. When they have honed their skills and accumulated substantial competitive experience (2), female athletes tend to peak earlier than male athletes; they can also. In contrast, the women's singles match numbers feature a more comprehensive age range, with gold medalists ranging from 21.49 to 33.27 years old, with an average age of 24.6 years.

Other number studies at the Olympic level, including in men's, women's, and mixed doubles, reveal further differences in the age profiles of gold medalist athletes. In men's doubles, the average age of gold medalists is 27.81 years old, so the experience of playing with a partner for an extended period dramatically determines success in the prestigious event. In the women's and mixed doubles, the average age of gold medalists is 25.04 and 25.68, respectively.

The results of this study show that the optimal age, or "Golden Age" for badminton athletes, plays an essential role in the success of achievements in the Olympics (5) and varies significantly for each match number. For men's singles, for example, the peak age is in the late 20s with an average of 26.73 years, which shows that athletes reach the peak of physical and mental performance at this age. In contrast, in the women's singles, the optimal age is slightly lower, namely in the mid-20s (average 24.6 years). The physical demands and different playing strategies in each match number likely influence this variation. A study on the evolution of the age of badminton players in the top 100 World Rankings from 1994 to 2020 found that the average age of male players increased from 23.7 ± 3.2 years to 26.3 ± 4.4 years during this period (2).

The study found that the average height of men's singles athletes was 183.78 cm, higher than that of athletes in other match numbers (6). This height advantage can provide significant benefits, especially in implementing techniques such as smash punches and net play (7). Although the average height of women's singles athletes is lower than that of men's singles, around 170.56 cm, this does not limit their capacity to perform and excel (3,8).

The distribution of racket grips among Olympic athletes shows exciting dynamics. Although most athletes are dominated by right-handed grips, many left-handed athletes have achieved great success and consistency of achievement at the Olympics (9). One shining example is Lin Dan, a Chinese badminton player who won back-to-back gold medals in 2008 and 2012 despite using his left hand (10).

CONCLUSION

This study confirms that the factors of optimal age (Golden Age), height, and racket grip play a crucial role in determining the success of badminton athletes in the Olympics. The data analysis showed that the ideal age for athletes to reach peak performance ranged from their mid to late 20s, with the average age of champions in men's singles being 26.73 years old and women's singles being 24.60 years old. Height has also been proven to provide a competitive advantage, especially in men's singles, where the average height of the champion reaches 183.78 cm, allowing for a broader range of shots and dominance in net games as well as smashes. However, in the women's event number, although height remains a significant factor with an average of 170.56 cm, technique, and speed of play are the main determinants, allowing athletes of shorter height to still compete and win gold medals. In addition, although most athletes use right-handed racket grips, the success of left-handed athletes such as Lin Dan, Carolina Marin, and Fu Hai Feng shows that left-handed grips can provide a strategic advantage through different game patterns that are difficult for opponents to predict.

APPLICABLE REMARKS

- A descriptive analysis of golden age, height, and racket grip factors reveals their critical roles in the success of Olympic badminton athletes.
- The golden age represents the peak performance period, while height influences reach and court coverage.
- Proper racket grip enhances control, power, and precision in shots.
- Evaluating these factors provides valuable insights into optimizing athlete training and performance strategies, ensuring they reach their full potential on the Olympic stage.

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This research article can be carried out well thanks to the help of various parties. Therefore, the researchers want to express their deepest gratitude, especially to the campus, Padang State University.

AUTHORS' CONTRIBUTIONS

Concept and design of the study: Donie. Data acquisition: Eval Edmizal. Data analysis and interpretation: Eval Edmizal. Compiled the script: Donie. Critical revision of the manuscript for important intellectual content: Eval Edmizal. Statistical analysis: Donie. Administrative, technical, and material support: Donie. Study supervisor: Eval Edmizal.

CONFLICT OF INTEREST

The authors mention no "Conflict of Interest" in this study.

ETHICAL CONSIDERATION

This research has met the standards of research ethics and has received approval to be a sample of all respondents.

FUNDING/SUPPORT

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FINANCIAL DISCLOSURE

The authors have no financial interests related to the material in the manuscript.

ARTIFICIAL INTELLIGENCE (AI)

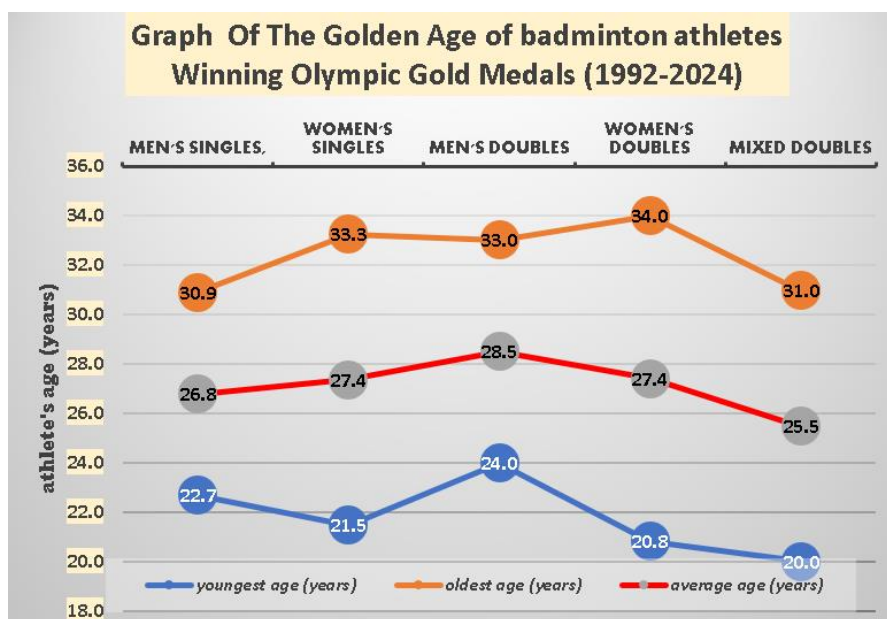
USE There was NO use of artificial intelligence (AI) for preparation, writing, or editing this manuscript.

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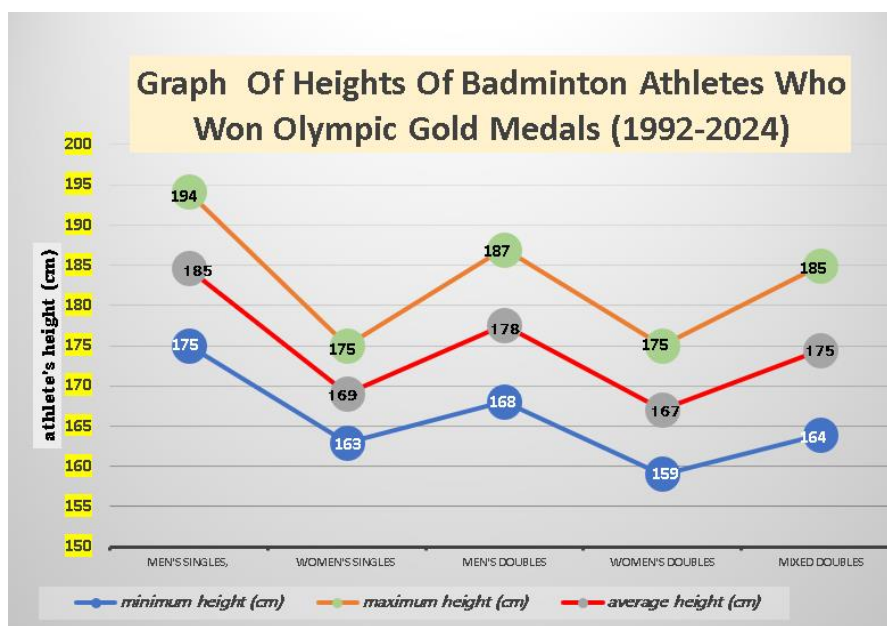
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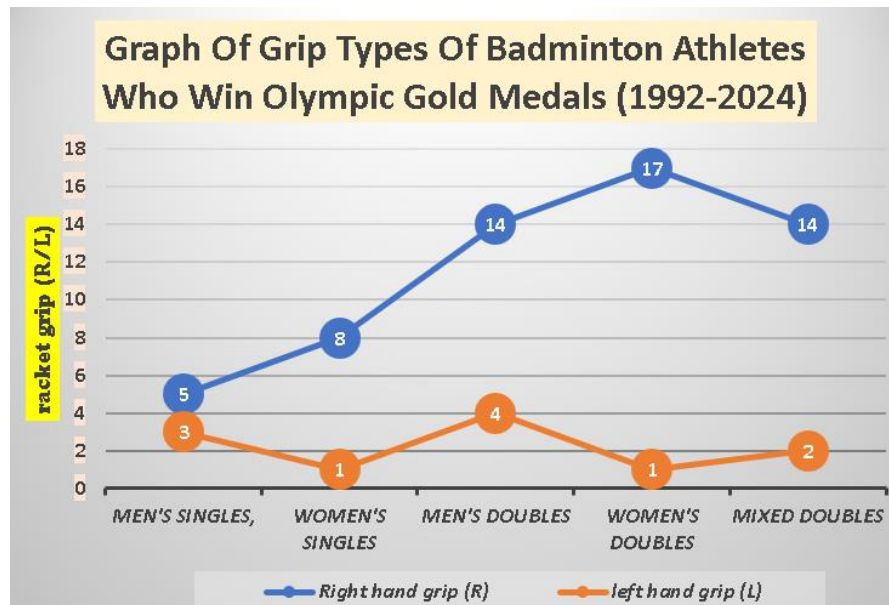
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Graph 1. Average Age of Olympic Champion for Each Match Number



Graph 2. Distribution of the average height of Olympic champions per match number



Graph 3. Distribution of right and left-hand use in Olympic champion athletes

Electroencephalography Evaluation of Brain Waves in Youth Shooting Athletes of Indonesia

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ABSTRACT

Background. The Electroencephalography (EEG) evaluation of brain waves in Indonesian youth shooting athletes aims. **Objectives.** This study explores the modulation of alpha and beta brain waves in young Indonesian shooting athletes to understand their impact on cognitive and motor control during performance. **Methods.** EEG provides a non-invasive approach to monitor brain activity, allowing us to investigate the relationship between mental states and precision in sports. Alpha waves, associated with a relaxed but focused mental state, are critical for filtering distractions, while beta waves, linked to cognitive engagement and motor control, are key during task execution. Nine youth athletes (ages 15 ± 0.58) participated in this study, with brain wave activity recorded using an EEG system during shooting tasks. **Results.** The study highlights the balance between alpha and beta waves as essential for optimal performance in precision sports such as shooting. Understanding these patterns can inform tailored training programs to enhance focus, reduce anxiety, and improve decision-making under pressure, contributing to improved shooting accuracy. **Conclusion.** This research adds valuable insights to sports neuroscience, particularly how brain wave modulation supports cognitive and motor performance in shooting athletes.

KEYWORDS: *Electroencephalography, EEG, Shooting, Brain Waves*

INTRODUCTION

The study of alpha and beta brain waves in athletes, particularly those engaged in precision sports like shooting, has emerged as a crucial area of research for understanding and improving cognitive performance. In shooting sports, where mental focus, motor control, and emotional regulation are critical to success, brain wave modulation plays a significant role in shaping performance outcomes. Electroencephalography (EEG) is a non-invasive way to monitor brain activity and observe how mental states impact athlete performance.

Alpha and beta waves influence attention, relaxation, and cognitive control. The mechanisms they interact to support shooting performance have not been fully elucidated. Understanding these brain wave patterns could lead to more effective training interventions that optimize mental states for shooting athletes. By exploring the role of alpha and beta waves in regulating cognitive and motor processes, this research can inform the development of tailored neurofeedback and mental training programs for shooting athletes. Modifying these

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brain waves could help athletes improve focus, manage anxiety, and make better decisions under pressure, ultimately leading to enhanced performance. This study contributes to the broader field of sports neuroscience, offering insights that could be applied to other precision-based sports that rely on similar cognitive and motor skills.

Shooting sports demands exceptional concentration and fine motor skills, requiring athletes to manage cognitive processes such as attention, decision-making, and emotional control. Brain waves, mainly alpha (8–12 Hz) and beta (12–30 Hz) waves, are thought to be critical for these processes. Alpha waves are associated with relaxed but focused mental states, essential for filtering distractions and maintaining calm during competition. Research by (1) shows that increased alpha power in the left temporal lobe improves attention to visuospatial cues during shooting tasks, while Cheng found that higher occipital alpha activity precedes successful air-pistol shooting (2). Gu et al. also highlighted the role of alpha modulation in integrating brain regions for optimal visuospatial processing during the shooting preparation phase (3).

Beta wave activity during the execution phase of shooting has been correlated with improved motor control and cognitive flexibility (4,5). The importance of beta wave modulation in shooting performance is further underscored by (6), who identified a relationship between increased beta activity and enhanced decision-making capabilities during precision sports. Together, these findings suggest that a balance between alpha and beta wave activity is crucial for peak performance in shooting.

MATERIALS AND METHODS

This study utilizes a quantitative research approach, incorporating electroencephalography (EEG) to measure brain wave activity in shooting athletes during performance.

Participants. The study will involve 9 (5 Male, 3 Female; 15 ± 0.58) youth and intermediate-level shooting athletes, ensuring a diverse sample of participants with varying experience levels. All participants will be briefed on the nature of the study and provide informed consent.

Instruments and Data Collection Procedures. Electroencephalography (EEG) will be used to measure the brain wave activity of participants during shooting tasks. A 32-channel EEG cap will be fitted to each participant to record electrical activity.

RESULTS

In recent years, electroencephalography (EEG) has become increasingly prevalent in sports science to examine brain wave patterns and their correlation with athletic performance. EEG provides a non-invasive method to record electrical activity in the brain, offering insights into athletes' mental states during tasks requiring focus and precision. This study focuses on identifying the dominant brain waves of athletes engaged in shooting tasks.

DISCUSSION

Research indicates that experienced archers often face challenges in performance due to stress and anxiety, which can activate the hypothalamic-pituitary-adrenal (HPA) axis and the sympatho-adrenal medullary (SAM) system, leading to increased catecholamine levels that may adversely affect shooting accuracy (7). The mental demands of archery necessitate a high concentration level (8). The intense concentration required to shoot can increase beta wave activity (Table 1), facilitating rapid information processing and effective responses to dynamic situations (9). This heightened beta activity is particularly evident in competitive or high-pressure scenarios, where the need for precision and focus on the target is paramount. The brain activity is more efficient during the aiming phase (10).

Factors such as skill level, emotional state, and tension can lead to variations in brain activity among athletes (11). For instance, while beta waves are generally dominant during focused tasks, the interplay of anxiety and concentration can lead to fluctuations in brainwave patterns, indicating a complex relationship between mental states and performance (12). Moreover, neurofeedback training has been explored to enhance performance by promoting optimal brainwave patterns, particularly in elite athletes (13). The predominance of beta waves during shooting reflects the high demands of focus and precision required in the sport. Understanding these dynamics can provide valuable insights into optimizing performance through psychological and neurophysiological interventions (14,15).

CONCLUSION

Engaging in shooting activates brainwaves, particularly beta waves, linked to concentration, focus, and quick information processing. These waves, with a frequency range of 13 Hz to 30 Hz, tend to increase during high-stress or competitive situations as individuals coordinate precise movements and maintain attention on

the target. The level of beta wave activity may vary depending on factors such as experience, emotional state, and tension, highlighting the unique nature of each person's mental and physiological response during these activities.

APPLICABLE REMARKS

- Engaging in shooting activates brainwaves, particularly beta waves, associated with concentration, focus, and rapid information processing.
- The frequency range of these waves, from 13 Hz to 30 Hz, typically increases during high-stress or competitive situations, as individuals must coordinate precise movements and maintain attention on their targets.
- Moreover, the level of beta wave activity can fluctuate based on various factors, including an individual's experience, emotional state, and tension.
- This variability underscores each person's distinct mental and physiological responses during shooting activities, suggesting that personalized training approaches may enhance performance by considering these individual differences.

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AUTHORS' CONTRIBUTIONS

Study concept and design: Del Asri and Tandiyo Rahayu. Acquisition of data: Heny Setyawati and Hari Setijono. Analysis and interpretation of data: Aridhotul Haqiyah and Sri Indah Ihsani. Drafting the manuscript: Johansyah Lubis and Fatih Hazar.

CONFLICT OF INTEREST

The authors mention no "Conflict of Interest" in this study.

FUNDING/SUPPORT

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There was NO use of artificial intelligence (AI) for preparation, writing, or editing this manuscript.

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Table 1. Dominant Waves Athletes

No Respondent	Point	Dominant Waves
Athletes 1 Air Rifle	9	Delta, beta, alpha, theta, gamma
	10	Beta, delta, alpha, theta, gamma
	10	Beta, delta, alpha, theta, gamma
	10	Alpha, delta, beta, theta, gamma
	10	Delta, alpha, beta, theta, gamma
Athletes 2 Air Pistol	9	Theta, beta, delta, alpha, gamma
	9	Delta, beta, alpha, theta, gamma
	9	Beta, delta, alpha, theta, gamma
	10	Beta, Delta, Theta, Alpha, Gamma
	8	Beta, delta, alpha, theta, gamma
Athletes 3 Air Pistol	8	Beta, delta, alpha, theta, gamma (no glasses)
	8	Beta, Gamma, Alpha, Delta, Theta (no glasses)
	7	Beta, Gamma, Alpha, Delta, Theta (no glasses)
	7	Delta, alpha, beta, theta, gamma
	10	Beta, Delta, Alpha, Gamma, Theta
Athletes 4 Air Rifle	7	Alpha, beta, delta, gamma, theta
	10	Beta, alpha, gamma, delta, theta
	9	Beta, gamma, alpha, delta, theta
	10	Beta, alpha, delta, theta, gamma
	9	Beta, alpha, gamma, delta, theta
Athletes 5 Air Rifle	10	Alpha, beta, delta, theta, gamma
	9	Alpha, beta, gamma, theta, delta
	10	Alpha, beta, delta, gamma, theta
	10	Alpha, beta, gamma, delta, theta
	10	Alpha, beta, delta, theta, gamma
Athletes 6 Air Rifle	10	Beta, alpha, gamma, delta, theta
	9	Beta, alpha, delta, gamma, theta
	10	Beta, alpha, gamma, delta, theta
	10	Beta, alpha, gamma, delta, theta
	10	Beta, gamma, alpha, delta, theta
Athletes 7 Air Pistol	9	Delta, alpha, beta, theta, gamma
	9	Beta, alpha, gamma, delta, theta
	10	Beta, alpha, delta, gamma, theta
	9	Beta, gamma, alpha, delta, theta
	10	Beta, gamma, delta, alpha, theta
Athletes 8 Air Pistol	7	Delta, alpha, beta, theta, gamma
	9	Alpha, beta, delta, theta, gamma
	10	Alpha, delta, beta, theta, gamma
	6	Delta, alpha, beta, theta, gamma
	10	Delta, alpha, theta, beta, gamma
Athletes 9 Air Rifle	9	Alpha, beta, gamma, delta, theta
	10	Beta, gamma, alpha, delta, theta
	9	Beta, gamma, alpha, delta, theta
	10	Beta, gamma, alpha, delta, theta
	9	Beta, alpha, delta, gamma, theta

Mental Fatigue in Athletes: How Mental Toughness Affects Competition?

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ABSTRACT

Background. This study investigates the relationship between mental toughness and mental fatigue among athletes competing in Indonesia's 2024 XXI National Sports Week (PON), recognizing psychological resilience's critical role in optimal performance under pressure. **Objectives.** The research examines how mental toughness may influence athletes' ability to cope with mental fatigue during rigorous training schedules. **Methods.** A total of 30 athletes from various sports disciplines participated in the study, completing the Fatigue Assessment Scale (FAS) 10-item questionnaire and the Mental Toughness Questionnaire (MTQ-27) with conduct crosstabulations and chi-square tests. **Results.** The results indicate a significant negative correlation between mental toughness and mental fatigue, suggesting that athletes with higher mental toughness experience lower mental fatigue levels, enhancing their capacity to maintain focus and performance during intense preparation. **Conclusion.** These findings underscore the importance of developing mental toughness in athletes to mitigate mental fatigue in competitive environments.

KEYWORDS: *Mental Toughness, Mental Fatigue, Fatigue Assessment Scale, National Sports Week*

INTRODUCTION

The relationship between mental toughness and mental fatigue in athletes is a complex and critical area of study, especially in national-level competition preparation. Athletes at this level face intense psychological and physical demands, requiring not only physical conditioning but also strong mental resilience. Given the intense demands of national-level competitions, understanding how mental toughness interacts with mental fatigue is essential for improving mental and physical preparation strategies.

While mental toughness is widely recognized as a critical factor in athlete success, its relationship with mental fatigue remains under-explored, particularly in elite competition preparation. Athletes preparing for national-level competitions are frequently subjected to prolonged and uninterrupted training, which can lead to mental fatigue and impair performance. This study addresses these gaps by examining the relationship between mental toughness and mental fatigue in athletes preparing for national-level competitions.

Mental toughness, maintaining focus, motivation, and confidence under pressure (1), enables athletes to

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cope with stress and perform optimally even under challenging conditions. This attribute is fundamental during the rigorous training and competition schedules that often lead to mental fatigue, a condition marked by diminished cognitive and emotional energy (2).

Research highlights that mental toughness significantly influences athlete performance, particularly in high-pressure situations where cognitive and motor tasks are affected. Athletes with higher levels of mental toughness are better equipped to handle the mental fatigue that can impair focus and decision-making (3). Although mental toughness is believed to help athletes mitigate the effects of fatigue, the precise mechanisms through which this occurs and whether mental toughness can always buffer the negative impacts of mental fatigue require further investigation (2,4).

MATERIALS AND METHODS

This study evaluated the psychometric properties of mental fatigue questionnaires and athletes' mental toughness.

Participants and procedures. A quantitative method was utilized in this study. 30 Athletes (20 Male and 10 Female with Age; $M=23.1$, $SD=1.6$). Regarding ethical considerations, written consent from participants was obtained before completing the questionnaire. After being briefed by the research team, the participants were requested to sign an informed consent form.

Instruments. A background questionnaire was used to collect participant information, such as gender, age, and level of competition. The dimension Fatigue Assessment Scale (6) consists of 10 items: 5 questions for physical fatigue and 5 for mental fatigue (5-6). The response scale is a 5-point scale (1 = never to 5 = always). Scores on the FAS can range from 10 to 50. The mental toughness questionnaire consists of 27 items with 5 Likert scales from 1 (never) and 5 (always) (7-8).

Data analysis. The SPSS software V26, developed by IBM Corp in 2017, was employed to perform descriptive statistics, generate participant demographic profiles, and conduct crosstabulations and chi-square tests.

RESULTS

The demographic profile shows that most athletes are male (66.7%) and highly experienced, with 90% competing nationally and 83.3% attending training camps longer than five months. Recently, 80% completed training camps within the last 1-3 months. A rigorous schedule is standard, with 63.3% training 6-10 times per week and 30% exceeding 10 sessions weekly. Training intensity is high, with 56.7% training at 80% intensity and 20% at 90%. This reflects a disciplined, elite group focused on peak performance for national and international competitions. The data reveals a strong connection between training variables and athletes' fatigue and mental toughness (MT). Athletes participating in camps longer than five months show significantly higher fatigue levels ($p = .000$), indicating that extended training without proper rest may lead to physical and mental exhaustion. Additionally, those training at 80–90% intensity also report higher fatigue ($p = .008$), while the number of sessions per week does not significantly impact fatigue ($p = .258$). This suggests that intensity and duration are more critical to fatigue than frequency. On mental toughness, athletes in camps exceeding five months typically fall into the medium MT category, with a notable correlation ($p = .004$). Training frequency, particularly 6–10 sessions per week, is also linked to medium MT levels ($p = .002$). Moreover, training intensity, especially at 80%, significantly impacts MT ($p = .038$). However, the time since the last camp does not correlate with MT ($p = .241$), underscoring the importance of consistent training intensity and duration over time.

The Pearson Correlation analysis found a strong negative correlation of -0.671 between mental toughness and mental fatigue, indicating a significant inverse relationship between these two variables. This suggests that athletes with higher mental toughness experience lower mental fatigue as they prepare for national-level competitions.

DISCUSSION

The analysis reveals that extended training camps (over five months) and high-intensity sessions (80%-90%) significantly increase athlete fatigue ($p = .000$, $p = .008$), while training frequency has no significant impact ($p = .258$). Managing training intensity and duration is crucial to preventing fatigue and burnout. A strong negative correlation between mental toughness and fatigue ($r = -0.671$, $p = .000$) (table 4) suggests that athletes with higher mental toughness experience less fatigue maintaining focus and resilience during intense training. Developing mental toughness through moderate-intensity training helps athletes cope with physical and mental challenges. Research highlights mental toughness as the key to success, enabling athletes to handle stress, recover from setbacks, and perform under pressure.

Athletes with higher mental toughness demonstrate better cognitive control and emotional regulation, helping them manage mental fatigue during critical moments in competition (9-10). Mental toughness allows athletes to maintain focus, motivation, and confidence under pressure, recover quickly from mistakes, and perform optimally despite adversity (1,11). This resilience is developed through repeated exposure to challenging conditions and stress (3,12). Research shows that mentally tough athletes are better equipped to handle cognitive demands (13).

APPLICABLE REMARKS

- Mental fatigue can significantly impact athletic performance, reducing focus, decision-making, and physical efficiency during competition.
- However, mental toughness is a critical buffer, enabling athletes to persevere through psychological stress and maintain optimal performance.
- Traits like resilience, self-confidence, and emotional control help athletes manage fatigue, recover faster, and adapt to competitive pressures.
- Understanding this relationship is essential for developing strategies that enhance mental resilience and ensure peak performance under challenging conditions.

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AUTHORS' CONTRIBUTIONS

Concept and design of the study: Aridhotul Haqiyah. Data acquisition: Dindin Abidin. Data analysis and interpretation: Johansyah Lubis. Compiled the script: Dani Nur Riyadi. Critical revision of the manuscript for important intellectual content: Bujang. Statistical analysis: Hasan Basri. Administrative, technical, and material support: Aridhotul Haqiyah. Study supervisor: Yunita Lasma.

CONFLICT OF INTEREST

The authors mention no "Conflict of Interest" in this study.

ETHICAL CONSIDERATION

This research has met the standards of research ethics and has received approval to be a sample of all respondents.

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ARTIFICIAL INTELLIGENCE (AI)

USE There was NO use of artificial intelligence (AI) for preparation, writing, or editing this manuscript.

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Table 1. The demographic profile of athletes

Demographic		Frequency	Percentage (%)
Gender	Male	20	66.7
	Female	10	33.3
Higher Level Performance	Province	1	3.3
	National	27	90
	International	2	6.7
	Local	0	0
Match Experience	Province	2	6.7
	National	27	90
	International	2	3.3
Long Training Camp	3 – 5 month	5	16.7
	>5 month	25	83.3
The Last Training Camp	1 – 3 months ago	24	80.0
	<1 month ago	4	13.3
	>5 months ago	2	6.7
Times train per week	3 – 5	2	6.7
	6 – 10	19	63.3
	>10	9	30.0
Intensity of Training	100%	4	13.3
	60%	1	3.3
	70%	1	3.3
	75%	1	3.3
	80%	17	56.7
	90%	6	20.0

Table 2. Analysis of FAS (Fatigue Assessment Scale) Results with Chi-Square Test

		FAS			Pearson Chi-Square	Asymptotic Significance (2-sided)
		Low	Medium	High		
Long Training Camp	3 – 5 month	4	0	1	23.829 ^a	.000
	>5 month	0	19	6		
The Last Training Camp	1 – 3 months ago	3	16	5	1.577 ^a	.813
	<1 month ago	1	2	1		
	>5 months ago	0	1	1		
Times train per week	3 – 5	1	0	1	5.295 ^a	.258
	6 – 10	2	14	3		
	>10	1	5	3		
Intensity of Training	100%	0	2	2	23.839 ^a	.008
	60%	1	0	0		
	70%	1	0	0		
	75%	1	0	0		
	80%	1	13	3		
	90%	0	4	2		

Table 3. Analysis of MTQ (Mental Toughness Questionnaire) Results with Chi-Square Test

		MT			Pearson Chi-Square	Asymptotic Significance (2-sided)
		Low	Medium	High		
Long Training Camp	3 – 5 month	0	3	2	10.892 ^a	.004
	>5 month	2	23	0		
The Last Training Camp	1 – 3 months ago	1	22	1	5.481 ^a	.241
	<1 month ago	1	2	1		
	>5 months ago	0	2	0		
Times train per week	3 – 5	1	0	1	16.538 ^a	.002
	6 – 10	0	19	0		
	>10	1	7	1		
Intensity of Training	100%	1	3	0	19.219 ^a	.038
	60%	0	1	0		
	70%	0	0	1		
	75%	0	1	0		
	80%	0	16	1		
	90%	1	5	0		

Table 4. Pearson Correlation

Pearson Correlation	-.671
Sig. (2-tailed)	.000

The Effect of Providing Physical Education Learning Models Using Virtual Reality on Improving the Physical Fitness of High School Students

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ABSTRACT

Background. A learning model is needed for high school students using virtual reality because it is expected to impact the activities and achievement of PJOK learning objectives positively. **Objectives.** This study aims to determine the effect of providing a physical education learning model on improving students' physical fitness based on virtual reality. **Methods.** The research sample is high school students in grade IX. After the pre-test, all samples were given a physical education learning model and a post-test was carried out. The results of the pretests-posttests recorded were physical fitness data using TKJI. **Results.** The provision of the learning model significantly influenced the improvement of physical fitness, characterized by the acquisition of the calculation of the obtained sig value. (2-tailed) from $0.001 < 0.05$. **Conclusions.** Based on the Physical Education learning model, there is a difference in the average fitness results of students. Based on the testing of this hypothesis, it was concluded that the VR learning model influenced the physical fitness of high school students. This means that training programs can be recommended to be implemented to improve fitness.

KEYWORDS: *Learning Model, Physical Fitness, Virtual Reality*

INTRODUCTION

The current situation and conditions provide excellent opportunities for technology, such as applications, to develop and have greater benefits in the sustainability of human activities. One of the teachers who is a member of the MGMP PJOK Payakumbuh said that students still do not have high enthusiasm for learning PJOK, especially female students. Sports activities will help improve students' physical fitness and make them healthy and able to participate in teaching and learning activities at school well. This is because during COVID-19, students do practical PJOK learning at home, and this is not easy to condition because they tend to feel comfortable with theoretical learning where they only sit in front of their cellphones or laptops. This is undoubtedly a concern for researchers under the government's expectations to control education online, but for PJOK subjects, it has become a polemic and a big obstacle because of its practical nature. Our physical education should focus on how best to promote beneficial educational outcomes for students across multiple domains (1). Developing a learning model using digital media is expected to impact students positively.

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Presentation of game-based learning using virtual reality can be an alternative for students to be more interactive. In physical education classroom teaching, teachers should make full use of students' inquiry consciousness to improve students' creativity and enhance their intelligence level(2) Virtual Reality (VR) has become a trendy IT topic in the past few years (3) Virtual reality is a man-made condition that is produced with programming and exhibited to the client so that the client suspends conviction and acknowledges it as a certifiable domain(4). Virtual reality (VR) is something everyone can access quickly and at any time. As a tool, media has the function of smoothing the way towards achieving goals. This is based on the belief that the teaching and learning process, with the help of media, enhances students' learning activities over a reasonably long period. This means that students' learning activities with the help of media will produce better learning processes and results than without the help of media (5). VR has also been recognized as beneficial in its application for team development with pedagogically valuable factors (6). Virtual reality works in that it starts with the user seeing a virtual world, which is a dynamic image resulting from a computer simulation. Then, through a tool shaped like VR glasses, a user can interact with the virtual world and get honest physical and fictional feedback so that everyone can learn various things using this 3D animation. Virtual Reality (VR) is starting to be used in psychological therapy worldwide.

Large-scale user efficiency in virtual reality needs to be improved (7), and immersive virtual reality simulations can be used to improve the basic conditions of physical education (8). VR has been developed from year to year, and now VR can be enjoyed widely at an economical price, using high-quality equipment that is easily accessible. VR works by manipulating the human brain so that it seems to make various virtual things feel like real things. It can be said that VR is the process of eliminating the real world around humans and making the user feel led into a virtual world without contact with the real world. VR also has differences in the conscious experience of reality between waking, dreaming, and psychotic states (9). VR is also a motor rehabilitation for people who feel bored and lose motivation to practice (10). Therefore, a learning model is needed for high school students using virtual reality because it is expected to positively impact the activities and achievement of PJOK learning objectives.

MATERIALS AND METHODS

Based on the problems that have been discussed, this study is a quasi-experimental study, which is a study that approaches actual treatment where it is impossible to control and manipulate all relevant variables. The sample in this study was 20 high school students in grade IX. This study began by giving a pre-test to the sample, then giving a VR learning model treatment 16 times, and after that, a post-test was given. The physical fitness test used the "Indonesian Physical Fitness Test (TKJI)". Moreover, data analysis used the t-test with SPSS v29.

RESULTS

The results of the normality data analysis are shown in Table 1. A significant value > 0.05 was found, and the data was normally distributed. An analysis was carried out using a t-test to see the effect of the training given. The results of this test are described in Table 2.

Based on the output of Pair 1, the value of sig is obtained. (2-tailed) of $0.001 < 0.05$, it can be concluded that there is a difference in the average fitness results of students given the Physical Education learning model for the experimental group's pre-test and the experiment's post-test. This shows that the treatment of the VR learning model has a significant effect on physical fitness. This means that the training program can be recommended to be implemented to improve athletes' physical fitness. Based on this hypothesis testing, it is concluded that the VR learning model affects the physical fitness of high school students.

DISCUSSION

Based on the analysis obtained from this study, it has been seen that there is an increase in physical fitness from the initial test before training and the final test after being given VR learning model training. The VR learning model influences increasing physical fitness. This means that the VR learning model provided can improve physical fitness. The findings obtained between the VR learning model and physical fitness show a positive relationship and have a significant effect because the VR learning model can influence physical fitness. Therefore, the VR learning model for students can be given periodically to improve the physical fitness of high school students. This effort is made so that high school teachers have references and guidelines for providing interesting learning models and still aim to improve students' physical fitness at school. Until now, there are still not too many teachers in schools who provide play activities as they should according to the needs of students. Physical education can improve physical fitness so that students can be healthy and cheerful and carry out learning activities at school well. This study aims to see the effect of providing a Physical

Education learning model through Virtual Reality Applications. The application contains physical education materials to create more effective and efficient learning. The subjects of this study were high school students.

CONCLUSION

Based on the analysis and discussion of this study, it can be concluded that the VR learning model has a significant influence on improving physical fitness abilities. The study's results showed that the provision of the learning model significantly influenced the improvement of physical fitness.

APPLICABLE REMARKS

- If given interactively and engagingly, physical education learning can positively impact students, improving fitness.
- If the student's fitness is good, it is hoped that the student will be able to participate in learning at school well and achieve the maximum learning goals.

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AUTHORS' CONTRIBUTIONS

Study concept and design: Sari Mariati, Alex Aldha Yudi. Acquisition of data: Hendri Irawadi Desi Purnama Sari. Analysis and interpretation of data: Willadi Rasyid, Yogi Arnaldo, Drafting the manuscript: Fathurrahman Hafid, Jepri Naldi. Critical revision of the manuscript for important intellectual content: Sari Mariati. Statistical analysis: Suci Nanda Sari

CONFLICT OF INTEREST

The authors mention no "Conflict of Interest" in this study.

ETHICAL CONSIDERATION

The Guidelines for Research Ethics and Scientific Publication of Universitas Negeri Padang were unanimously decided by the members participating in the meeting to provide this document as the "Ethics Committee Approval Document" for the research.

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FINANCIAL DISCLOSURE

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ARTIFICIAL INTELLIGENCE (AI) USE

There was NO use of artificial intelligence (AI) for preparation, writing, or editing this manuscript.

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Table 1. Test of Normality

	Kolmogorov-Smirnova			Shapiro-Wilk		
	Statistic	df	Mr.	Statistic	df	Mr.
Pre Test	.176	20	.106	.932	20	.172
Post Test	.148	20	.200*	.944	20	.280

*. This is a lower bound of the true Significance.

a. Lilliefors Significance Correction

Table 2. Results of the t-test

		Paired Differences					Significance			
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference		t	df	One-Sided p	Two-Sided p
					Lower	Upper				
Pair 1	Pre-Test - Post-Test	2.100	1.165	.261	2.645	1.555	8.059	19	<.001	<.001

Development of a Psychomotor Domain Self-Assessment Application in Tennis Court Education

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ABSTRACT

Background. Effective feedback and assessment are critical to skill acquisition in field tennis courses, particularly those with a psychomotor focus. **Objectives.** This research aims to develop a responsive web-based self-assessment application for field tennis courses that allows students to evaluate their skills using an application. **Methods.** This one-year study involved system design, programming, performance measurement, and field testing. Following Borg and Gall's ten-step product development approach, it engaged 10 experts (subject matter, IT, and assessment specialists). The final stage included small-group trials (n=20) and large-group trials (n=50), with data analyzed using descriptive quantitative methods. **Results.** Research data showed a validity score of 86.76%, indicating a highly feasible category, and reliability of 92.76%, indicating high feasibility and practicality, with 90.77% in the very valid category. **Conclusion.** The psychomotor domain self-assessment application can thus be effectively used in field tennis courses.

KEYWORDS: *Self-Assessment, Psychomotor, Field Tennis*

INTRODUCTION

The government implemented a policy advocating that teaching and learning should move online (1). While this measure has helped to reduce the number of coronavirus cases, it has already raised thousands of problems with performance-oriented classes. Common issues included inadequate learning systems, limited facilities, and the need for teachers and students to adapt to new digital learning environments.

At the Faculty of Sports Science (FIK UNP), over 65% of courses emphasize psychomotor skill development, including mandatory field tennis courses. Despite efforts to improve learning quality through better resources and facilities, achievement rates in psychomotor-based courses remained below 75% (2). A significant challenge was students' low proficiency in physical tasks due to the need to master techniques across multiple sports. Additionally, the assessment system relied solely on video submissions, limiting feedback to grading without constructive input (3). This one-way approach lacked interaction, essential for psychomotor learning (4,5). This study suggests a responsive web-based self-assessment model to remedy these problems and allow students to evaluate their skill levels independently. The model empowers students to assess their abilities, with results guiding instructors' interventions as needed. Self-assessment in motor skills can improve learning by reducing technique errors, though implementing these assessments online has been challenging due to limited interaction. The proposed application aims to replicate the instructor's role in guiding students through motor skill self-assessment, even in remote learning environments. Shifting to online learning during COVID-19 significantly impacted educational practices. Physical education courses at FIK are pushed to online formats to prevent virus

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transmission, emphasizing that students must master various basic techniques across nine areas in the PJOK curriculum, seven focusing on psychomotor skills (7). Consequently, over 80% of learning activities are movement-based, demanding precise execution of foundational sports skills. Although the principles of practical learning remain the same, face-to-face elements have moved to digital formats, preserving similar procedures.

Assessment is essential for measuring student outcomes, particularly in skill-based courses, as it allows lecturers to gauge achievements across cognitive, affective, and psychomotor domains (8). Feedback plays a crucial role in refining motor skills (9). In practical courses, performance assessments measure students' abilities in real-life contexts, aligning with expected standards. Research also shows that self-assessment closely aligns with teacher assessments, underscoring its value as a learning tool (10).

This study builds on previous research, focusing on developing a web-based self-assessment tool specifically for the psychomotor domain. The application includes two-way feedback, allowing students to receive real-time guidance on their performance through features such as video uploads and discussion forums. The application will help students independently assess their motor skills, with their evaluations recorded and analyzed digitally to provide instant feedback.

MATERIALS AND METHODS

Study design. This research is organized into three stages over one year. The first stage involves designing the application, the second stage consists of laboratory-scale testing, and the third stage focuses on refinement and field testing. The development approach follows Borg and Gall's 10 stages of product development research. A flowchart of these research stages is provided in Figure 1.

Measurement. The research instrument for this study is a validation questionnaire that will be administered to the target respondents. The questionnaire is developed using a Likert scale with five response options. A test-retest method will be employed to test the application's reliability. Data analysis will be conducted using a percentage analysis technique.

Research Procedure and Statistical Analysis. The research procedure consists of the following stages: 1) Application Development: The team designed a self-assessment model tailored for psychomotor courses, explicitly addressing the needs of field tennis lecturers; 2) Validation and Reliability Testing: Validation involved 10 experts in IT, pedagogy, and testing, while reliability was tested using the test-retest method to ensure consistency across Android applications; 3) Small-Scale Field Testing: This phase assessed usability with 20 randomly selected participants; 4) Large-Scale Field Testing: Targeted at university students, this test evaluated the application's performance on field tennis stroke techniques, involving 50 respondents.

RESULTS

The self-assessment application is specifically designed for field tennis courses and is tailored to evaluate basic skills in field tennis techniques. It assesses four fundamental techniques: forehand stroke, backhand stroke, volley, and service (Figure 2).

Figure 2 shows the workflow of the student-developed application. The interface includes an identity menu and options for selecting assessments. Students self-assess their skills in specific techniques, with results displayed upon completing all indicators. The assessment includes three main phases: initial, core, and final. Students receive a skill score, which instructors manually convert into grades. This research utilizes App Inventor, a web-based system for creating Android apps without coding, using visual block programming to make app development accessible to users with minimal programming experience (11).

App Inventor uses the Kawa Language Framework and Kawa's dialect, developed by Per Bothner. These tools serve as compilers to translate Visual Blocks. App Inventor provides an easy-to-use interface with drag-and-drop features for designing the user interface of Android applications. This makes it an ideal tool for projects that aim to develop Android applications without requiring complex coding skills, as users can build functional interfaces and program behaviors in a simplified visual environment (12).

In line with the research objectives, the data analyzed in this study will include the developed application's validity, reliability, and practicality. The application's validation process begins with assessments by content experts, comprising five field tennis specialists.

The assessment emphasizes accuracy across three phases: initial, core, and final. Research data showed a validity level of 86.76%, which is classified as highly appropriate. Reliability testing, conducted through a test-retest technique, confirmed a reliability score of 92.76%, which was also deemed highly suitable—practicality data aimed to capture user perceptions on the application's ease of use, collected via questionnaires. Results indicated a practicality score of 90.77%, categorized as highly valid. These findings suggest that the psychomotor domain self-assessment application is effectively suited for use in field tennis courses.

DISCUSSION

The self-assessment application for field tennis courses was developed to provide students with a tool for accurately evaluating fundamental tennis techniques while encouraging self-directed skill improvement. The application assesses four essential tennis skills—forehand, backhand, volley, and serve—by guiding students through each stage of skill execution (13,14). These are the initial, core, and final stages, with indicators of all the components to ensure the technique is implemented correctly. This structured assessment requires little instructor intervention and

lets students know where they stand and what areas they need to work on. Students are assessed on how thoroughly they answer the questions. Upon completion, teachers manually convert responses into grades. The application's design uses App Inventor, a user-friendly interface incorporating visual block programming and drag-and-drop features to help development. This approach helps build an application efficiently without being an expert in programming, as suggested by previous research (11,15) that revealed App Inventor's ease of use for non-programmers.

Validation, reliability, and practicality tests confirmed the application's suitability for educational use. Content validation by five field tennis experts yielded an 86.76% validity rate, indicating high accuracy and relevance for tennis skill assessment. Reliability testing, using the test-retest method, showed a consistency score of 92.76%, underscoring the tool's dependability. Practicality, assessed through user perception surveys, scored 90.77%, highlighting its user-friendly design and accessibility. This high practicality aligns with the goals of App Inventor-based applications, intended to be intuitive and easy to use, even for beginners (12).

The study's results suggest using a self-assessment application to assess psychomotor skills in tennis courses. The application offers a structured and standard approach for students to learn essential techniques privately but with benchmark criteria in place. The success in field testing suggests similar tools could be created for other sports, potentially enhancing psychomotor education across disciplines. Future studies could focus on refining the application with features like automated grading and personalized feedback to improve the self-assessment experience and minimize the need for instructors to grade it manually.

CONCLUSION

Based on the tests and data collected, it can be concluded that 1) The developed application has high validity, 2) The developed application has high reliability, and 3) The developed application has high practicality. Therefore, the application is suitable for use in supporting field tennis courses.

APPLICABLE REMARKS

- This research can be applied to enhance tennis gameplay or performance, benefiting coaches, tennis instructors, and academics.

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AUTHORS CONTRIBUTIONS

Study concept and design: Kamal Firdaus, Nurul Ihsan, and Ilham. Acquisition of data: Imantara Subagio, Indri Wulandari. Analysis and interpretation data: Ilham, Rully Effendi,. English and AI control: Ilham.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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ROLE OF SPONSOR

The funding organization is a public institution and has no role in the design and conduct of the study, the collection, management, and analysis of the data, or the manuscript's preparation, review, and approval.

FINANCIAL DISCLOSURE

The authors have no financial interests related to the material in the manuscript.

ARTIFICIAL INTELLIGENCE (AI) USE

No artificial intelligence was used to prepare, write, or edit this manuscript.

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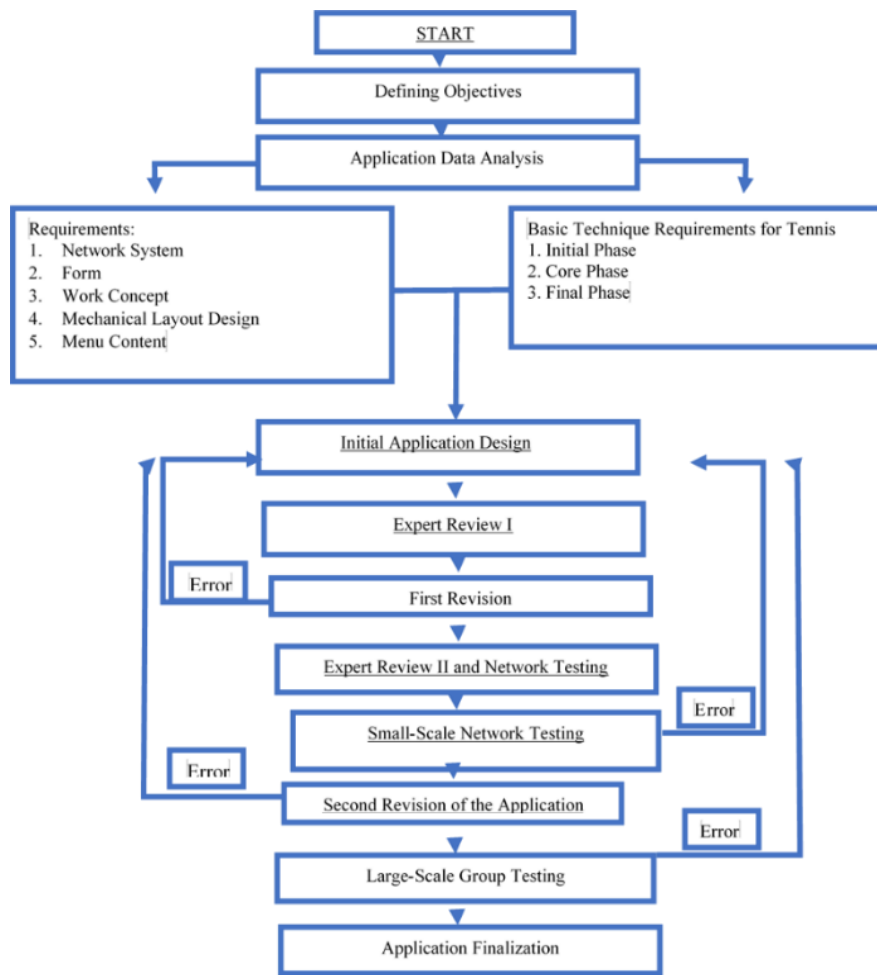


Figure 1. Product Development Research Stages

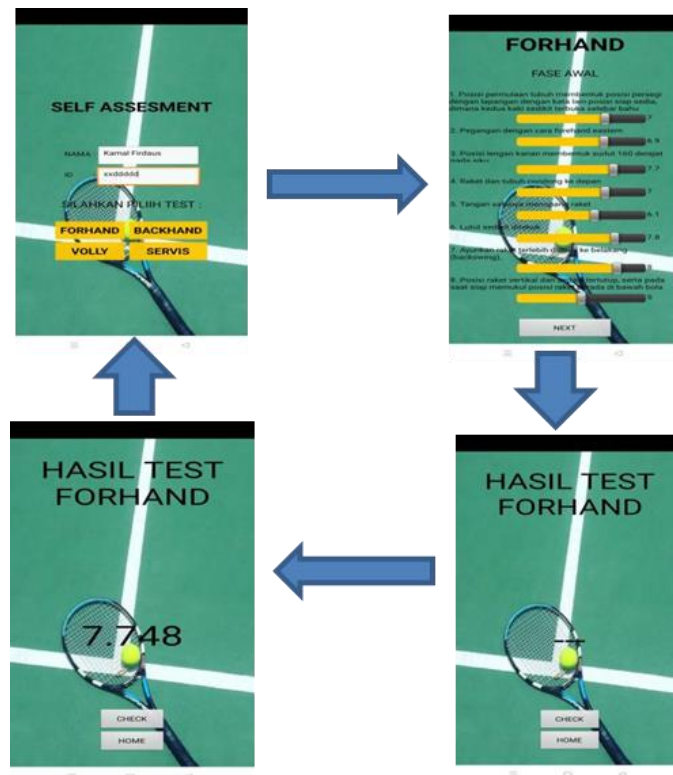


Figure 2. Application Workflow

Table 1. Application Validation

No.	Technique	Phase	Instruction
1	Forehand	Initial Phase	- The initial body position forms a square stance relative to the court, also known as the ready position, where both feet are slightly open and shoulder-width apart. - The grip technique using the eastern forehand grip - The position of the right arm forms a 160-degree angle at the elbow. - The racket and body are angled forward. - The other hand supports the racket. - The knees are slightly bent. - Swing the racket forward first. - Swing the racket back first (backswing).
			- The racket position is vertical and slightly closed. When ready to strike, the racket is positioned below the ball. - The stroke movement is directed forward, moving toward the ball as it approaches. - Swing the racket parallel to the court. - Do not move the wrist.
		Core Phase	- Keep your focus on the ball. - Hit the ball as quickly as possible. - Afterward, swing the racket upward with the support of the left foot and the movement of the elbow, changing the elbow angle to 90 degrees. - The right foot is positioned to support the body weight slightly. - Rotate the shoulders to the right side. - The racket moves forward toward the left shoulder. - The racket moves forward toward the top of the left shoulder. - Keep your gaze focused on the ball.
			- The body weight is supported on the left foot. - Hit the ball as quickly as possible. - The follow-through position after the strike. - Swing across and upward. - Guide the racket toward the target. - Return to the ready position to receive the opponent's shot. - Hold the racket with an eastern grip. - Stand with your feet shoulder-width apart, facing forward. - Position your knees parallel and slightly bent.
		Final Phase	- Lean your body forward with your heels slightly lifted. - Position your right arm to form a 160-degree angle at the elbow. - Swing the racket backward. - Berputar menyamping terhadap net - Step forward toward the target. - Shift your body weight forward. - Swing the racket parallel to the court. - Focus on the ball. - Hit the ball as early as possible. - The stroke movement is directed forward. - As the ball approaches, rotate your shoulders to the left. - The left foot supports the body weight slightly, and then the racket is swung upward with the support of the right foot and elbow movement, adjusting the elbow angle to 90 degrees. - When hitting the ball, strike it at its highest point. - The racket moves forward, following the direction of the ball. - Swing the racket up toward the right shoulder. - Keep your gaze focused on the ball. - The body weight is supported on the right foot. - Move the elbow so that the angle at the elbow changes to 90 degrees upon striking the ball. - Strike the ball at its highest point. - Swing your arm back to the starting position. - Return to the ready position to prepare for the opponent's next shot. - Hold the racket with a continental grip for the volley shot. - Spread your feet to about shoulder-width apart. - Bend your knees slightly to achieve a good balance point. - Bend your body slightly forward. - Bend your knees. - Your body movement should be relaxed and dynamic.
2	Backhand	Core Phase	
		Final Phase	
3	Volly	Initial Phase	

4	Service	Core Phase	• The body position should be quick and alert. • Position your feet on tiptoe. • Position your elbow in front of your body. • The racket grip is positioned above the wrist. • Hit the ball when it is in front of your body. • Shift your body weight forward.
			• Step forward with your left foot as you hit the ball. • Use your wrist when hitting the ball. • The racket position is slightly open. • Make a short, quick swing from top to bottom. • Adopt a ready stance before reaching the hitting area. • Position yourself in line with the ball's trajectory and swing the racket as you approach the ball.
			• After hitting the ball, follow its direction with the racket face.
		Final Phase	• Step forward as you hit the ball. • Allow the back foot to lift after the shot, using it to move toward the next position. • Return the racket to the starting position. • Return your feet to a parallel position. • Keep your gaze focused forward. • Ready position for the next shot. • The ideal ready position.
			• Position your left foot in front, angled at 45 degrees to the baseline. • The distance between your feet should be shoulder-width apart.
			• Position your feet parallel to the baseline.
		Initial Phase	• Position your body standing behind the baseline. • Position your head to align your gaze with the target. • Focus on directing the ball to the opponent's service area. • The grip used for serving is the continental grip. • Toss the ball upward, slightly in front of your head. • The ball toss should reach a height of approximately 20-30 cm. • The arm that tosses the ball should be straight.
			• The ball travels straight upward.
			• Shift your body weight to the back foot. • Swing the racket behind the body. • Keep your eyes focused on the tossed ball. • Use the tossing hand as a guide when striking the ball. • Swing the racket so that it finishes in the upper front position. • The ball makes contact at the center of the racket. • The racket is swung forward.
			• At the moment of contact, full power is transferred from the body to the racket.
			• Shift your body weight forward. • The back foot steps forward. • The body lifts off the ground and moves forward into the court. • The ball travels with power and precision. • The body is balanced and ready for the next shot.
		Final Phase	

The Effect of Giving Feedback and Training Motivation on the Physical Condition of Athletes in the 2024 West Sumatera Tarung Derajat Martial Sport

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ABSTRACT

Background. Little research has been directed at understanding mentally challenging behaviors, and their correlates are the drive that arises within a person, consciously and unconsciously, to act with a particular purpose. **Objectives.** This study examines the effect of providing feedback and training motivation on improving the physical condition of Tarung Derajat athletes in West Sumatra. **Methods.** Thirty-two athletes were randomly divided into four groups (Direct Feedback high motivation n=8), (Direct Feedback high motivation n=8) (Indirect Feedback high motivation n=8), (Indirect Feedback high motivation n=8) who were assigned to complete a physical training intervention with a feedback approach for 6 weeks, 3 days/week. This study used several physical condition tests under the Tarung Derajat sport. **Results.** The results of the study showed 1) There is a difference in the physical condition of fighting athletes who train using direct feedback with indirect feedback, 2) There is an interaction effect between direct feedback and training motivation on physical condition, 3) There is a difference in the physical condition of athletes who have high motivation with training that is given a direct feedback approach is higher than indirect feedback 4) There is a difference in the physical condition of athletes who have low motivation with training that applies direct feedback is higher than indirect feedback. **Conclusions.** Providing direct feedback is better than indirect feedback for athletes with high motivation for physical conditioning abilities. For athletes with low motivation, providing direct feedback is better than indirect feedback for physical conditions.

KEYWORDS: *Physical Training, Feedback, Motivation, Tarung Derajat*

INTRODUCTION

Coaches endeavor to engage in behaviors that facilitate each athlete's progress toward achieving particular goals in competition or practice environments (1–3). Physical condition in a sport is critical to pay attention to because physical condition is one of the supporting elements of an athlete's achievement (4). In line with that, a sport's training and learning process requires a unique approach according to the athlete's needs. Athletes will require considerable time to restore their optimal physical conditions. (5) This revealed that there is an approach that can be used during the training and learning process that has a very good impact on individual change, namely feedback. According to (6), motor learning theory often discusses the importance of feedback in learning.

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Feedback is information received by learners about performance. Feedback has been characterized as knowledge of results and knowledge of performance. The same thing was also conveyed by feedback, which can be defined as information about the response used to modify the subsequent response. Feedback is needed for learning". Feedback can be interpreted as information about the response used to modify the subsequent response, and the feedback is needed for learning. The coach gives Direct feedback to improve his ability by providing corrections regarding the athlete's direct motor tasks. Direct feedback is given directly after the skill attempt is completed or at least before the next skill attempt occurs. The more important motivation is for each athlete in training, the higher the motivation of an athlete in training, the faster the athlete's ability to improve physical abilities will increase, and vice versa. Motivation is one of the most important factors raised in communities. Motivation also attracted the attention of researchers (7–9). However, little research has been directed at understanding mentally challenging behaviors, and their correlation is the drive that arises within a person, both consciously and unconsciously, to act with a particular purpose. In physical training, psychological factors also considerably influence athletes in every training process (10), especially in materials with a complex difficulty level. The performance phase refers to processes during movement performance and includes motivation.

MATERIALS AND METHOD

This research method uses a 2 x 2 level treatment experiment. This research design is described as follows:

The research was implemented through tests and treatments at the Tarung Derajat Sports Hall in West Sumatra. The sample of this study consisted of 24 people in the group (Direct Feedback high motivation $n = 8$), (Direct Feedback high motivation $n = 8$) and (Indirect Feedback high motivation $n = 8$), (Indirect Feedback high motivation $n = 8$) who were assigned to complete a physical training intervention with a feedback approach for 6 weeks, 3 days/week. The data collection on athletes' physical condition was carried out through a series of tests and measurements, including the following: 1. muscle strength test: a (Push Up), b. (Sit Up), c. leg muscle strength (Back Leg Dynamometer Test). 2. Speed Test: 30 Meter Run, 3. Agility: Illinois Agility Run Test, 4. Endurance (Bleep Test), 4. Flexibility: Standing Trunk Flexion Meter. Moreover, the data analysis technique using IBM SPSS v.26.

RESULTS

Based on the results of the analysis, it is known that the distribution of data on the Physical Condition of Tarung Derajat athletes is normally distributed and homogeneous, so the explanation of the hypothesis test is as follows:

The alternative hypothesis (H_a), which states that the physical condition of fighting athletes is different between groups of athletes who train with direct and indirect feed methods, is accepted. The F_{count} value is $6.12 > F_{table} = 4.20$ (meaning accepting h_a rejects h_0), so it can be concluded that there is a significant difference between direct feedback and feedback on the ability of the physical condition of fighting athletes.

The alternative hypothesis (H_a), which states that there is an interaction effect between direct feedback and training motivation on physical condition, is accepted, the F_{count} value = $17.32 > F_{table} = 4.45$ (accepting h_a rejects H_0), so it can be concluded that there is a significant interaction between direct feedback and motivation on physical condition.

The alternative hypothesis (H_a) states that the physical condition of highly motivated fighting athletes with training that implements direct feedback is higher than the indirect feedback received. The value of $F_{count} = 0.071 < F_{table} = 4.45$ (rejecting H_a , accepting H_0) indicates no significant difference in the increase in physical condition between participants with high motivation and participants with low motivation.

DISCUSSION

The success of condition training is an activity influenced by internal and external factors; one of the influencing factors is the use of methods (11). The methods used to facilitate athletes' interaction with learning resources are direct and indirect feedback. The results of the study showed that there was a significant difference between direct and indirect feedback on physical condition. Athletes who trained using direct feedback had higher test results than indirect feedback in both groups. Indicate an interaction between the feedback method and motivation. Athletes feel motivated by direct feedback, which encourages athletes to be interested in their learning outcomes and progress, and those who are highly motivated will be increasingly motivated to learn more, understand more broadly, and be more accepting and responsive to what the coach says. Motivated athletes have a strong drive, are more focused, and are resilient enough to face difficulties in progressing in their learning (12). Motivated athletes are more involved in the learning process, especially with direct feedback from the coaches. The improvement in physical condition obtained from direct feedback in the high-motivation group is more significant than in other groups, especially with direct feedback where athletes can improve. The practices of athletes with high motivation are stronger and more intense than those of less

motivated athletes. Direct information obtained by motivated athletes will be more strongly stored in their memory and interpreted correctly, including direct information from the instructor. The study's results showed that athletes who were given direct feedback differed from athletes who were trained with the indirect feedback method. The difference in motivation itself affects how the athlete's learning outcomes. Athletes who have low motivation tend to have decreased results compared to athletes who have high motivation even though they are given indirect feedback (13–15). Indirect feedback will affect how athletes who have low motivation respond to improve their physical abilities.

CONCLUSION

The direct feedback method is better than the indirect feedback method for improving the physical condition of Tarung Derajat athletes. There is an interaction between providing feedback and motivation for the physical condition of Tarung Derajat athletes. Overall, from the statistical calculations, it can be concluded that there are significant differences between research groups. Providing direct feedback is better than indirect feedback for athletes with high motivation for physical conditioning abilities. For athletes with low motivation, providing direct feedback is better than the indirect feedback method for physical conditions because, with direct feedback, athletes with low motivation still understand better than with indirect feedback.

APPLICABLE REMARKS

- There is an interaction between providing feedback and motivation for the physical condition of Tarung Derajat athletes.

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AUTHORS' CONTRIBUTIONS

Study concept and design: Desi Purnama Sari, Badai Meganagara Dradjat Acquisition of data: Suci Nanda Sari, Sari Mariati, Desi Purnama Sari. Analysis and interpretation of data: Desi Purnama Sari, Suci Nanda Sari. Drafting the manuscript: Desi Purnama Sari, Yogi Arnaldo Putra, Sari Mariati. Critical manuscript revision for important intellectual content: Argantos, Hendri Irawadi, Fathurrahman Hafid. Statistical analysis: Suci Nanda Sari.

CONFLICT OF INTEREST

The authors mention no “Conflict of Interest” in this study.

ETHICAL CONSIDERATION

This research has met the standards of research ethics and has received approval to be a sample of all respondents.

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ROLE OF THE SPONSOR

The funding organizations are public institutions and have no role in the design and conduct of the study, collection, management, and analysis of the data, or preparation, review, and approval of the manuscript.

FINANCIAL DISCLOSURE

The authors have no financial interests related to the material in the manuscript.

ARTIFICIAL INTELLIGENCE (AI)

USE There was NO use of artificial intelligence (AI) for preparation, writing, or editing this manuscript.

REFERENCE

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Tabel 1. Factorial Design 2x2

Feedback (A) \ Motivation (B)	Direct Feedback (A1)	Indirect Feedback (A2)
High (B1)	A1. B1	A2, B1
Low (B2)	A1,B2	A2,B2

Table 2. ANAVA Two-Track Analysis Physical Condition of Combat Athletes

Source Variance	Db	JK	RJK	Fcal		FTable	
						0.05	0.01
Between Columns	1	413.12	413.12	6.12	**	4.14	7.49
Inter-Line	1	7.23	7.23	0.071	**	4.14	7.49
Interaction	1	1255.86	1255.86	17.32	**	4.14	7.49
In the	28	2650.88	99.56				
Total Reduced	31	4156.19					

***=Significant**=Very Significant**

The Effect of Dynamic Neuromuscular Stabilization Exercises on Neck Muscle Stability to Enhance Agility and Dynamic Balance in Soccer Players

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ABSTRACT

Background. The neck muscles are crucial in soccer matches' function and performance. **Objectives.** This study examines the effect of dynamic neuromuscular stabilization (DNS) exercises on neck muscle stability to improve agility and dynamic balance in soccer players. **Methods.** The design of this study is experimental, using a quasi-experimental approach of a single group pre-test and post-test. The study subjects were UNP football players aged between 18-25 years old with healthy physical conditions and no history of serious neck injuries. The instrument in this study uses the stability of the neck muscles using a pressure stabilizer biofeedback device. The Illinois Agility Test measures agility, and dynamic balance is measured by the *Star Excursion Balance Test* (SEBT), which will then be analyzed using the T-Test. **Results.** Implementing a training method based on dynamic neuromuscular stabilization can enhance the capacity of soccer players to maintain balance and agility during dynamic movements. **Conclusion.** DNS exercises are more effective at influencing agility than a football player's dynamic balance.

KEYWORDS: *Dynamic Neuromuscular, Stabilization Exercises, Muscle Stability, Agility, Balance, Soccer*

INTRODUCTION

Football consists of kicking, catching, and heading movements with a risk of injury because they are very susceptible to physical contact and body imbalance when competing with other players (1,2). Muscle stabilization is one of the important training programs to strengthen the mobility of core muscles, such as the cervical and neck muscles (3,4). In soccer players, neck muscles are often overlooked in training programs, even though these muscles have an important role in maintaining balance and stability of the body. The importance of well-trained and stable neck flexors and extensors allows players to perform a good header movement without causing injury in the future (5). One of the sports rehabilitation techniques that can increase neck muscle strength is the DNS technique (6). This exercise focuses on strengthening and controlling muscles through exercises that challenge the nervous system and muscles to work together in maintaining balance and stability (7). This study aims to examine the effect of DNS training on neck muscle stability to improve agility and dynamic balance in soccer players, thus contributing to developing a more comprehensive and practical training program for soccer players.

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MATERIAL AND METHODS

The design of this study is experimental, using a quasi-experimental approach of a single group pre-test and post-test. The study subjects were UNP football players aged between 18-25 years old with healthy physical conditions and no history of serious neck injuries. The instrument in this study uses the stability of the neck muscles using a pressure stabilizer biofeedback device. The Illinois Agility Test measures agility, and dynamic balance is measured by *the Star Excursion Balance Test* (SEBT), which will then be analyzed using the T-Test.

RESULTS

The significance value (*sig. 2-tailed*) in the *pretest* and *posttest* was less than $\alpha = 0.05$. Here is dynamic balance data on soccer players tested using *the Star Excursion Balance Test* (SEBT).

Based on the calculation of the T-test above, the DNS training method influences improving dynamic balance in football players.

Based on the T-test calculation above, the DNS training method influences increasing agility in football players.

Based on the T-test calculation above, DNS training is more effective in influencing agility than the dynamic balance of football players.

DISCUSSION

Good agility and balance will make it easier for players to complete movement tasks effectively to score as many goals as possible in the opponent's goal (8,9). The game of soccer involves responding to external stimuli such as the movement of the ball, opponents, and teammates and is usually preceded by a rapid change in the direction of movement (10), which, of course, will pose a risk of injury to football players. The effect of DNS training can improve the functionality of football players' physiological components while improving the musculoskeletal system's functionality (11). The concept of sports safety in football players is one of the injury prevention strategies (12). In this case, DNS plays an important role in increasing the strength of the musculoskeletal system of football players. This study explores the important role of the neck and core muscles in improving football players' dynamic balance and agility. A strong neck helps maintain balance and postural control, which is especially important in physical activities such as soccer (13–15). The findings from this study show that DNS training effectively improves football players' dynamic balance and agility. This improvement contributes directly to player performance, especially in game situations that require quick responses and sudden changes in direction.

CONCLUSION

Based on the results of this study, it can be concluded that DNS training significantly improves football players' neck muscle stability, agility, and dynamic balance. In addition, DNS exercises are more effective in influencing agility than the dynamic balance of football players.

APPLICABLE REMARKS

- DNS training effectively improves the dynamic balance and agility of football players.
- This improvement contributes directly to player performance, especially in game situations that require quick responses and sudden changes in direction.

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AUTHORS' CONTRIBUTIONS

Concept and design of the study: Donal Syafrianto, Jhon Roby Purba Data acquisition: Arif Fadli Muchlis, Andra Rizky Putra. Data analysis and interpretation: Firunika Intan Cahyani Compiled the script: Donal Syafrianto, Firunika Intan Cahyani. Critical revision of the manuscript for important intellectual content: Donal Syafrianto. Statistical analysis: Andra Rizky Putra Administrative, technical, and material support: Adi Ahmad Supendi. Study supervisor: Donal Syafrianto

CONFLICTS OF INTEREST

The author states no conflict of interest concerning this article's research, authorship, and publication.

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This research has met the standards of research ethics and has received approval to be a sample of all respondents.

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Table 1. One-Sample Test

	Test Value = 0					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
SEBT Pretest	53.121	15	.000	78.5625	75.410	81.715
SEBT Posttest	55.264	15	.000	83.3125	80.099	86.526

Table 2. One-Sample Test

	Test Value = 0					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Illinois Pretest	53.267	15	.000	21.23125	20.3817	22.0808
Illinois Posttest	51.003	15	.000	19.63063	18.8103	20.4510

Table 3. Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	SEBT Pretest & SEBT Posttest	16	.704	.002
Pair 2	Illinois Pretest & Illinois Posttest	16	.894	.000

Table 4. Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	SEBT Pretest - SEBT Posttest	-4.7500	4.5971	1.1493	-7.1996	-2.3004	-4.133	15	.001
Pair 2	Illinois Pretest - Illinois Posttest	1.60063	.72374	.18094	1.21497	1.98628	8.846	15	.000

The Relationship Between Speed Reaction, Arm Muscle Power, and Leg Muscle Power Towards Speed and Accuracy of Attacks in Fencing Athletes

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ABSTRACT

Background. Fencing skills are performed by stabbing, blocking, and slashing the opponent. Athletes need strong and fast arm power to straighten their arms and attack their opponents, and this is where the explosive power of the arm muscles plays a role when fighting opponents. Explosive or leg muscle power helps fencers expand their reach and accelerate leg throws. **Objectives.** This study aims to analyze (1) The relationship between reaction speed and attack accuracy, (2) The relationship between arm muscle power and attack accuracy, and (3) The relationship between leg muscle power and attack accuracy. **Methods.** This study is correlational. The population in this study was 32 fencing athletes from Surabaya and Sidoarjo. The sampling technique in this study was purposive sampling, which is based on a specific purpose. The data collection technique in this study used the test and measurement technique of Reaction Speed (Whole Body Reaktion), Arm Muscle Power (Medicine Ball), Leg Muscle Power (Vertical Jump), and Attack Accuracy (Kuhadja Parry Four-Riposte-Lunge). The data analysis technique used prerequisite tests, normality tests, linearity tests, and hypothesis tests. **Results.** The results of the analysis show that there is a significant relationship between reaction speed and the results of attack accuracy in fencing athletes, with a value of $r_{x1.y} = 0.162 > r(0.05)(12) = 0.553$, meaning the correlation coefficient is significant. The results of the analysis show that there is a significant relationship between arm muscle power and the results of attack accuracy in fencing athletes, with a value of $r_{x1.y} = 0.099 > r(0.05)(12) = 0.553$, meaning the correlation coefficient is significant. A positive value means that the greater a person's arm muscle power, the better the results of their attack accuracy. The results of the analysis show that there is a significant relationship between leg muscle power and the results of attack accuracy in fencing athletes, with a value of $r_{x1.y} = 0.423 > r(0.05)(12) = 0.553$, meaning the correlation coefficient is significant. A positive value means that the greater a person's leg muscle power, the better the results of their attack accuracy. **Conclusions.** There is a relationship between reaction speed $r_{x1.y} = 0.162 > r(0.05)(13) = 0.553$, arm muscle power $r_{x2.y} = 0.099 > r(0.05)(13) = 0.553$, leg muscle power $r_{x3.y} = 0.423 > r(0.05)(13) = 0.553$, with the results of attack accuracy in fencing athletes with a value. There is a relationship between arm muscle power and the results of attack accuracy in fencing athletes, with a value.

KEYWORDS: *Speed Reaction, Arm Muscle Power, Leg Muscle Power, Accuration, Fencing*

INTRODUCTION

Fencing skills are performed by stabbing, blocking, and slashing the opponent. This is a martial art of dexterity. There are three signals that the referee will use to signal the start of a fencing match: on guard (stance), pre (ready),

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and ale (start). Athletes are awarded points if they successfully make a legitimate attack during the match on the part of the opponent's body that is the target. Athletes need strong and fast arm power to straighten their arms and attack their opponents, and this is where the explosive power of the arm muscles comes into play. So reaction time includes the time needed for processes in the sense organs, brain, nerves, and muscles. A similar opinion says that reaction speed is the period from the emergence of a stimulus to the beginning of a response (1). In other words, reaction speed is the time needed for the initial birth of a response or the interval from stimulus to response (2). When making an attacking movement against an opponent, explosive or leg muscle power helps fencers expand their reach and accelerate their leg throws. The ability to react quickly to the opponent's onslaught is a skill that athletes must have.

Athletes must attack their opponents accurately to get points, especially when launching direct counterattacks (3). Fencing is a sport that both men and women can do. Three measurements are commonly used in fencing: out-of-reach distance, at the proper distance, and close range. Fencing requires accuracy, one aspect of getting points in a match (4). Operationally, the accuracy referred to by researchers is placing the sword in the determined target area. This is, of course, based on the motion mechanics system, which is entirely supported by movement units, movement fluidity, movement relationships, and the ability to anticipate that have been processed through movement control during training that has been carried out repeatedly (5,6). So, target accuracy is a follow-up movement carried out by an athlete to control free movements for a purpose. An effective attack is needed to get accuracy in the target. The accuracy of direct attacks in fencing martial arts is reviewed from the classification of motor tasks based on environmental stability, which is included in open skills. Thus, this article will review the reaction speed and power of accuracy in fencing athletes in Indonesia.

MATERIALS AND METHODS

This study is a correlational study with a population of 134 fencing athletes in Indonesia, and the sample was 32 people. Sampling was based on specific traits, properties, or characteristics, which are the main characteristics of the population. The subjects taken as the sample are indeed the subjects that contain the most characteristics found in the population (7). Determination of population characteristics is carried out carefully in the preliminary study. Data collection techniques in this study used test and measurement techniques. The instruments used in this study were reaction speed (whole body reaction), arm muscle power (medicine ball), leg muscle power (vertical jump), and attack accuracy (kuhadja parry four-riposte-lunge). Data analysis techniques used prerequisite tests, normality tests, linearity tests, and hypothesis tests. If the significance is below 0.05, the normality test means that the data to be tested has a significant difference from the standard normal data, meaning the data is not normal. If the significance is above 0.05, there is no significant difference between the data to be tested and the standard normal data, meaning the data is expected.

RESULTS

The data in this study consisted of (1) leg muscle power measured using a vertical jump test with units (cm), (2) reaction speed measured using whole-body reactions, (3) arm muscle explosive power using a medicine ball with units (m), (4) Accuracy and speed of attacks using the Kuhadja Parry Four-Riposte-Lungs Test. The results of the calculation of the reaction speed data of the fencers produced an average of 0.306 and a standard deviation of 0.036. The smallest value was 0.255, and the largest was 0.356. The calculation results of the fencers' arm muscle explosive power data produced an average of 3.880 and a standard deviation of 0.464. The smallest value was 3.21, and the largest was 4.55. Calculating the leg muscle explosive power data of the fencers produced an average of 57.231 and a standard deviation 5.974. The smallest value is 47, and the largest is 66. The results of calculating the accuracy data of fencing athletes produce an average of 38.692 and a standard deviation of 4.049. The smallest value is 30, and the largest is 45.

Based on the results of the analysis above, the correlation coefficient of reaction speed with the results of the accuracy of the attack is 0.162 with a positive value, meaning that the greater the value that influences, the greater the value of the result. The significance test of the correlation coefficient is carried out by consulting the price of $rx1.y = 0.162$ with $r(0.05)(13) = 0.553$. Because the correlation coefficient between $rx1.y = 0.162 > r(0.05)(13) = 0.553$, the correlation coefficient is significant. Thus, the hypothesis, "There is a relationship between reaction speed and the results of attack accuracy in fencing athletes in Surabaya and Sidoarjo," is accepted. This means there is a significant relationship between reaction speed and the results of attack accuracy in fencing athletes in Surabaya and Sidoarjo".

DISCUSSION

The results of this study were that there was a significant relationship between reaction speed and the results of attack accuracy in fencing athletes, with a value of $rx1.y = 0.162 > r(0.05)(12) = 0.553$, meaning the

correlation coefficient is significant. There is a significant relationship between arm muscle power and the results of attack accuracy in fencing athletes, with a value of $r_{x1.y} = 0.099 > r(0.05)(12) = 0.553$, meaning the correlation coefficient is significant. A positive value means that the greater a person's arm muscle power, the better the results of their attack accuracy. There is a significant relationship between leg muscle power and the results of attack accuracy in fencing athletes, with a value of $r_{x1.y} = 0.423 > r(0.05)(12) = 0.553$, meaning the correlation coefficient is significant. A positive value means that the greater a person's leg muscle power, the better the results of their attack accuracy.

CONCLUSION

This study concluded that there is a relationship between reaction speed, arm muscle power, and leg muscle power with the results of the accuracy of the attack on fencers so that coaches are expected to pay attention to the speed of reaction, arm muscle power, and leg muscle power of fencers which can affect the results of attacks when fencers compete.

APPLICABLE REMARKS

- To develop speed reaction and power in fencing athletes.

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AUTHORS' CONTRIBUTIONS

Concept and design of the study: Rini Ismalasari and Oce Wiriawan. Data acquisition: Rini Ismalasari. Data analysis and interpretation: Fransisca Januarumi. Compiled the script: Afif Rusdiawan. Critical revision of the manuscript for important intellectual content: Oce Wiriawan. Statistical analysis: Resti Nurpratiwi. Administrative, technical, and material support: Lucy Widya Fathir. Study supervisor: Rini Ismalasari.

CONFLICT OF INTEREST

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Table 1 Research Result Data

Kecepatan Reaksi	Daya Ledak Otot Lengan	Daya Ledak Otot Tungkai	Ketepatan
0,306	3,880	57,231	38,692
0,255	3,21	47	30
0,356	4,55	66	45
0,036	0,464	5,974	4,049

Table 2. The correlation coefficient between reaction speed, arm muscle power, and accuracy

Correlation	r_{count}	r_{table}	Information
<i>Reaction Speed - accuracy of attack</i>	0.162	0,553	Significant
<i>Arm muscle power - accuracy of attacks</i>	0,099	0,553	Significant
<i>Leg muscle power - attack accuracy</i>	0.423	0.553	Significant
<i>Reaction speed, arm muscle power, leg muscle power - attack accuracy</i>	0.432	0.553	Significant

Sports and Disability: A Ten-Year Bibliometric Review of Research Trends

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ABSTRACT

Background. The burgeoning field of sports disability research demands a thorough examination to delineate its evolving landscape and address existing gaps. **Objectives.** This study investigates trends and patterns in this field using a bibliometric analysis approach. **Methods.** Analyzing 987 articles published from 2013 to 2023, employing Scopus for data extraction and analysis. By visualizing co-authorship networks and keyword co-occurrences using VOSviewer, this research identifies prominent themes, influential authors, leading countries, and citation patterns within sports disability literature. **Results.** The analysis reveals increasing scholarly interest and contributions in physical education inclusion, Paralympics media portrayals, parasport participation narratives, and policy implications. Moreover, this study underscores the global impact of research from nations like the United States, the United Kingdom, and Canada. **Conclusion.** By synthesizing current trends and highlighting critical research gaps, this research provides a roadmap for future investigations, emphasizing the need for interdisciplinary approaches and comprehensive database utilization to advance understanding and practice in sports disability research.

KEYWORDS: *Bibliometric Analysis, Literature Review, Research Trends, Sports Disability*

INTRODUCTION

Sports for individuals with disabilities is a crucial field, given its significant role in the physical, mental, and social development of individuals with disabilities (1). Throughout various stages of life, individuals with disabilities face unique challenges that can be mitigated with appropriate Sports. Research in the field of Sports for individuals with disabilities has undergone significant and dynamic developments (2). One example is that Sports also develop social and emotional skills for individuals with disabilities. They learn about teamwork, discipline, leadership, and handling defeat and victory (3–7). Studies have found a positive relationship between physical activity and academic performance, indicating that physically active individuals with disabilities tend to have better learning abilities (8,9). However, not all consequences of Sports are beneficial. The excessive growth of Sports and the lack of planning over the last few decades of the twentieth century have led to some educational institutions experiencing negative impacts from their sports programs, challenging their capacity for sustainability (10). In-depth research is needed to identify frequently researched and underexplored topics in Sports to comprehensively understand dominant research focuses and less-explored aspects in this field.

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Bibliometric analysis has emerged as a leading method for comprehensively investigating trends, patterns, and advancements in the scientific literature (11). In Sports, bibliometric analysis provides valuable insights into research trajectories, key themes, and scholarly collaborations. The primary focus of this study is to conduct a bibliometric analysis of research related to Sports and associated topics between 2013 and 2023. This study aims to examine the network of occurrences containing keywords selected by the authors, analyze the patterns of publication and citation growth, and identify leading papers, top authors, active countries, and influential articles. Through these findings, researchers and readers can monitor the development and expansion of subjects related to Sports, as well as understand current and emerging areas of study.

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MATERIALS AND METHODS

We commenced our investigation by utilizing bibliometric analysis to gather substantial literature on physical education in schools for disabilities. Bibliometric analysis is a valuable tool for mapping extensive scholarly literature, akin to systematic literature reviews, ensuring the quality and accuracy of the information utilized and the outcomes produced (12). Bibliometric analysis enables researchers to explore collaboration networks among authors, countries, and research topics, which in turn can reveal underlying relationships between these entities. For our bibliometric analysis focused on physical education in schools for disabilities, we selected Elsevier's Scopus database as the primary source for bibliographic research. This involved a comprehensive background analysis covering approximately 904 articles over more than 10 years, from 2013 to 2023. Our exploration of the Scopus database on June 15, 2024, aimed to gather journals and articles. In a bibliographic repository encompassing over 2000 multidisciplinary subjects, we conducted a bibliometric study centered on visualization methods of similarity. Details of the analysis flow can be seen in Figure 1.

To enhance the relevance of our data, we narrowed our search to specifically focus on sports education and disabilities, extracting relevant information such as citations, bibliographic details, abstracts, keywords, findings, and other related data. We utilized keywords such as "Physical Education" and "Disability Student," applying filters aligned with practices of sports education in schools for disabilities.

RESULTS

Published Document Analysis. From 2013 to 2023, researchers have published articles related to sports for disabilities. The overall publication trend in sports for disabilities from 2013 to 2023 is depicted in Figure 2. Analysis based on the Scopus database shows that in 2013, 43 published articles. In 2014, the number of published articles increased to 59. In 2016, there was a slight decrease in published articles to 54, respectively. However, in 2017 and 2018, there was an increase in the number of publications, with articles reaching 82, 90, and 88 in 2019. In 2020, the number of articles increased to 106. The upward trend continued from 2021 to 2023, with 117, 135, and 148 articles. Thus, there was a significant increase in publications from 2021 to 2023, indicating a growing interest in research on Sports for Disabilities.

In Table 1, the top 10 authors with the most influential articles in research on Sports for Disabilities are listed. The first position is held by the article published by Hutzler et al., with 87 citations. The second position is occupied by the article published by Bartsch et al., with 76 citations. The third position is held by the article published by Evans et al., with 66 citations. Allan et al.'s article ranks fourth, with 66 citations. Meanwhile, articles by Jeanes, Iverson, Willis, Houck, Brittain, Slater, and Baker have citations under 60, in descending order. This table summarizes the most influential articles and their respective citation counts in Sports for Disabilities, providing insights into the impactful research contributions of various authors.

Author Analysis. Based on the bibliometric analysis in this study, Smith, B. stands out as the most influential author in disability sports research, with 14 documents and 624 citations. Although Latimer-Cheung, A.E. has the same number of documents (14), Smith, B.'s significantly higher citation count indicates that his work is more frequently cited and more impactful within the relevant literature. Other notable contributors include Howe, P.D., with 12 documents, and Darcy, S., with 11 documents with substantial citation counts.

Country Analysis. Table 3 showcases the top 10 countries contributing to disability sports research.

Co-occurrence Analysis of Keywords. This network analysis can be a crucial key in future research efforts, where less prominent keywords have the potential to be further enhanced through relevant studies. Although our network analysis provided valuable insights, minor gaps could be addressed through further research and the addition of

relevant additional keywords. By strategically incorporating essential keywords in future research endeavors, we aim to enhance our understanding of sports disability and its broader implications for sports and disability contexts.

DISCUSSION

The analysis of sports and disability research trends from 2013 to 2023 reveals a growing interest in this field, marked by significant peaks in publication activity during 2021, 2022, and 2023. Key studies, such as Hutzler's (2019) on physical education teachers' attitudes toward inclusion, emphasize the impact of personal experience and professional training on self-efficacy in inclusive sports. Major research clusters focus on physical education, parasports participation, Paralympic games, and sports development, with prominent researchers like Smith, B., Latimer-Cheung, A.E., and Howe, P.D. contributing significantly to the field. The United States leads in document production, while the United Kingdom excels in citation impact. Other countries like Canada, Australia, Germany, and the Netherlands also play vital roles in advancing disability sports research. Studies by authors like Bartsch et al. (2018) and Seo et al. (2021) have deepened our understanding of factors influencing parasport participation and inclusion, such as empathy, volunteer roles, and policies. However, bibliometric limitations, such as gaps in citation coverage and reliance on the Scopus database, suggest a need for broader citation practices and database utilization in future research.

CONCLUSION

The field of sports and disability research has grown considerably, with increased interest and impactful contributions from key scholars and countries. Major research areas, including parasports participation, Paralympic games, and sports development, reflect a commitment to inclusivity and improved self-efficacy in physical education. However, limitations in citation coverage and database reliance highlight the need for more comprehensive research practices. Expanding bibliometric approaches will enhance understanding and continue driving progress in adaptive sports research.

AUTHORS' CONTRIBUTIONS

This study began with the formulation of the concept and design by Mustika Fitri, Septian Willyanto, and Sandey Tantra Paramitha, who provided the foundational direction for the entire research. The data was acquired by Hilmy Apriady and Slamet Raharjo, who were responsible for gathering the relevant information. Muhammad Azhar Robbani and Nor Eeza Zainal Abidin conducted data analysis and interpretation and thoroughly examined the data to extract meaningful insights. Mustika Fitri and Septian Willyanto wrote the initial manuscript draft, which underwent critical revision by Mustika Fitri to ensure the intellectual content was accurate and relevant.

CONFLICT OF INTEREST

The authors mention no "Conflict of Interest" in this study.

ETHICAL CONSIDERATION

This research has met the standards of research ethics and has received approval to be a sample of all respondents.

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USE There was NO use of artificial intelligence (AI) for preparation, writing, or editing this manuscript.

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Table 1. Top 10 articles with the most citations on Scopus

No	Document title	Authors and Year	Citation
1	Attitudes and self-efficacy of physical education teachers toward inclusion of children with disabilities: a narrative review of international literature	Hutzler 2019	87
2	Inspired by the Paralympics: Effects of Empathy on Audience Interest in Para-Sports and the Destigmatization of Persons With Disabilities	Bartsch 2018	76
3	Integrating insights from the parasport community to understand optimal Experiences: The Quality Parasport Participation Framework	Evans 2018	66
4	Narratives of participation among individuals with physical disabilities: A life-course analysis of athletes' experiences and development in parasport	Allan 2018	66
5	'Yes we are inclusive': Examining provision for young people with disabilities in community sports clubs.	Jeanes 2018	57
6	High School Athletes With ADHD and Learning Difficulties Have a Greater Lifetime Concussion History	Iverson 2020	54
7	Enabling physical activity participation for children and youth with disabilities following a goal-directed, family-centered intervention	Willis 2018	50
8	Socioeconomic Status and Race Outperform Concussion History and Sport Participation in Predicting Collegiate Athlete Baseline Neurocognitive Scores	Houck 2018	50
9	Ableism as a regulator of social practice and disabled peoples' self-determination to participate in sports and physical activity	Brittain 2020	48
10	Doing Social Identity Leadership: Exploring the Efficacy of an Identity Leadership Intervention on Perceived Leadership and Mobilization in Elite Disability Soccer	Slater 2019	47

Table 2. Authors, documents, and citations.

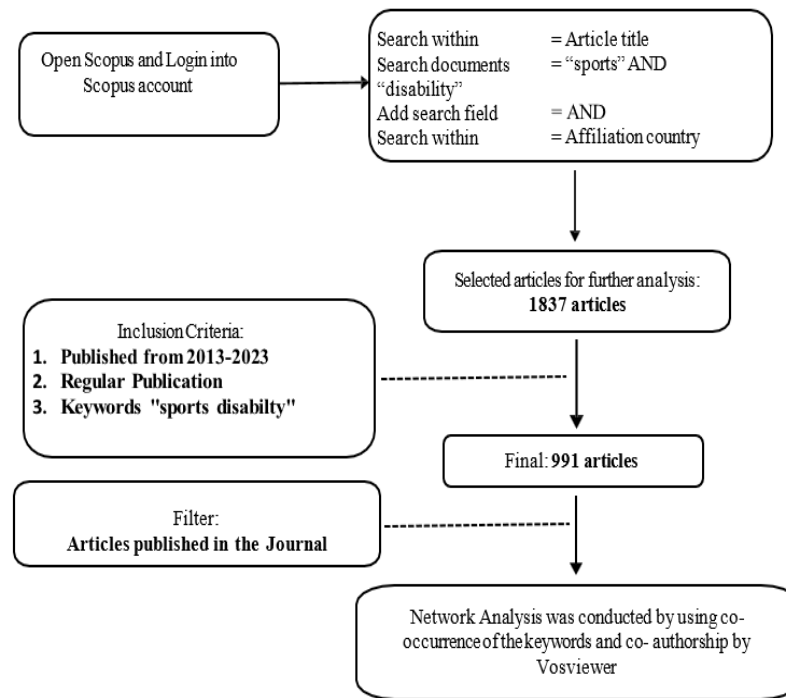
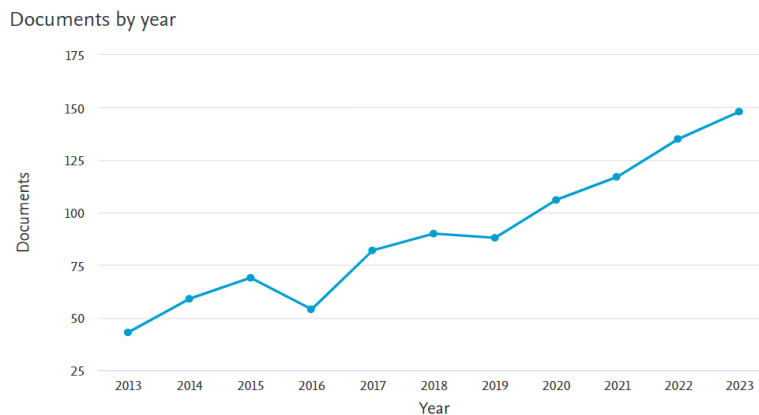
Rank	Author	Doc.	Cite	Rank	Author	Doc.	Cite
1	Latimer-Cheung, A.E.	14	290	6	Misener, L.	9	241
2	Smith, B.	14	624	7	McConkey, R.	9	42
3	Howe, P.D.	12	179	8	Shirazipour, C.H.	8	147
4	Darcy, S.	11	349	9	Bundon, A.	8	199
5	Haeghele, J.A.	10	84	10	Brittain, I.	8	178

Table 3. Country, documents and citations.

Rank	Author	Doc.	Cite	Rank	Author	Doc.	Cite
1	United States	225	2554	6	Brazil	52	267
2	United Kingdom	198	3302	7	Germany	31	468
3	Canada	130	2004	8	Belgium	31	353
4	Australia	89	1758	9	Netherland	28	389
5	Spain	72	518	10	France	26	205

Table 4. Clusters and Keywords based on VOSViewer

Cluster	Item	Color	Percent	Total
Cluster 1	Access, action author body, challenge disability sport, disabled athlete, disabled person, event, field, focus, gap, identity, implementation, inclusion, interview, issue, knowledge, narrative, Organization, para-athlete, paralympic, paralympic athlete, paralympic game, paralympic sport, perspective policy, recommendation, researcher, social inclusion, society, stakeholder, strategy, success, theme, theory understanding, world, young person, Effectiveness, Exercise, female, gender, improvement, influence, injury, intellectual disability, intervention, male, man, outcome performance, player program quality, questionnaire respondent, risk, scale, sex, unique, Olympic sports, activity, test, variable, week, woman,	Red	25%	8
Cluster 2	Child, Peer, physical education, school, student, teacher,	Green	19%	6
Cluster 3		Blue	19%	7
Total			100%	75

**Fig. 1. Document Article Filtering Process in Scopus****Fig. 2. Document Published on Scopus Databased**

The Influence of The Sports Environment on Positive Youth Development

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ABSTRACT

Background. Youth participation in sports activities is the main attraction for researchers who want to learn more about the benefits of sports for positive youth development. Positive youth development is one of the best programs for developing young people to become more qualified in the school, family, and community environment. **Objectives.** This research aims to determine how much influence the sports environment has on positive youth development. **Methods.** The study used a survey method using a questionnaire as a research instrument. The research sample comprised 40 students from the Department of Sports Science at UNP. **Results.** The study results show that the value of R Square is 0.623, which means that the Sports Environment (X) influences Positive Youth Development (Y), with a final score of 62.3%. The study's results illustrate the impact of the sports environment on positive youth development. **Conclusions.** Thus, it can be seen that physical activity and sports play an important role in encouraging cognitive development at a young age.

KEYWORDS: *Environment, Sports, Positive Youth Development*

INTRODUCTION

Youth have an important role in determining the future of the nation. Indonesia currently requires quality human resources to develop its civilization [1]. Therefore, education is important in increasing the potential of individuals who can support the nation's progress. The function of education is not only the transformation of knowledge; education is also an essential requirement in efforts to develop self-potential, which helps form human resources for society and the nation. The educational process consists of three parts: family education, school education, and education in the community [2].

Youth become a driving force for change; positive youth development (PYD) is a new trend that can be an alternative to improving the quality of youth. Positive youth development (PYD) is the development of skills and potential that occurs naturally and aims to help youth become healthier, more active, and more creative [3]. Involving young people in positive activities can help improve the quality of human resources for the nation's future continuity. According to the National Research Council and the Institute of Medicine, youth development has four main areas: physical, intellectual, psychological/emotional, and social [4].

Youth participation in sports activities is the main attraction for researchers who want to learn more about the benefits of sports for positive youth development. PYD is one of the best programs for developing young people to become more qualified in the school, family, and community environment. In this study, the

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researchers looked specifically at the benefits of PYD in terms of physical condition, social, psychological, and emotional development, and intellectual development.

MATERIALS AND METHODS

The research was carried out by directly collecting data through a survey using the instruments provided and distributed to the research subjects. The research sample was 40 students from the Department of Sports Science at Universitas Negeri Padang. The type of research instrument is the Development and Validation of a Positive Youth Development Measure: The Bridge-Positive Youth Development [5]. This study uses the Simple Linear Regression test. The purpose of this is to determine the relationship between variables. In this study, researchers did not look deeper into the influence of other variables that were not tested.

RESULT

The results showed that the calculated value was 49.980. This number is a constant, meaning that if the Sports Environment (X) does not exist, the Positive Youth Development (Y) constant is 49.980. Meanwhile, the coefficient on the regression is -7.12. This means that if the factors that cause the Sports Environment (X) to decrease by 1%, then the Positive Youth Development (Y) level will increase by -7.12. Because the total value of the regression coefficient has a negative (-) value, it can be said that the Sports Environment (X) has a very positive effect on Positive Youth Development (Y). So, the equation for the regression is $Y = 49.980 - 7.12 X$. Test the effect or research hypothesis to find out whether it is significant.

In addition, to ensure that the regression coefficient is significant or not (variable X affects variable Y), it is necessary to test the hypothesis by comparing it with the results of the significance value (sig) and using a probability of 0.05 or by comparing the value in t-count with the value in ttable. If the value at significance (sig) is smaller than the probability (0.05), it means that the Sports Environment (X) influences Positive Youth Development (Y). However, if the value is significant (sig) > (large of), the probability is 0.05, which means that there is no influence of the Sports Environment (X) on Positive Youth Development (Y). The result of the research calculation is 0.002, which is smaller than the probability of 0.05. So, it can be seen that H_0 is not accepted while H_a is accepted, which means".

The research results can be seen in Tables 1 and 2 below. Based on the results of the table above, it is known that the value of R Square is 0.623, which means that the influence of the Sports Environment (X) on Positive Youth Development (Y) is 62.3%.

DISCUSSION

The study's results stated that the sports environment (X) positively influenced youth development (Y), with a value of 62.3%. The influence of the sports environment significantly impacts the development of adolescents. The sports environment is an environment for youth character development. The study results show that many young people claim to have had many positive changes after being involved with people who like sports. The study's results also stated that the sports environment greatly influenced positive youth development, especially in men. This is under the opinion of [4], which states that youth will be more confident and have a better mentality by being around a sports environment. In addition, the male respondent stated that he used to be a smoker, and since being active in sports activities, the habit of smoking has slowly disappeared. Male respondents claimed to be active in sports, making them more productive; they rarely hung out or wasted time. The sports environment is a positive influence in shaping one's personality [6].

Youth involvement through sports activities is one of the most important developments, especially in sports. Diverting youth through sports activities is one of the best ways to reduce negative actions and improve the quality of human resources among young people [7]. The importance of physical activity as a means of fostering positive youth development has received considerable attention among researchers. Physical activity is beneficial for the optimal development of adolescents; it facilitates growth and development through positive things for the growth and development of children and adolescents [8]. In addition, adolescents who engage in regular sporting activities are less likely to smoke than adolescents who do not engage in regular sporting activities.

CONCLUSION

The research results can conclude if the sports environment influences positive development among adolescents. A positive environment can improve a person's attitude and behavior. In this study, it is known how the environmental impact of sports affects positive youth development. The results prove that sports and physical activity can play an important role in encouraging cognitive development in youth. Moreover, it needs

to be realized that positive youth development through sports is not automatic; this depends on many factors that must be considered again.

APPLICABLE REMARKS

- Sports not only provide the ability to perform the skills; more than that, sports can provide changes in positive youth development.
- So that in the future, the coaches do not ignore the integration of positive youth development into the training program that has been created.

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AUTHORS' CONTRIBUTIONS

Study concept and design: Eko Purnomo, Mohd Huzairi Mohd Sani. Acquisition of data: Faradifta Tirta Ardita, Nina Jermaina. Analysis and interpretation of data: Faradifta Tirta Ardita, Eko Purnomo. Drafting the manuscript: Eko Purnomo, Nina Jermaina, Eddy Marheni. Critical revision of the manuscript for important intellectual content: Eko Purnomo. Statistical analysis: Mohd Huzairi Mohd Sani

CONFLICT OF INTEREST

The authors mention no "Conflict of Interest" in this study.

ETHICAL CONSIDERATION

The Guidelines for Research Ethics and Scientific Publication of Universitas Negeri Padang were unanimously decided by the members participating in the meeting to provide this document as the "Ethics Committee Approval Document" for the research.

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ROLE OF THE SPONSOR

The funding organizations are public institutions and have no role in the design and conduct of the study, collection, management, and analysis of the data, or preparation, review, and approval of the manuscript.

FINANCIAL DISCLOSURE

The authors have no financial interests related to the material in the manuscript.

ARTIFICIAL INTELLIGENCE (AI) USE

There was NO use of artificial intelligence (AI) for preparation, writing, or editing this manuscript.

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Table 1. Simple Linear Regression Equations

Model	Unstandardized Coefficient		Standardized Coefficient	t	Sig
	B	Std. Error	Beta		
(Constants)	49,980	3,537		16,660	,000
Sports Environment	-7,12	180	-,900	-6,662	,002

Dependent Variables: Sports Environment

Table 2. The amount of influence from variable X to variable Y

Model	R	R "Square"	Adjusted R Square	Std Error of The Estimate
1	.785	.623	.520	1,31581

Teacher Involvement in Integrating Universal Values in Schools

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ABSTRACT

Background. The application of universal values in schools through physical education at various levels has different impacts, and the results or what is obtained or caused will also be different. **Objectives.** This study aims to look more deeply into the implementation and or application of universal values in physical education at various school levels. **Methods.** This study used a comparative study method, with the research sample being teachers at elementary and junior levels who were taken randomly. One hundred sixty-nine teachers were willing to fill out the instrument with details (111 elementary school teachers and 35 junior high school teachers). This research uses the Universal Values in Sport Instrument (USSI) with a reliability level 0.990. Five dimensions are assessed in this research instrument: Ethics and Morals, Knowledge and understanding, Social, Psychological, Leadership, and Organization. **Results.** The study results showed no significant difference in applying universal values between the three levels of education. This is indicated by a p-value greater than 0.05, indicating that the average difference found was not statistically significant. **Conclusions.** This study concludes that teachers play an essential role in implementing these universal values.

KEYWORDS: *Teacher Involvement, Universal Values, Educational Integration, School Students, Comparative Study*

INTRODUCTION

Integrating universal values within the educational system is crucial to shaping future generations' moral and ethical foundations (1). Teachers, as the primary facilitators of learning, play a pivotal role in this process, as their personal qualities, moral values, and pedagogical approaches significantly impact the development of students' self-esteem and character (2). Research suggests that training and supporting teachers in inclusive practices is vital in transforming education towards more inclusive models that reflect the changing social landscape (3). Classrooms guided by teachers who imbue inclusivity, compassion, and social justice foster an environment where every learner feels wanted and included, ensuring that all students, regardless of their background, can benefit from the learning process (4).

However, achieving true inclusiveness is not without its challenges. Literature has shown that while teachers

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agree that inclusive education is important, many find it challenging to apply in practice (5). This underscores the need for collaborative efforts between teachers of diverse educational backgrounds and teaching experiences to solve emerging problems in the school atmosphere (6). To address this, teacher training colleges are crucial in building teachers' confidence and competence in implementing inclusive practices (5). Fundamental changes in attitudes towards diversity and equity are needed at all levels of society, and research on teacher change suggests that challenging and changing teachers' beliefs is an essential step in this transformation (3,7).

Only when teachers are allowed to actively participate and experience success in using inclusive practices in their classrooms will they undergo a positive change in attitude and perception towards inclusion (3)? Empowering teachers to develop confidence in their capabilities to support the learning and achievement of an increasingly diverse range of students is essential in creating genuinely inclusive educational environments (8). Teacher involvement in integrating universal values in schools is a multifaceted challenge that requires a holistic approach (9). Equipping teachers with the necessary skills, resources, and support to foster inclusive classrooms that nurture the diverse needs of all students is a critical step in shaping a more just and equitable educational landscape (8).

Teachers are the primary facilitators of learning and play a pivotal role in shaping future generations' moral and ethical foundations (3,5). Their personal qualities, moral values, and pedagogical approaches significantly impact the development of students' self-esteem and character (8). It is necessary to prepare responsible and promising teachers for inclusive education to bring about the desired change in the education of diverse children (10).

MATERIALS AND METHODS

Research design. The method used in this study is an experiment with a multigroup experimental design. The assumption underlying the selection of this design is that there are two groups in this study, namely, the elementary school group and the junior high school group.

Respondents. The respondents in this study consisted of physical education teachers spread across various levels of education, namely elementary, middle, and high schools. Furthermore, to facilitate grouping, the following is made.

Research Instruments. This research uses the Universal Values in Sport Instrument (USSI). This instrument uses five dimensions and 23 indicators. Dimensions of Universal Values: Ethics and Morals (Respect for the rules, respect for others, fair play, self-esteem, honesty, tolerance); Knowledge and understanding (Problem-solving, understanding, how to win, how to lose); Social (Cooperation, communication, connecting with others, teamwork, trust); Psychological (Value of effort, resilience, confidence, discipline, self-respect); Leadership and Organization (Leadership, how to manage competition, sharing) (11). The instrument has met the criteria for use with a Cronbach's Alpha value of 0,990.

Statistical analysis. The data analysis used to process the research data uses the variance analysis (ANOVA) test. ANOVA tests whether there are significant differences in the average teacher engagement at all three school levels. Meanwhile, if only two groups are compared, the t-test can be used. Then, the study results regarding teacher engagement in elementary, middle, and high schools are compared.

RESULTS

Based on the comparative data analysis of the assessment of Universal values in physical education between Group A and Group B, several things can be concluded. The data shows that 111 groups A and 35 groups B were analyzed. The results show that group A has an average value of 375.13 with a standard deviation of 28,482, while group B has an average value of 368.63 with a standard deviation of 25,346. For further details, please see Table 2.

The first step in this analysis is to conduct a Levene test for equality of variance. The results of the Levene test show an F value of 0.644 with a significance (Sig.) of 0.424. Because this value is more significant than 0.05, we can conclude that the assumption of equality of variance is met, which means that the variance of the two groups can be considered the same.

In addition, effect size analysis using Cohen's d, Hedges' correction, and Glass's delta was also conducted to understand the magnitude of the difference between the two groups. The results showed that Cohen's d was 0.234, Hedges' correction was 0.233, and Glass's delta was 0.256. These effect sizes have a 95% confidence interval that includes the value of zero, indicating that the difference between the two groups is minimal and not practically significant. The analysis showed no significant difference between the assessment of Universal values in physical education in elementary school teachers (group A) and junior high school teachers (group B).

DISCUSSION

This finding underscores the need for a holistic and coordinated effort by educators, policymakers, and the broader community to ensure that universal values are seamlessly integrated into the fabric of the educational experience, from the elementary to the high school level (12). Teachers play a crucial role in this process, as they

are the primary facilitators of learning and the conduits through which universal values are transmitted to students (13). Regardless of the grade level, teachers equipped with the necessary knowledge, skills, and mindset to effectively integrate universal values in their classrooms can profoundly impact the development of their students' character, social-emotional well-being, and overall academic performance (14).

This consistency in the effectiveness of integrating universal values can be attributed to several factors: First, the importance of universal values, such as empathy, respect, and ethical decision-making, is recognized across all grade levels. These values are not limited to a specific developmental stage but serve as foundational principles for students' holistic growth and well-being throughout their academic journey. Second, integrating universal values in schools is often supported by a comprehensive and coherent approach that spans multiple grade levels. This ensures that students receive consistent and progressive exposure to these values, building upon the foundational knowledge and skills acquired in the earlier grades. Third, teachers across all grade levels are increasingly equipped with the knowledge, skills, and mindset to integrate universal values in their classrooms effectively. As evidenced by the research, well-trained teachers committed to integrating universal values can significantly impact their students, regardless of the grade level they teach (15).

CONCLUSION

In reality, both intentionally and unintentionally, the implementation of universal values in education in schools has been applied by teachers to students, just not explicitly. Based on the results of this study, almost all physical education teachers apply and provide universal values in implementing physical education. No matter at what level, the core of the implementation and application of these universal values depends on the method and consistency of its application. It will still provide good results for students' universal values if applied at any level.

APPLICABLE REMARKS

- The results of this study are significant in that they serve as a guide for physical education teachers in schools to teach not only about improving sports skills but also about improving universal values that are deliberate, planned, and implemented well because those values will be valuable to students in the future.

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Study concept and design: Eko Purnomo, Omar Firdaus, Nina Jermaina. Acquisition of data: Agus Gumilar, Mutiara Felicita Amsal. Analysis and interpretation of data: Andri Gemaini, Amin Akbar. Drafting the manuscript: Eko Purnomo, Rila Muspita, Nor Eeza Zainal Abidin. Critical revision of the manuscript for important intellectual content: Eko Purnomo. Statistical analysis: Nor Eeza Zainal Abidin.

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Table 1. Group Research

No	Group	Levels	Quantity
1	Group A	Elementary School Teachers	111
2	Group B	Junior High School Teachers	35

Table 2. Levene's Test for Equality of Variances results of Universal Values at Elementary and Junior High School levels

		F	Sig.	t	df	Significance	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								5.384	Lower	Upper
USSI	Equal variances assumed	.644	.424	1.20	144	.229	6.498		-4.144	17.139
	Equal variances are not assumed.			1.28	63.36	.204	6.498	5.066	-3.625	16.620

Table 3. Independent Samples Effect Sizes of Universal Values Results in Elementary and Junior High School Levels

		Standardize	Point Estimate	95% Confidence Interval	
				Lower	Upper
USSI	Cohen's d	27.773	.234	-.147	.614
	Hedges' correction	27.919	.233	-.147	.611
	Glass's delta	25.346	.256	-.130	.639

Intervention of Motivation to Improving Forward Roll Skill: An Experimental Study of Gymnastics in Elementary School

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ABSTRACT

Background. This study began with many children who failed to do a forward roll. The ability to do a forward roll is part of physical education in elementary schools that supports coordination and muscle strength.

Objectives. This study aims to determine whether children's forward roll ability can be improved through motivational intervention compared to conventional approaches. **Methods.** The method used in this study was quasi-experimental, involving 40 children aged 8-10 years. This study was divided into two groups: an experimental group of 20 people and a control group of 20. Data were obtained from the ability of forward rolls and analyzed using the t-test. **Results.** Children with intervention are better at performing forward rolls, as seen from the results of measuring the ability of forward rolls sig, 0.000 <0.05. Compared to the conventional approach, which has a lower ability to roll forward than the intervention group, which has a higher ability to roll forward. So, it can be said that intervention should be given to children aged 8-10 years.

Conclusion. Because there is a difference in forward roll ability between children with conventional and intervention approaches, teachers need to understand and provide motivation to children. We can provide motivational intervention to children in doing forward rolls, make children brave in doing activities, and increase self-confidence.

KEYWORDS: *Motivation, Children, Forward Roll, Motoric, Gymnastics*

INTRODUCTION

Motor skills are abilities that must be mastered as early as possible, making the initial foundation in physical activity(1) motor skills are closely related to physical education, which makes physical education a learning that teaches motor skills to children(2) motor learning in physical education, one of which is gymnastics. Gymnastics is a sport that uses highly coordinated movements by demanding quality in movement(3). Gymnastics in Australia is a popular sport reaching 92% of athletes aged 12 years and 9.6% of the population aged 0-14 years who participate each year(4), and 164,000 junior gymnasts in the United States participate each year(5), in 2021 there was an increase of 10% (6)

Gymnastics activities predominantly use complex movements (4) and cause many novice gymnasts to fail in performing gymnastic movements. Gymnastics is a high-risk sport that involves knee/foot, hip, and ankle/hand injuries(7). Ankle injuries are the most common at 17.9%(8). Healing takes a long time and results

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in gymnasts having a negative psychological impact (9). Many children fail to perform forward rolls and candle positions and are not brave because gymnastics has a reasonably high injury rate.

If this is not handled correctly, it will become a big problem later (10). Aspects that hinder gymnastics movements need to be overcome, such as overcoming fears that are embedded in the child's psychology. High anxiety in gymnastics needs to be given education such as competency support, autonomy support, and an efficient learning system(11).

With the obstacles that occur, researchers make the foundation for researching gymnastics learning, and researchers provide understanding and motivation to children by providing motivation and engaging learning that certainly makes children more interested in learning. Motivation can also make children more diligent and continue to practice until they succeed. In addition, motivation can also make children more focused on understanding the correct technique to avoid the risk of injury that often occurs. This research aims to improve children's skills in performing forward rolls through motivational intervention.

MATERIALS AND METHODS

This study used a quasi-experimental method with 40 participants aged 8-10 years. This study was divided into two groups: an experimental group of 20 people and a control group of 20. To conduct research, of course, some requirements must be done, such as research preparation by preparing a test format, conducting a pre-test, and determining groups using Ordinally Matching Pairing to be able to determine the experimental group and the control group, after everything is done with the stages that have been determined, the next step is to conduct a post-test to obtain research data. The instrument used in this study was the forward roll skill. After the data was obtained in the study using the existing instrument, data testing was continued using the quantitative T-test to describe meaningful data(3).

RESULTS

The researcher has requested permission from the relevant parties to conduct this research. With the granting of permission, the researcher continued this research by conducting a learning experiment on Motivational Intervention.

With descriptive results, the data is valid and can be continued for normality testing to see the results obtained. By conducting a normality test, it can be seen that the data is normally distributed, which can be seen in Table 2.

With the results of sig 2-tailed <0.05 , it can be said that there is a significant difference. By conducting experimental research on motivational intervention with a conventional approach, it can be seen that motivation significantly influences children's forward roll ability compared to the conventional approach. This can be seen in Table 3.

DISCUSSION

Based on the findings of a recent study, children who received special attention and treatment in doing forward rolls were better than children who used conventional learning methods. This is because doing activities requires better encouragement and motivation, and high motivation can optimize the activities. The results of the study are in line with research(12) that social support and autonomous motivation have a significant influence on moderate to high-intensity physical activity (MVPA). With high motivation, children can do activities with high intensity and fun(13). By doing continuous training, speed and accuracy can increase (14).

Children who did not receive motivational intervention in performing FMS tasks had minimal locomotor improvements but did not show any changes in object control skills (15). Thus, motivational interventions support increasing student motivation and achievement and help children become more involved in FMS learning (11). The presence of motivation can encourage children to participate in achieving goals(15)

Motivation provides the power to condition the mind in training, and high motivation increases desire, while low motivation makes children unable to achieve goals. However, researchers realize there are still shortcomings, such as the small number of samples not yet netted from various regions. Future researchers hope this research will be a guideline for conducting further research.

CONCLUSION

Motivation must be given to children from an early age so that they have a high desire to achieve what they want. High motivation makes children enthusiastic about learning new things. This study has concluded that children who are given motivational intervention in carrying out forward rolls make children dare to try and carry out forward roll skills, in contrast to children who get forward roll learning only using conventional

models. The study is not yet perfect, such as samples that are not yet very wide, and there may still be other factors that inhibit children's forward roll skills. Therefore, the researcher conveys to the reader the importance of examining things that can affect forward roll skills.

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AUTHORS' CONTRIBUTIONS

Study concept and design: Ronni Yenes, Yayang Yulia Sari, Acquisition of data: Yayang Yulia Sari, Yendrizal. Analysis and interpretation of data: Heru Andika. Drafting the manuscript: Yayang Yulia Sari, Heru Andika. Critical revision of the manuscript for important intellectual content: Ronni Yenes, Inge Angelia. Statistical analysis: Yendrizal, Yayang Yulia Sari.

CONFLICT OF INTEREST

The authors mention no "Conflict of Interest" in this study.

ETHICAL CONSIDERATION

This research has met the standards of research ethics and has received approval to be a sample of all respondents.

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Table 1. Descriptive Data

	N	Minimum	Maximum	Mean	Std. Deviation
Pre-Tes Motivational Intervention	20	44,00	68,00	55,30	5,99
Post-Tes Motivational Intervention	20	52,00	77,00	63,25	6,32
Pre-Tes Konvensional	20	44,00	61,00	52,75	3,58
Post-Tes Konvensional	20	53,00	72,00	60,20	4,12
Valid N (listwise)	20				

Table 2. Normality Test

Children		Kolmogorov-Smirnova		Shapiro-Wilk	
		Statistic	df	Sig.	Statistic
Forward Roll Skill	Pre-Test Motivational Intervention	0.084	20	0.200*	0.982
	Post-Test Motivational Intervention	0.124	20	0.200*	0.981
	Pre-Test Konvensional	0.172	20	0.122	0.953
	Post-Test Konvensional	0.131	20	0.200*	0.930
a. Lilliefors Significance Correction					
*. This is a lower bound of the true significance.					

Table 3. Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	α 0,05				
					Lower	Upper			
Pair 1	Pre-Tes Motivational Intervention Post-Tes Motivational Intervention	-7.95	1.50	0.34	-8.65	-7.25	-23.65	19	0.000
Pair 2	Pre-Tes Konvensional Post-Tes Konvensional	-7.45	1.32	0.30	-8.07	-6.83	-25.30	19	0.000

Motor Skills Improving by Developing an E-Module Program Play in Children

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ABSTRACT

Background. Motor development in children is significant, but there is a lack of engaging learning media. This study aims to develop an E-Module to support motor development. This study provides learning in Video and audio that is easy to access Where I am and anytime and can be repeated in learning. **Methods.** This study uses the Brog and Gall research and development (R&D) approach. The population of this study included teachers, parents, and early childhood students in Padang City. Data collection used a validity sheet with a Likert scale and was analyzed using a correlation coefficient. **Results.** The e-module development from material experts was 86.76 in the category of "very good" and 84% for media experts in the category of "very good," with an average percentage of 85.5 in the category of "very good." This product contains educational game material about cooperation, competition, sportsmanship, and fighting spirit. The test results are valid, and the e-module of the TACSSPORT (Teamwork, Agility, Competition, Spirit, Strength, Sportsmanship) play activity program can improve motor skills in early childhood. **Conclusion.** TACSSPORT e-module is an effective and innovative learning tool that can be applied to children and provides interesting and fun games. This research has not been conducted for trials on large groups. Therefore, in the future, large-scale trials will be conducted in 3 provinces.

KEYWORDS: *E-Module, Playing, Motor, Early Childhood*

INTRODUCTION

The challenges in the world of education are increasing. Education plays an important role in the progress of the country(1) education is one way to keep up with the times, which is suitable for yourself, your family, and others(2) education has begun to penetrate the digital era, which encourages teachers to take a role in improving learning, such as providing engaging and easily accessible modules anywhere(3). The need for good, interesting learning media will make learning more effective in keeping up with current developments.

Good learning certainly provides complete and capable facilities and infrastructure (4 in quality and quantity. The lack of facilities and infrastructure makes children less motivated and makes it challenging for them to understand learning(5). Likewise, learning media that are less interesting means that children will get bored quickly and become lazy about learning. Facilities and infrastructure affect children's motivation(6).

The basis for implementing E-Learning is good knowledge of TIK(7) to overcome the challenges of the times and the world of education with E-Modules. E-module is learning material that is systematically arranged and presented in electronic format linked to the program link and is equipped with interesting learning, presenting video tutorials, animation, and audio to enrich the learning experience, which can be repeated as many times as

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needed(8). The e-module created in this research is the TACSSPORT Play Activity Program (Teamwork, Agility, Competition, Spirit, Strength, Sportsmanship) to improve children's motor skills. To answer this question, we will research the development of the TACSSPORT play activity program e-module for early childhood.

MATERIALS AND METHODS

Study design. This research is a development research (R&D) of the TACSSPORT Play Activity Program E-Module for early childhood, which uses the Borg and Gall model, aiming to determine the validity of a product.

Participant. Involving teachers, parents, and kindergarten/early childhood education students in Padang city.

Statistical Analysis. After the data is obtained, continue with testing using the correlation coefficient.

RESULTS

Learning difficulties drove this development study. The rapid growth of technology, especially the Internet, creates opportunities for research and development. Problems with teaching materials provided by schools and the Padang City Government must be resolved immediately so that the learning process can be more effective and efficient in achieving learning goals. As a result, the researchers created the TACSSPORT play activity program e-module, which includes play activities for early childhood.

1. TACSSPORT play activities are essential for young children; children's motor skills can improve with proper play activities. 2. After determining the content that will be combined into an e-module playing program, use the Kvisolf Flip Maker Pro application for the material, the Publisher 2007 application for the background and cover, Paint for image animation, and combine it into a Module file in PDF form. 3. After the data is collected, create an initial product strategy for the playing program e-module by using

The valid test results of TACSSPORT playing materials by validators who are experts in the field of games in the TACSSPORT Play Activities Program module are "very Decent," with a percentage of 86.76 from 17 question items.

In this stage of developing the TACSPORT game e-module for early childhood, it can be concluded that the validation results by media experts can be categorized as "Very Good." So, the TACSPORT game e-module can be used.

Based on the validation results that have been carried out by media and materials experts, it can be said that the products produced in the TACSSPORT Play Activities e-module are "very feasible" with an average percentage of 85.5, for use as game materials, especially for children aged early.

DISCUSSION

By carrying out the research, the results were obtained that the development of the TACSSPORT playing activity program met the requirements to be included in the very feasible or very good category. Validity in research is everything that shows truth or veracity(9). The high level of validity of the resulting tool will help its acceptance among the public (10).

Electronic learning modules, or E-Modules, are learning based on science and technology in the era of globalization(8). Today's activities are increasingly facilitated by sophisticated technology(11), such as learning through media. This makes researchers want to raise issues that are currently trending. Through E-modules developed using the Borg and Gall development model, teachers can use this E-module anytime and anywhere(12) with only a mobile phone/android (13). Children will find it easier to understand and comprehend the games arranged and displayed, which contain writing and images accompanied by audio and video(14). Thus, the existence of interesting TACSSPORT playing activities that motivate children to learn will improve their learning outcomes and knowledge.

Research shows that using e-learning can improve positive learning outcomes (8), and e-learning integrates education and technology in the world of learning (7). Technological advances have a positive effect on education.

The results of this study show that the development of TACSSPORT play activities in the form of E-Modules has a high level of validity and is suitable for use in early childhood. With the implementation of this research, we still have shortcomings in this study, such as the absence of its application in large groups, which we have only applied to small groups. Researchers suggest that readers can apply it and continue research in the future.

CONCLUSION

E-Module is an innovative and efficient learning media that can help children play, learn, and improve their motor skills. From the research that has been done, it is proven that the TACSSPORT game E-Module is declared feasible and valid for use both in terms of media and materials. For further researchers, they can

combine the application of the E-Module with TACSSPORT playing activities on children's nutritional status and motivation.

AUTHORS' CONTRIBUTIONS

Study concept and design: Yanuar Kiram, Padli Padli, Muhmad Sazeli Rifki Acquisition of data: Sri Gusti Handayani. Analysis and interpretation of data: Heru Andika. Drafting the manuscript: Heru Andika, Sri Gusti Handayani. Critical manuscript revision for important intellectual content: Yanuar Kiram, Padli Padli. Statistical analysis: Padli Padli, Sri Gusti Handayani.

CONFLICT OF INTEREST

The authors mention no "Conflict of Interest" in this study.

ETHICAL CONSIDERATION

This research has met the standards of research ethics and has received approval to be a sample of all respondents.

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The authors have no financial interests related to the material in the manuscript.

ARTIFICIAL INTELLIGENCE (AI)

USE There was NO use of artificial intelligence (AI) for preparation, writing, or editing this manuscript.

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Figure 1. TACSSPORT Play Activity E-Module

Table 1. Material Validity

Amount of Data	Percentage	Category
59	86,76%	Very Decent

Table 2. Material Validity

Amount of Data	Percentage	Category
54	84%	Very Good

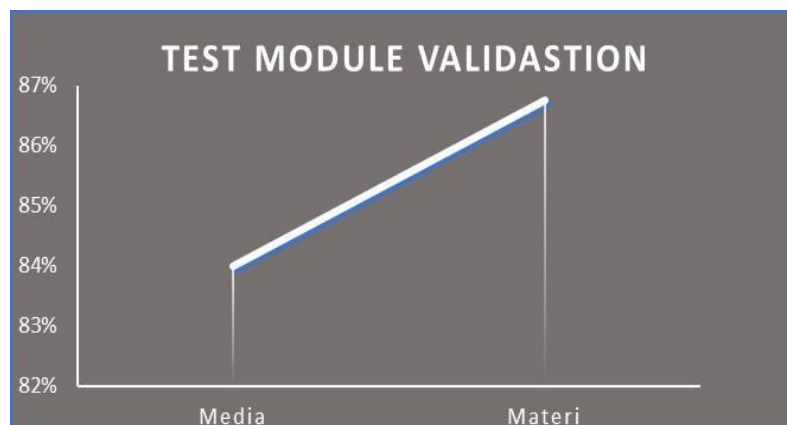


Figure 2. Histogram of e-module validation results

The Effect of The Eat Clean, Nourish Your Body (ECNYB) Program on Overweight and Obese Students

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ABSTRACT

Background. Weight loss among teenagers who are overweight and obese is an issue that is gaining more attention in Malaysia. Although short-term weight loss interventions have shown positive results, their long-term effectiveness is still debated. **Objectives.** This study aims to evaluate the effects of the ECNYB program, which combines balanced nutrition and physical activity, on weight loss over 8 weeks. **Methods.** This quasi-experimental study involved 40 students randomly assigned into two groups: the treatment group, which followed the ECNYB program, and the control group, which only continued their usual Physical and Health Education (PHE) classes. Data were analyzed using descriptive and inferential statistics, focusing on weight, height, and Body Mass Index (BMI) changes. **Results.** The results showed a significant weight reduction in the treatment group ($M = 33.8$ kg, $SD = 4.2$ in the first term, $M = 31.1$ kg, $SD = 3.9$ in the second term), while the control group did not show significant changes. A paired sample t-test confirmed significant differences between the treatment and control groups. **Conclusion.** This study suggests that the ECNYB intervention could have positive short-term effects, and further studies are recommended to extend the intervention to 12 weeks to evaluate its long-term effects.

KEYWORDS: *Weight Loss, Obesity, Over-weight, Adolescent, Physical Activity*

INTRODUCTION

In Malaysia, obesity has become increasingly alarming, with more than 30% of children and adolescents reported to be overweight or obese [1].

The ECNYB program was introduced as a structured intervention that combines healthy nutrition and physical activity. Previous studies have shown that an integrated approach involving nutrition and physical activity can potentially reduce weight and improve the health status of adolescents [2].

Obesity and overweight are growing global health threats. Body Mass Index (BMI) is commonly used to measure an individual's weight status. Individuals with a BMI over 25 are considered overweight, while those with a BMI over 30 are categorized as obese [3]. Global data shows that more than 4 million deaths annually are attributed to complications related to obesity and overweight [1].

Long-term school-based interventions for obesity prevention are effective in reducing obesity rates among

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children and adolescents. The success of these interventions is linked to the consistency of the programs and the ongoing support from schools and the community [4].

MATERIALS AND METHODS

This study employed a quantitative approach using a quasi-experimental design involving pre-tests and post-tests. The design consisted of a treatment group and a control group. Instruments used in quantitative research generate data in numerical form, and experimental or quasi-experimental procedures are considered part of quantitative research [5].

Sample. The sample in this study consisted of overweight and obese students aged between 14 and 16 years old. The total sample size was 40 students, with 20 assigned to the control group and 20 to the treatment group.

Instruments. This instrument underwent face and content validity processes and was evaluated by three appointed experts. A minimum of three experts is required for validation [6], [7].

In addition, the instrument used to measure the participant's weight and height was the Omron Karada Scan Body Composition Monitor (HBF-375). This device has been validated for its reliability and is widely used in studies related to body composition monitoring [8], [9].

Research Procedure. *Nutrition and Healthy Lifestyle Talk.* A healthy eating briefing delivered by a certified health officer from the Ministry of Health Malaysia (MOH) also served as a key benchmark for the participants involved. This ensured that the study participants received accurate information regarding healthy and balanced nutrition [10].

Physical Activity Interventions. Some proposed activities included morning walks before assembly, scheduled brisk walks every afternoon, and the teachers' construction of the Anjung Cergas track. This track was built to ensure that the study participants fully engaged in physical activities throughout the 8-week study period. These additional activities were designed to target the upper body, lower body, and core body. The activities involved were Agility, Octagon Jump, Dynamic Lunges, Hoop Boxes, Single Leg Jump, Sumo Squat, High Jump, Recovery Session, Jumping Jack, Jump Smash, Spider Crawl, Push Up, Active Calf, Red Rangers Burpee, Pole Touch, Crab Crawl, and Shuttle Run.

Body Mass Index. Implementing BMI measurements in the National Physical Fitness Standard for Malaysian School Students (SEGAK) in Malaysia is important in assessing students' physical fitness, particularly in maintaining a healthy weight.

RESULTS

The data analysis used descriptive and inferential methods. Descriptive analysis covered BMI frequency, mean, and standard deviation for ECNYB participants. The inferential analysis included a t-test comparing pre- and post-test BMI results for the control group in the first term and the treatment group in the second term after the 8-week ECNYB program.

Based on Table 1, for the control group, the average body weight (BW) and BMI in the pre-test were 81.9 kg and 31.1 kg/m², respectively. Meanwhile, the average BW and BMI in the post-test were 85.9 kg and 31.8 kg/m². The standard deviation for BW and BMI in the pre-test were 9.3 kg and 2.3 kg/m², respectively, while for the post-test, they were 9.9 kg and 2.7 kg/m². These findings indicate an increase in weight among students at risk of being overweight and obese in the control group.

Based on Table 2, for the treatment group, the average weight (BW) and BMI in the pre-test were 90.2 kg and 33.8 kg/m², while the average BW and BMI in the post-test were 85.9 kg and 31.3 kg/m². The standard deviation for BW and BMI in the pre-test were 12.9 kg and 4.2 kg/m², respectively, while for the post-test, they were 12.1 kg and 3.9 kg/m².

These findings indicate a significant weight reduction and suggest a positive effect of the ECNYB program on students at risk of being overweight and obese in the treatment group.

The inferential analysis used a paired two-sample t-test. The findings for the control group showed no significant difference ($p = 0.115$, $p > 0.05$) in weight loss from the first term ($M = 31.1$, $SD = 2.3$) to the second term ($M = 31.8$, $SD = 2.7$) over the 8 weeks. This indicates that, without the implemented intervention, this group showed less encouraging results. In contrast, the analysis for the treatment group showed a significant difference ($p = 0.005$, $p < 0.05$) in weight loss from the first term ($M = 33.8$, $SD = 4.2$) to the second term ($M = 31.1$, $SD = 3.9$). This indicates that the ECNYB program had a positive and encouraging impact on weight loss among the participants.

DISCUSSION

The ECNYB program has a positive impact on weight reduction among at-risk students. These findings are consistent with the study, which emphasizes that exercise practices and involvement in school sports are key

factors influencing changes in BMI. Also, interventions combining healthy eating and physical activity are effective in addressing obesity and related comorbidities [11], [12], [13], [14]. Recent research found significant reductions in weight and increased nutrition awareness among participating students [15].

CONCLUSION

Overall, the study results indicate that the ECNYB program is effective in addressing the needs of students who are overweight and obese. Based on the findings of the conducted study, the following suggestions for future research are recommended to enhance knowledge in this field: it is proposed that a detailed fitness plan be implemented for 12 weeks. By planning a more extended program, it is hoped that sufficient time will be provided for students to adapt and achieve significant fitness and weight loss progress.

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APPLICABLE REMARKS

- The results of this study are significant for teachers as a guide for developing a structured intervention model like the Eat Clean, Nourish Your Body (ECNYB) program.
- This model aims to improve nutrition habits and promote physical activity among overweight and obese students, ultimately enhancing their overall health and well-being.

AUTHORS' CONTRIBUTIONS

Study concept and design: Siti Aishah Md Yusop, Rozaireen Muszali. Acquisition of data: Az Zuhra Zainal, Shahrulfitri Borhan, Mas Nur Zafirah Muhamad Saad. Analysis and interpretation of data: Mohd Hafizuddin Baki, Siti Musliha Mat Rasid. Drafting the manuscript: Eko Purnomo. Critical revision of the manuscript for important intellectual content: Siti Aishah Md Yusop. Statistical analysis: Rozaireen Muszali.

CONFLICT OF INTEREST

The authors mention no "Conflict of Interest" in this study.

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Table 1. Pre- and post-test scores for the Control Group

Statistic	Pre-test			Post-test		
	BH (cm)	BW (kg)	BMI (kg/m ²)	BH (cm)	BB (kg)	BMI (kg/m ²)
Mean	162.4	81.9	31.1	164.3	85.9	31.8
Standard Deviation	9.8	9.3	2.3	10.2	9.9	2.7
Minimum	138.0	64.3	27.1	140.0	66.7	27.1
Maximum	177.0	105.7	36.1	179.0	106.8	38.0

Table 2. Pre- and post-test scores for the Treatment Group

Statistic	Pre-test			Post-test		
	BH (cm)	BW (kg)	BMI (kg/m ²)	BH (cm)	BB (kg)	BMI (kg/m ²)
Mean	163.3	90.2	33.8	165.6	85.9	31.3
Standard Deviation	6.6	12.9	4.2	6.5	12.1	3.9
Minimum	154.0	70.4	29.3	156.0	68.0	26.1
Maximum	182.0	112.4	42.0	184.0	107.0	38.5

Table 3. Results of the Dependent Samples t-Test

Group	Test	n	Mean	Varian	df	t Stat	P (two-tail)	t Critical
Control Group	Pre-test	20	31.1	5.6	19	1.684	0.115	2.093
	Post-test	20	33.3	7.7				
Intervention Group	Pre-test	20	33.8	18.0	19	9.548	0.005	2.093
	Post-test	20	33.3	15.5				

Design Phase of the Development of a Self-Assessment Instrument of Doping Knowledge, Attitudes, and Practices Among National Youth Athletes: The Fuzzy Delphi Method

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ABSTRACT

Background. The use of doping among Malaysian athletes has become a worrying issue in the sports industry. Doping refers to the use of performance-enhancing substances or methods to gain an unfair advantage.

Objectives. This study aimed to design a self-assessment instrument for doping knowledge, attitudes, and practices among the country's youth athletes. **Methods.** The Fuzzy Delphi method was used in this research phase with five Likert scales. This study aimed to develop a self-assessment instrument capable of assessing the level of knowledge, attitudes, and practices of national youth athletes related to doping according to expert consensus. Therefore, the researcher obtained the consensus of 11 experts from various fields, especially sports organizations and sports coaching. This questionnaire has 22 items involving three constructs, namely (i) knowledge, (ii) attitude, and (iii) practice. Each item's ranking (ranking) is determined using the Defuzzification Process. **Results.** The findings of this study show expert consensus on all items in the primary construct. The findings of this study show that 21 out of 22 items were accepted and passed the three Fuzzy conditions, namely the threshold value (d) not exceeding or equal to 0.2, the percentage of expert agreement exceeding or equal to 75%, and the Defuzzification value (alpha cut) exceeding or equal to 0.5. **Conclusion.** Developing a self-assessment instrument can provide a new way to measure adolescent athletes' knowledge, attitudes, and doping practices.

KEYWORDS: *Fuzzy Delphi, Doping, Instrument Development, Design*

INTRODUCTION

Anti-doping education is a matter that needs to be emphasized in controlling the use of doping among athletes. (1) In Asia, no instrument is built according to the knowledge level of teenage athletes and the language level of teenagers. (2). The use of doping among Malaysian athletes has become a worrying issue in the sports industry.

A study conducted by (3) found that many adolescent athletes have a poor level of knowledge regarding the use of doping and anti-doping. The study also showed that 1.5 to 1.8% of the 614 respondents who participated tended to be positive towards the practice of doping use in sports. Anti-doping education programs and appropriate instruments should be developed to help athletes understand the dangers of using banned substances, and studies conducted by (4) found that anti-doping education and awareness programs are a practical approach to reducing the use of banned substances among athletes. Knowledge related to doping is essential because there are still many adolescent athletes who do not know the dangers of consuming prohibited

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substances in sports, such as the findings of a study conducted by (5). The construct of attitude needs to be emphasized because it can see the extent of athletes' attitudes towards the use of banned substances in sports (6).

MATERIALS AND METHODS

The study is a quantitative study that applies the fuzzy Delphi method (FDM). The use of the FDM is aimed at obtaining expert consensus on developing a self-assessment instrument on doping knowledge, attitudes, and practices among adolescent athletes. Researchers believe using FDM can overcome the disadvantages of the Traditional Delphi Fuzzy Method, where a consent process takes a long time (7). The researcher used a questionnaire instrument to conduct this study. This questionnaire was formed based on the findings of literature highlights, needs studies, and content analysis. Researchers have also validated the content and language of four experts in the fields related to this study. The researcher has also appointed the services of 11 experts to obtain expert consensus on the items to be tested in this study. The researcher used *Excel FDM* software Version 1.5 of 2022.

RESULTS

Table 1 shows that the threshold value (d) was not greater than or equal to 0.2, the percentage of expert consensus was above or equal to 75%, and the defuzzification value (alpha cut) was above 0.5. As such, all expert-rated items and elements of knowledge are accepted. The items in this knowledge section consist of eight question elements. These questions include types of prohibited substances, anti-doping organizations, banned drugs and food supplements, foods and drinks at risk of doping, effects of doping, anti-doping education programs, prohibited natural products, and the latest doping equipment technology.

The findings of this section include an attitude section comprising eight question elements. These questions include doping laws, awareness of prohibited substances, risks of doping use, attitude towards the use of banned substances, desire to use prohibited substances, improving sports performance, hunting for victory, and finally, achieving victory.

Table 2 showed that the threshold value (d) was not greater than or equal to 0.2, the percentage of expert consensus was above or equal to 75%, and the defuzzification value (alpha cut) was above 0.5. As such, all expert-rated attitude elements are accepted.

Based on Table 3, five of the six items given to the experts were accepted except for one item, which a group of experts rejected. The item questions in this section consist of the importance of obtaining correct information, giving or receiving substances such as food or drugs, the influence of the internet (applications and social media) on the consumption of performance-enhancing substances, the tendency to use doping among fellow athletes, the impact of the environment (coaches, peers, mass media, etc.) to take banned substances and finally influence from coaches, peers and sports managers to take banned substances to improve performance.

DISCUSSION

As a result of the analysis data using the Fuzzy Delphi Method, researchers successfully formed the constructs and elements to build the instrument items to be developed. The results of the data analysis showed that all experts agreed to accept all the items proposed by the researcher except for one element of the practice construct that the experts rejected. The consensus of these experts shows that all agreed values are high. The analysis of these findings also answers the question of a study conducted by researchers to develop a doping self-assessment instrument among national youth athletes.

Based on the findings of this study, all elements in the knowledge and attitude constructs are accepted by experts by consensus. Meanwhile, the expert accepted five of the six elements in the practice construct, while one was rejected.

CONCLUSION

This study can contribute ideas and innovations to forming doping self-assessment instruments among adolescent athletes, which have not been developed to meet their needs. This statement is in line with the findings. (8) His study showed that athletes' level of knowledge, attitude, and practice towards doping was low, and there should be a specific instrument for Baggi youth athletes to assess their level of expertise." athlete" and "sport." Some subjects and terms commonly used in this theme can potentially be further developed in connection with the study results. Researchers and scientists interested in this topic might also use several publications, authors, and trending keywords as references for further research. Sports academics worldwide should research communication in sports and apply what they learn in training and competition.

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APPLICABLE REMARKS

- The results of this study are important for developing new instruments suitable for teenage athletes.
- It provides a new experience for obtaining accurate measurements of the athlete's level of knowledge about prohibited substances.

AUTHORS' CONTRIBUTIONS

Study concept and design: Rosly Yusoff, Norhazira Abdul Rahim, Mohd Hafizuddin Baki. Data acquisition: Rosly Yusoff, Hafizuddin Baki. Data analysis and interpretation: Rosly Yusoff, Norhazira Abdul Rahim, Eko Purnomo. Drafting the manuscript: Rosly Yusoff. Critical manuscript revision for important intellectual content: Rosly Yusoff, Eko Purnomo. Statistical analysis: Rosly Yusoff.

CONFLICT OF INTEREST

The members who participated in the meeting unanimously decided to provide Universiti Pendidikan Sultan Idris and the Publication Ethics Directive as an "Ethics Committee Approval Document" for research.

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Table 1. Threshold Value (d), Percent Expert Consensus, Defuzzification, and Item Ranking for Doping-Related Knowledge Construct Elements.

Statistic	1	2	3	4	5	6	7	8
Value of the item	0.025	0.025	0.025	0.174	0.061	0.045	0.081	0.025
Value of the construct								0.055
Item <0.2	11	11	11	11	10	11	11	10
% of item < 0.2	100%	100%	100%	100%	91%	100%	100%	91%
Average of % consensus defuzzification	0.967	0.967	0.967	0.967	0.967	0.967	0.967	0.967
Ranking	1	2	2	2	8	6	5	7
Status	Accepted	Accepted	Accepted	Accepted	Accepted	Accepted	Accepted	Accepted

Table 2. Threshold Value (d), Percentage of Expert Consensus, Defuzzification, and Item Ranking for Doping-Related Attitude Construct Elements.

Statistic	1	2	3	4	5	6	7	8
Value of the item	0.045	0.076	0.076	0.119	0.061	0.113	0.045	0.025
Value of the construct								0.073
Item <0.2	11	11	11	10	11	10	11	11
% of item < 0.2	100%	100%	100%	91.0%	100%	91.0%	100%	100%
Average of % consensus defuzzification	0.948	0.921	0.912	0.870	0.939	0.888	0.948	0.958
Ranking	2	5	6	8	4	7	2	1
Status	Accepted	Accepted	Accepted	Accepted	Accepted	Accepted	Accepted	Accepted

Table 3. Threshold Value (d), Percentage of Expert Consensus, Defuzzification, and Item Ranking for Doping-Related Practice Construct Elements.

Statistic	1	2	3	4	5	6
Value of the item	0.076	0.131	0.071	0.310	0.025	0.112
Value of the construct						0.121
Item <0.2	11	10	11	3	11	10
% of item < 0.2	100%	91%	100%	27%	100%	91.0%
Average of % consensus defuzzification	0.902	0.916	0.930	0.812	0.958	0.924
Ranking	4	5	2	-	1	3
Status	Accepted	Accepted	Accepted	Rejected	Accepted	Accepted

The Impact of Circuit Training on Muscular Endurance, Cardiovascular Endurance, Power, and Flexibility of Academy Emran Futsal Players

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ABSTRACT

Background. Futsal is becoming increasingly popular in Indonesia, especially among teenagers and university students. However, Academy Emran Futsal has experienced a decline in performance due to a lack of adequate physical conditioning programs. **Objectives.** This study aims to examine the effectiveness of circuit training in improving the physical condition of futsal players, including cardiovascular endurance, muscular endurance, power, and flexibility. **Methods.** The research involved 15 players from Academy Emran Futsal using a pre-experimental design with a one-group pretest-posttest approach. Circuit training was conducted over 16 sessions, with measurements taken before and after the program using methods such as the Multistage Bleep Test and Sit and Reach Test. **Results.** The analysis results showed significant improvements in all physical variables tested, with $p < 0.05$. Circuit training was found to be effective in enhancing cardiovascular endurance ($t = 2.172$), muscular endurance (Squat: $t = 7.364$; Sit Up: $t = 2.797$), power ($t = 2.904$), and flexibility ($t = 3.261$). **Conclusions.** This study emphasizes the importance of integrating physical training into the development of futsal players to achieve better performance. The findings are expected to serve as a reference for coaches in designing effective training programs.

KEYWORDS: *Futsal, Circuit Training, Physical Conditioning, Cardiovascular Endurance, Performance Improvement*

INTRODUCTION

Futsal is an increasingly popular sports branch in Indonesia, especially among teenagers and university students. Physical condition, comprising cardiovascular endurance, muscular endurance, power, and flexibility, is a crucial component that futsal players must possess to deliver optimal performance (1–3). Good cardiovascular endurance enables players to maintain a high intensity throughout the match. Strong muscular endurance aids players in executing effective and efficient movements (4,5). High power facilitates players in performing accelerations, decelerations, and jump shots.

Meanwhile, good flexibility reduces the risk of injuries to players. Suboptimal physical conditions can impact a player's performance in a match. Players with good physical condition can perform more effectively and efficiently and

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maintain their play quality until the end of the match. Conversely, players with poor physical condition will quickly become fatigued, thus unable to make maximum contributions to their team.

Considering the problems Academy Emran Futsal faces, a training method is needed to improve players' physical condition effectively. One training method that can be used is circuit training. Circuit training is a form of exercise consisting of several exercise stations or posts that are performed sequentially with short rest periods (6,7). This method is expected to improve the physical components required in futsal.

Previous research has shown that circuit training can improve team sports players' cardiovascular endurance, muscular endurance, power, and flexibility. (8) studied adolescent football players and found that circuit training can significantly improve cardiovascular and muscular endurance. In addition, (9,10) also reported that a circuit training program can improve power and flexibility in football players.

However, no specific research has examined the effects of circuit training on the physical condition of futsal players, especially at Academy Emran Futsal. Previous studies have been conducted primarily on football players, so further research is needed to determine the effectiveness of circuit training in improving the physical condition of futsal players.

Therefore, this study aims to fill this gap and contribute to the development of sports science, especially in futsal. It is hoped that the results of this study can be a reference for coaches in designing training programs to improve the physical condition of futsal players.

To see this problem, it is necessary to conduct a study to examine the effectiveness of the circuit training method in improving the physical condition of futsal players, especially at Academy Emran Futsal. The results of this study are expected to be a reference for coaches in designing the right training program to improve futsal players' physical condition to achieve better performance.

MATERIALS AND METHODS

The researcher used a pre-experimental design with a one-group pretest-posttest design in this research. This research was conducted at Academy Emran Futsal, Yogyakarta, from January to April 2024. The population in this study was all players of Academy Emran Futsal. The sampling technique used was purposive sampling. From this population, 20 players were selected to be research subjects. To measure these variables, the researcher used several instruments, namely: (1) Multistage Bleep Test to measure cardiovascular endurance, (2) Squat Test and Sit Up Test to measure muscular endurance, (3) Broad Jump Test to measure power, and (4) Sit and Reach Test to measure flexibility. Data collection techniques were conducted by conducting pre-tests and post-tests on the sample. The pretest was conducted to measure the initial condition of the players' physical components, while the post-test was conducted after the players were given treatment in the form of a circuit training program for 16 meetings. The data analysis technique in this study is hypothesis testing using a paired sample t-test.

RESULTS

The results of this study indicate that circuit training significantly positively impacts various physical aspects of Academy Emran Futsal players. Improvements in players' cardiovascular endurance, muscular endurance, power, and flexibility were proven by analyzing the test results. The results of each of these data are presented as follows:

The study results show that circuit training significantly impacts the cardiovascular endurance of players at the Academy Emran Futsal. From the analysis of the Multistage Bleep Test, a calculated t value of 2.172 was obtained, exceeding the table t value of 2.145, with a p value of 0.000. This indicates that the training program effectively improved the players' aerobic capacity.

The improvement in muscular endurance among players at the Academy Emran Futsal is reflected in the results of the Squat and Sit-Up tests. For the Squat test, the t value reached 7.364, while for the sit-up test, the t value was 2.797, with a p value of 0.000. This indicates that circuit training significantly improves the players' muscular endurance.

The study results indicate that circuit training significantly enhances players' power, measured through the Broad Jump test. With a calculated t value of 2.904 and a p value of 0.000, these results confirm that the applied training program is efficacious in improving players' explosive strength.

Players' flexibility also showed a significant improvement after circuit training implementation. The Sit and Reach test results indicated a t value of 3.261 and a p value of 0.000, indicating that the training effectively enhanced players' flexibility.

DISCUSSION

Research has shown that circuit training can significantly improve the cardiovascular endurance of futsal players.

A study conducted by (11) found that implementing circuit training for 8 weeks on futsal players improved VO₂ max test results, which is a primary indicator of cardiovascular endurance. Circuit training combines aerobic and

anaerobic exercises in one session, which helps improve the efficiency of the heart and lungs. According to (12), high-intensity interval training can improve aerobic capacity more effectively than traditional training methods. Increased cardiovascular endurance allows players to last longer in the game and maintain optimal performance. Next, a study by (13) also found that training programs combining strength and endurance training provide better results in improving muscular endurance than separate training. Circuit training can create varied muscle stimuli, increasing strength and endurance simultaneously. With good muscular endurance, players can perform movements more effectively and reduce the risk of injury. Next, a study by (14) shows that combining strength and plyometric exercises in circuit training can significantly increase power. Well-designed exercises can increase muscle strength and speed, contributing to increased power. Circuit training can help futsal players achieve optimal performance on the field. Next, Research by Nuzzo (2020) supports this finding, showing that training programs that include flexibility elements can improve athlete performance. Good flexibility allows players to perform movements more efficiently and effectively. With increased flexibility, players can reduce the risk of injury, especially when performing movements requiring rapid direction changes. From the results of this study, it can be concluded that circuit training significantly impacts the physical fitness of futsal players, including cardiovascular endurance, muscular endurance, power, and flexibility. A structured training program focused on various aspects of physical fitness is essential to improve player performance on the field.

CONCLUSION

Based on the research results and discussion, it can be concluded that circuit training can effectively improve important physical components, namely cardiovascular endurance, muscle endurance, strength, and flexibility in futsal players.

APPLICABLE REMARKS

- Circuit training is one of the physical exercises that can be applied to develop physical components such as cardiovascular endurance, muscle endurance, strength, and flexibility in futsal players.

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AUTHORS' CONTRIBUTIONS

Concept and design of the study: Darni. Data acquisition: Danny Eka Wahyu Saputra. Data analysis and interpretation: Darni. Compiled the script: Muhamad Ichsan Sabillah. Critical revision of the manuscript for important intellectual content: Muhamad Ichsan Sabillah. Statistical analysis: Danny Eka Wahyu Saputra. Administrative, technical, and material support: Darni. Study supervisor: Ilham.

CONFLICT OF INTEREST

The authors mention no "Conflict of Interest" in this study.

ETHICAL CONSIDERATION

This research has met the standards of research ethics and has received approval to be a sample of all respondents.

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FINANCIAL DISCLOSURE

The authors have no financial interests related to the material in the manuscript.

ARTIFICIAL INTELLIGENCE (AI)

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Table 1. Cardiovascular Endurance Hypothesis Test Results.

Variable	t Calculated	t Table	p Value
Cardiovascular Endurance	2.172	2.145	0.000

Table 2. Hypothesis Testing Results for Muscular Endurance.

Variable	t Calculated	t Table	p Value
Muscular Endurance (Squat)	7.364	2.145	0.000
Muscular Endurance (Sit Up)	2.797	2.145	0.000

Table 3. Hypothesis Testing Results for Power.

Variable	t Calculated	t Table	p Value
Power (Broad Jump)	2.904	2.145	0.000

Table 4. Hypothesis Testing Results for Flexibility.

Variable	t Calculated	t Table	p Value
Flexibility (Sit and Reach)	3.261	2.145	0.000

TGFU Learning Model in Badminton Instruction: A Systematic Review of Successes and Challenges of Implementation in Schools

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ABSTRACT

Background. Physical education in schools plays an important role in developing motor skills and understanding game concepts, including sports such as badminton. **Objectives.** This systematic review aimed to investigate the successes and challenges of TGFU implementation in badminton teaching in schools, focusing on its effects on students' skills. **Methods.** This study utilized a systematic review design that searched the literature from various academic databases such as Scopus, PubMed, and Web Of Science. The keywords used included "Teaching Games for Understanding," "TGFU," "badminton," "Physical Education," and other related variations. Inclusion criteria included studies that used the TGFU model in teaching badminton in schools, emphasizing empirical studies and evaluations of the successes and challenges of its implementation. **Results.** Analysis of the selected studies showed that implementing TGFU in badminton teaching consistently improved students' motor skills, understanding of tactics, and participation in sports learning. This success is supported by an approach emphasizing game concepts and problem-based learning. However, teacher preparation, curriculum adaptation, and time management remain significant barriers to effective implementation. **Conclusion.** This review concluded that the TGFU learning model has great potential to improve badminton learning in schools despite facing challenges in its implementation. Considering these factors, practical recommendations include increased teacher training, a more structured curriculum, and further research better to understand success factors and barriers in different contexts. Implementing the TGFU model with a deeper understanding can significantly contribute to physical education and sports learning as a whole.

KEYWORDS: *Teaching Games for Understanding, Badminton, Physical Education*

INTRODUCTION

Physical Education (PE) is vital to students' physical, mental, and social development. PE aims to improve physical fitness and develop motor skills, physical activity knowledge, and positive social behavior (1). One of the sports that is often taught in PE is badminton, a sport that is popular in various countries, including Indonesia. Badminton requires physical ability and good tactical and strategic skills (2,3). The Teaching Games for Understanding (TGFU) learning model was introduced as an alternative to the traditional approach to teaching sports. TGFU emphasizes understanding game concepts and decision-making, not just basic technical

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skills (4). This approach is designed to make sports learning more relevant and exciting for students by teaching them how to play the game as a whole before learning specific skills (5,6).

In the context of education, the relevance of badminton in the PE curriculum is significant. The sport improves physical fitness and teaches coordination, speed, and reflex skills important for children's physical development (7). Therefore, integrating the TGFU model in teaching badminton can benefit students. This study aims to systematically review the successes and challenges of implementing the TGFU learning model in badminton teaching in schools. Through this review, a comprehensive picture of the effectiveness of TGFU and the obstacles that may be encountered in its implementation in educational settings is expected. By evaluating the various studies conducted, this research will identify factors that support success and address challenges in implementing TGFU.

In addition, this study will also provide practical recommendations for educators and policymakers to optimize the use of TGFU in the PE curriculum (8,9). As part of the effort to improve the quality of physical education, this research is expected to contribute significantly to the field of sports education science. By better understanding the successes and challenges of TGFU implementation, appropriate solutions can be found to optimize badminton learning in schools, thus providing maximum benefits for the overall development of students.

MATERIALS AND METHODS

Research Design. The research design in this systematic review followed the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines. This study used a systematic approach to collect and synthesize evidence from studies relevant to teaching badminton using the TGFU model. Inclusion criteria included experimental and observational studies that addressed the effect of TGFU implementation on student learning outcomes in the context of Physical Education. Exclusion criteria excluded studies that did not meet adequate methodological requirements or did not fit the focus of the study. Data sources included academic databases such as Scopus, PubMed, and Web Of Science, using defined keywords to ensure comprehensive search coverage. Data analysis procedures involved data collection from the selected studies, qualitative and quantitative analysis depending on the characteristics of the included studies, and synthesis of findings tailored to the research objectives. Study quality assessment was conducted using appropriate evaluation tools to ensure the validity and reliability of the results presented. This method is expected to provide an in-depth understanding of the implementation of TGFU in the context of teaching badminton in schools.

Study Selection Process. Searches were conducted through credible databases such as PubMed, Scopus, and Web of Science using relevant keywords such as “Teaching Games for Understanding,” “badminton,” “physical education,” and the like.

Data Analysis. The authors used PRISMA, or the Cochrane Risk of Bias Tool, to transmit the quality of the included studies. With the right analytical approach, valid and meaningful findings on Teaching Games for Comprehension, badminton, and physical education.

RESULTS

A total of 400 studies were analyzed in this systematic review. A rigorous study selection process was conducted based on the pre-defined inclusion criteria to ensure the accuracy and precision of the results. A thorough literature search was conducted through various databases related to teaching games for understanding, badminton, and physical education, using relevant keywords to obtain a comprehensive range of literature. The process included meticulously eliminating duplicates ensuring the review's integrity. After applying the inclusion criteria, 31 studies were eligible for inclusion in the analysis. This presentation of the number of studies analyzed provides context for the depth and breadth of empirical evidence considered in this systematic review and demonstrates the diversity of literature sources used to support the findings and conclusions.

DISCUSSION

In discussing the implementation of the TGFU Learning Model in badminton teaching, this systematic review reveals some significant findings and challenges that need to be addressed to maximize the benefits of this approach. The results of this systematic review highlight that the TGFU approach has generally been successful in improving student learning outcomes in badminton contexts at various levels of education. Many of the studies in this review demonstrated significant improvements in motor skills, tactical understanding, and student participation in teaching and learning activities.

Interpretation of these findings confirms that using TGFU opens the door for teaching more focused on

understanding game concepts and developing strategic skills in badminton. Compared to traditional learning models that often focus more on basic techniques, the TGFU approach encourages students to understand the full context of the game, which can increase the meaningfulness of learning. These results align with previous research showing that methods that promote conceptual understanding in the context of sports games can positively impact students' skills.

However, several challenges need to be addressed in the implementation of TGFU. The review identified several obstacles often encountered, such as difficulties in properly integrating the curriculum, finding sufficient time to implement all aspects of the TGFU model, and the need for educators skilled in applying this approach effectively. These limitations may affect the overall implementation in different schools, especially where resources and support still need to be improved.

The implication of these findings for teaching practice is the importance of in-depth training for educators to understand and implement TGFU well. This will help overcome the challenges and maximize this approach's benefits. Recommendations include the need for intensive professional development programs to support educators in implementing TGFU and further research to explore ways to overcome the barriers identified.

Overall, this study shows that despite challenges in implementation, the TGFU learning model has great potential to improve badminton teaching and learning in schools. With proper development and adequate support, this approach can be an effective tool in helping students develop skills in badminton and a broad strategic understanding of various sports contexts. In conclusion, integrating TGFU into the physical education curriculum can enrich students' learning experiences and provide a strong foundation for their future sports skill development.

CONCLUSION

In conclusion, it is important to underline that the TGFU Learning Model has excellent potential to enrich badminton teaching in the context of Physical Education. Given the challenges and implications, this approach can be integral to improving the quality of sports education in schools. Ongoing support from all relevant parties will help ensure that the benefits of the TGFU model are fully realized in student learning.

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APPLICABLE REMARKS

- The TGFU learning model has great potential in developing badminton learning in schools, although it faces challenges in its implementation. Implementing the TGFU model with a deeper understanding can significantly contribute to learning physical education and sports as a whole.

AUTHORS' CONTRIBUTIONS

Research concept and design: Suwirman. Data acquisition: Rezha Arzhan Hidayat. Data analysis and interpretation: Muhamad Ichsan Sabillah. Compiled the script: Fiky Zarya. Critical revision of the manuscript for important intellectual content: Rezha Arzhan Hidayat. Statistical analysis: Muhamad Ichsan Sabillah. Administrative, technical, and material support: Suwirman. Study supervisor: Syahrastani.

CONFLICT OF INTEREST

The authors mention no "Conflict of Interest" in this study.

ETHICAL CONSIDERATION

This is a systematic review of research, so the implementation does not involve humans directly.

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FINANCIAL DISCLOSURE

The authors have no financial interests related to the material in the manuscript.

ARTIFICIAL INTELLIGENCE (AI)

USE There was NO use of artificial intelligence (AI) for preparation, writing, or editing this manuscript.

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Table 1. Inclusion and Exclusion Criteria

Inclusion Criteria	Exclusion Criteria
Studies that used the TGfU model in teaching badminton.	Studies that did not use the TGfU model or used other learning models.
Studies conducted in a school setting (e.g., elementary, secondary, or college).	Studies conducted outside the school environment (e.g., sports clubs, training centers).
Studies that evaluated students' learning outcomes or abilities in badminton after the application of TGfU.	Studies that do not have relevant data or do not measure student learning outcomes directly.
Studies published in peer-reviewed scientific journals.	Books, theses, or conference articles that have not been peer-reviewed.
Research published in English or Indonesian.	Studies that are not available in a language accessible to the author.

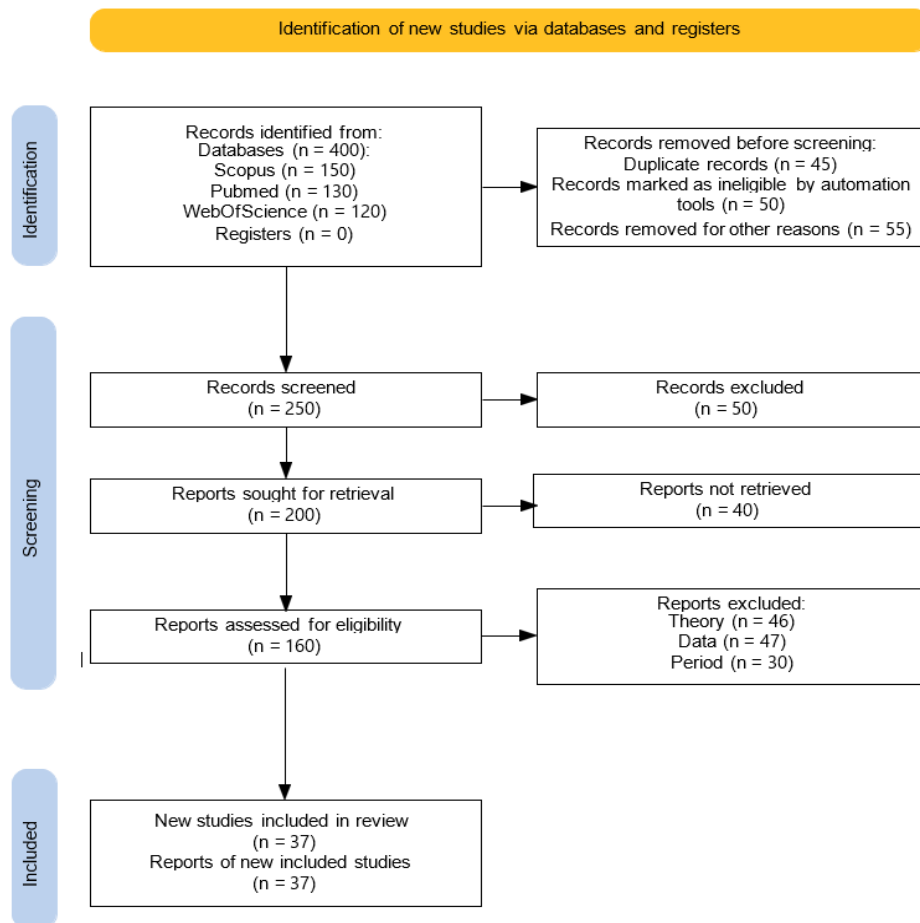


Figure 1. Selection process using PRISMA guidelines

Table 2. Key Findings

Key Findings from Systematic Review		
Findings	One of the supporting Journals of Systematic Review	Explanation
Significant improvement in badminton technical skills and student participation. Difficulties in adapting TGFU strategies to the existing curriculum.	(10,11) (12,13)	Students who learned through the TGFU approach significantly improved their badminton playing ability compared to those who learned through conventional methods. teachers often face difficulties adapting TGFU strategies to the existing curriculum and overcoming students' resistance to new learning methods. Some schools experienced difficulties finding sufficient time to implement lessons with the TGFU approach, while others faced limited resources and facilities.
Use of video analysis to improve students' tactical understanding.	(14,15)	showed that the effectiveness of TGFU in improving students' badminton skills also depends on a good integration between in-class and out-of-class learning. Supporting technologies, such as game analysis videos, can help students better understand tactical concepts and improve their learning outcomes in badminton games.

Integrating Psychotherapy into Sports: A Systematic Review of Mental Health Results in Athletes

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ABSTRACT

Background. The integration of psychotherapy into sports shows that mental health and psychological resilience are as important as physical strength. Training athletes to regulate their mental and physical reactions to stress enhances psychological resilience and assists in addressing various competition challenges. **Objectives.** This research aimed to adopt a systematic literature review through the Scopus database, which was selected for its high credibility and trustworthiness. **Methods.** All the analyzed data were collected from 578 articles, of which the number of English-language articles was reduced to 471. Furthermore, the Vosviewer was used to download the data as a CSV file for keyword network analysis. The data were re-selected based on the established theme and criteria. **Results.** The selected articles included six pieces of literature identified as a result of discussions conducted within the research. The results showed the emergence of six subthemes, including the impact of athletes' mental health on their performance, the use of relaxation and desensitization methods to manage anxiety, the application of cognitive behavioral therapy, and the use of evidence-based methods to manage post-traumatic stress disorder and anxiety. The combination of physical and psychological methods for athletes' recuperation, the need for social support in addressing mental health stigma in sports, and the role of psychotherapy in boosting athletes' self-assurance are all significant topics. Generally, psychotherapy in sports offered a more comprehensive method of supporting athletes. **Conclusion.** Psychotherapists, coaches, and athletes could work together to integrate mental health as a crucial component of the training program, preparing athletes not only physically but also mentally to tackle challenges in the competition arena.

KEYWORDS: *Psychotherapy, Mental health, Sportsman*

INTRODUCTION

The mental health of athletes is considered to be an important topic as physical and mental demands increase in professional sports. Although many training programs continue to focus on improving physical performance, there is a growing awareness that mental health plays a significant role in determining athletes' success (1,2). Research showed that many athletes experienced anxiety, depression, and trauma due to injury or negative experiences during the competition (3–5). In this context, psychotherapy can effectively support athletes' mental health and help them achieve peak performance (6,7).

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Competitive anxiety is one of the most common psychological challenges faced by athletes, particularly in sports that require advanced skills, such as Latin dance or gymnastics (3). The anxiety may arise before, during, and after the competition, affecting athletes' physical and mental performance (8,9). Systematic desensitization and cognitive behavioral therapy (CBT) are effective methods for addressing competitive anxiety and mental challenges, such as PTSD, that athletes may face. Systematic desensitization helps athletes manage stress by exposing them to anxiety-inducing situations, both imaginary and simulated, enhancing their calmness and focus. CBT, on the other hand, assists in recognizing and altering negative thinking patterns, which is crucial for handling performance anxiety, depression, and pressure. Integrating psychotherapy into sports training can improve mental health, performance, and confidence while combating the stigma surrounding mental health in sports. This research will analyze articles from the Scopus database to explore the impact and integration of psychotherapy in sports (3,4). The intervention aims to reduce anxiety symptoms and increase athletes' confidence in the face of pressure during the competition.

MATERIALS AND METHODS

This research used a systematic literature review (SLR) to comprehensively examine and synthesize literature on integrating psychotherapy in sports, focusing on methods like CBT and relaxation techniques to enhance athletes' mental health and performance by balancing mental and physical well-being.

This research only focused on the extraction of articles related to the examined topic from 1930 to 2024. Some articles were subject to limitations for a more detailed evaluation process. The following types of articles were used in this analysis.

The publication stage consisted of a final article (574) and an article in press (4). The source type included journal (541), book (34), book series (2), and conference proceedings (1). All the articles were analyzed until those most relevant to the research topic were discovered.

Using strict inclusion and exclusion criteria—such as English-language, Scopus-indexed articles on psychotherapy in sports from 1930-2024—the research identified 10 relevant articles, with types including retracted works, surveys, letters, conference papers, books, editorials, notes, book chapters, reviews, and articles.

Data Collection. This research employed a systematic review with explicit inclusion and exclusion criteria—selecting English, full-text articles on integrating psychotherapy in sports published between 1930 and 2024—and conducted a comprehensive search in the Scopus database in September 2024, with PRISMA flow chart documentation to enhance transparency.

A CSV file of 472 articles was imported into VOSviewer, where bibliographic data mapping, co-occurrence analysis, and keyword validation were conducted to visualize topic relevance, as illustrated in Figure 3.

Data Analysis. The thematic analysis produced 11 articles, including sequential procedures for identifying, analyzing, and interpreting patterns or themes in different datasets. Data-based inductive methods were used to derive themes from primary codes without preexisting categories, allowing for an unbiased understanding of data complexity; following an in-depth analysis, five articles were selected, and code generation captured key data features relevant to the research scope and purpose.

RESULTS AND DISCUSSION

This research highlights the importance of a multidisciplinary approach, including collaboration between coaches and psychotherapists, to foster a supportive environment that addresses athletes' mental and physical needs for peak performance (10–14).

This analysis identified seven key topics on integrating psychotherapy in sports, covering aspects like mental health's impact on performance, anxiety management through relaxation and desensitization, CBT for handling PTSD, and the importance of combining physical and psychological recovery methods. Psychotherapy's role in reducing mental health stigma, enhancing social support, and boosting athletes' confidence underscores its value in holistically supporting athletes' mental well-being and optimizing performance.

CONCLUSIONS

This research highlights the integration of psychotherapy into sports as a holistic approach to support athletes' mental and physical health, emphasizing collaborative methods, evidence-based techniques, and social support to enhance performance and address mental health challenges.

ACKNOWLEDGMENT

The author would like to thank the entire team involved in creating this article and Padang State University.

APPLICABLE REMARKS

- Integrating psychotherapy into sports demonstrates significant potential to improve athletes' mental health, resilience, and overall performance, as highlighted by systematic reviews in this field.

AUTHORS' CONTRIBUTIONS

Research concept and design: Ifdil. Data acquisition: M Fahli Zatra Hadi. Data analysis and interpretation: Daharnis. Compiled the script: Fiky Zarya. Critical revision of the manuscript for important intellectual content: Nilma Zola. Statistical analysis: Jeki Haryanto. Administrative, technical, and material support: Ifdil. Study supervisor: M Fahli Zatra Hadi.

CONFLICT OF INTEREST

The authors mention no "Conflict of Interest" in this study.

ETHICAL CONSIDERATION

This is a systematic review of research, so the implementation does not involve humans directly.

FUNDING/SUPPORT

No institution, organization, or person supported this study. **ROLE OF THE SPONSOR** The funding organizations are public institutions and have no role in the design and conduct of the study, collection, management, and analysis of the data or preparation, review, and approval of the manuscript.

FINANCIAL DISCLOSURE

The authors have no financial interests related to the material in the manuscript.

ARTIFICIAL INTELLIGENCE (AI)

USE There was NO use of artificial intelligence (AI) for preparation, writing, or editing this manuscript.

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Table 1. keywords in the Scopus database

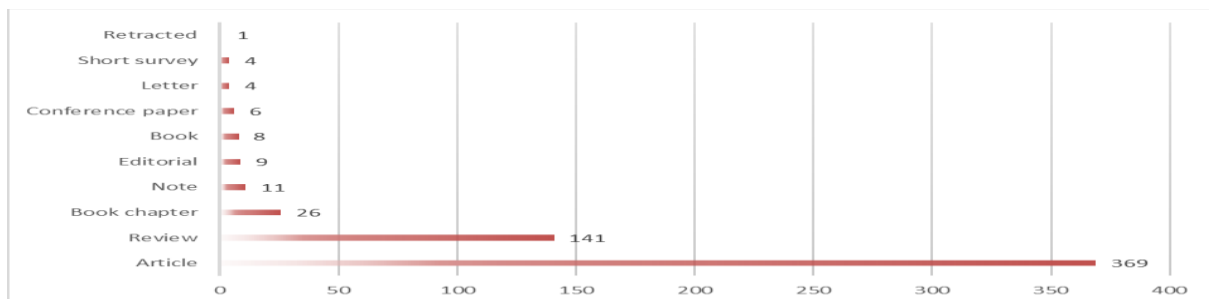
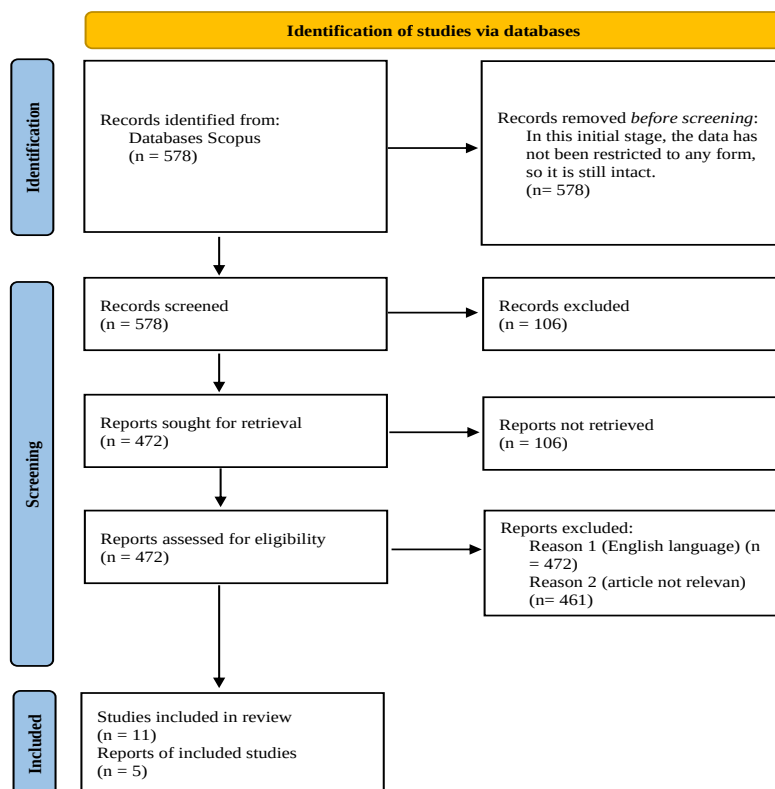
Title	Keywords
Article Abstract, Keywords	Title, ("Psychotherapy" OR "Therapeutic Interventions" OR "Psychological Interventions") AND ("Sports" OR "Athletes") AND ("Mental Health" OR "Psychological Well-being" OR "Mental Health Outcomes" OR "Anxiety" OR "Depression" OR "Stress")

Table 2. articles type

Publication stage		
No	Final	Article in press
	574	4

Table 3. Articles search type

Source type			
Journal	Book	Book series	Conference proceeding
541	34	2	1

**Figure 1. Selected article types****Figure 2. PRISM stages in research**

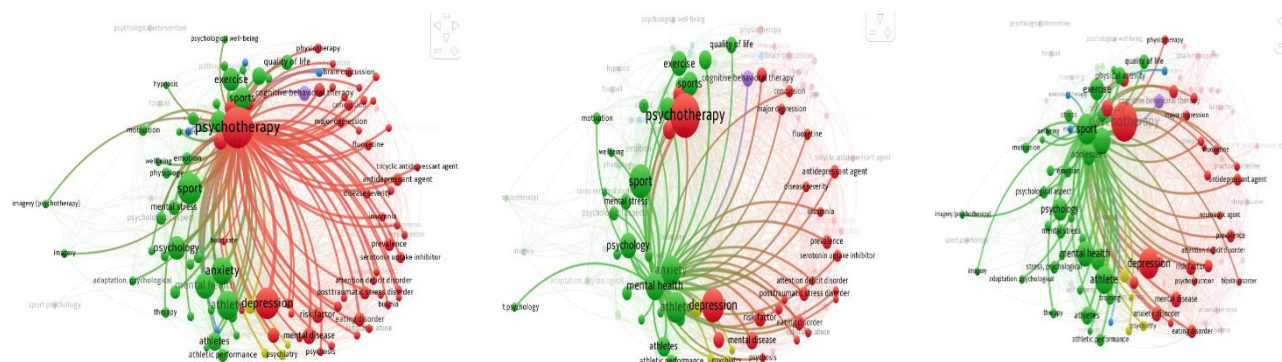


Table 4. Five selected articles after the limitation

Sports Motivation Scale II Questionnaire; Indonesian Version with 16 Items

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ABSTRACT

Background. The SMS does not yet have an Indonesian version, and the Malay language adaptation may be less suitable for participants in Indonesian **objectives.** Thus, further research is required to ensure its validity in the local context. **Methods.** The translation and validation process followed three stages. First, two native Indonesian translators translated the text from English to Indonesian. Then, a back translation was done from Indonesian to English. Next, seven experts in psychology and sports from Turkey, Malaysia, and Indonesia validated the instrument. Finally, a pilot test was conducted with 55 high school students to check content, construction, and reliability. There were 19 females and 36 males among the participants, with an average age of 15 years and 7 months. **Results.** Findings showed that the expert evaluation quantitatively yielded a value of $r = 0.96$, belonging to the high group. Each item was considered acceptable as the calculated r -value $> r$ table (0.266) for item validity. The intraclass correlation value of 0.96 in the test-retest indicated the reliability of this SMS questionnaire. **Conclusion.** In conclusion, applying forward and backward translation procedures and cultural adaptation strategies is crucial to successfully adapting the SMS research instrument. The Indonesian version of the SMS can be used by practitioners, teachers, and athletes to obtain precise data.

KEYWORDS: *Sport Motivation Scale, Adaptation, Indonesian Version, Instrument*

INTRODUCTION

Motivation is a crucial factor influencing a person's participation in sporting activities(1). Therefore, it is important to understand what drives people to engage in sports. Several instruments have been developed to determine this. One of them is the Sport Motivation Scale. SMS has undergone extensive validity and reliability testing across various cultural contexts. Initially developed by Vallerand et al., the SMS proved to be a robust tool for measuring motivation in sports with confirmatory factor analysis and high internal consistency(2). Further research shows that the SMS maintains its psychometric integrity in multiple languages, such as Greek, Czech, and Malay (3)(4).

The SMS has been shown to differentiate between different types of motivation-intrinsic, extrinsic, and motivation-with consistency in the literature (5). Compared to other instruments, such as the BRSQ, the SMS remains the top choice for measuring exercise motivation(6). However, the SMS does not yet have an Indonesian version, and the Malay language adaptation may be less suitable for participants in Indonesia, thus requiring further research to ensure its validity in the local context.

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MATERIALS AND METHODS

The translation and validation process followed standard guidelines and had three stages(7). First, two native Indonesian translators, one with a master's in English education and the other with a PhD in linguistics, translated the text from English to Indonesian. Then, a back translation was done from Indonesian to English. Next, seven experts in psychology and sports from Turkey, Malaysia, and Indonesia validated the instrument. Finally, a pilot test was conducted with 55 high school students to check content, construction, and reliability. Figure 1 shows the translation and validation process. The UiTM Research Ethics Committee has authorized all research ethics procedures with clearance number REC/10/2024 (PG/MR/538); the research procedures are by the Declaration of Helsinki and based on the Malaysian Good Clinical Practice Guidelines.

RESULTS

The material expert assessment shows that the average R-value of the entire evaluation is 0.96. This means that the validity value is in the high category. Expert validation is shown in Table 1.

Table 2 shows that all data from the first test (test) and the second test (retest) have a calculated r value more significant than the r table (0.266).

Furthermore, the Test-Retest test results obtained the following data: SMS has a reliability value of 0.96. According to Cohen, a reliability value greater than 0.85 is the highest value in the reliability of an instrument (8).

DISCUSSION

The results showed that there were two items below the T table, namely item numbers 16 and 17, which were included in the amotivation sub-variable, so these two items were not used for the reliability test, and only 16 items were to do the Test-Retest. Then, the retest results showed 0.96, exceeding the standard of 0.80 (8)(9). Various studies highlighting the need for a systematic approach to instrument adaptation underline the importance of this translation process. For example, Sousa emphasizes that performing forward translation alone is not enough; a comprehensive process that includes backward translation, expert review, and psychometric testing is essential to ensure the instrument's suitability for the target population(10). This is echoed in the work of Kellerer et al., who detail the cultural adaptation of the Nurse Professional Competence Scale, suggesting that translation and cultural considerations are essential for effective adaptation(11). The iterative nature of the translation process allows for continuous refinement and validation of the instrument(12). In addition, Ioane's research shows that cultural nuances significantly impact the interpretation and relevance of survey items(13). In conclusion, applying forward and backward translation procedures and cultural adaptation strategies is essential for successfully adapting research instruments.

CONCLUSIONS

Adapting research instruments requires appropriate procedures to ensure validity and reliability in different contexts. This approach strengthens semantic equivalence, improves instrument quality, and facilitates sustainable cross-cultural research. The SMS Indonesia Version can be used by practitioners, teachers, and athletes to get the correct data.

APPLICABLE REMARKS

- Adapting research instruments requires appropriate procedures to ensure validity and reliability across different contexts.
- This method enhances semantic equivalence, elevates the quality of the instruments, and supports sustainable cross-cultural research endeavors.
- The SMS Indonesia Version benefits practitioners, teachers, and athletes, providing accurate data for informed decision-making and effective interventions.
- Thus, stakeholders should implement this adapted version to improve research outcomes and practical applications in their respective fields.

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AUTHORS' CONTRIBUTIONS

Study concept and design: Endang Sepdanius and Nurul Diyana Binti Sanuddin. Acquisition of data: M. Adli Bin Mohd Sidi. Analysis and interpretation of data: Rini Afriani. Drafting the manuscript: Bekir Erhan Orhan.

CONFLICT OF INTEREST

The authors mention no "Conflict of Interest" in this study.

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ARTIFICIAL INTELLIGENCE (AI) USE

There was NO use of artificial intelligence (AI) for preparation, writing, or editing this manuscript.

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Table 1. Percentage trend of students' sports participation based on preferred sport

Sport	n	%
Swimming	6	11%
Cycling	4	7%
Volleyball	2	4%
Basketball	9	16%
Badminton	14	25%
Futsal	9	16%
Gym	1	2%
Walking	2	4%
Jogging	5	9%
Karate	1	2%
Pencak Silat	1	2%
Gymnastics	1	2%
N	55	100%

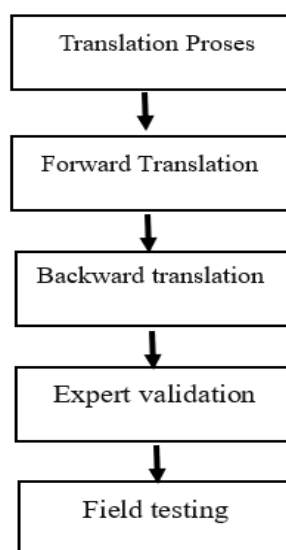
Table 2. Expert assessment of sports participation instruments

Item	Expert 5	Expert 1	Expert 2	Expert 3	Expert 6	Expert 4	Expert 7
X1	5	5	5	5	5	5	5
X2	4	5	5	4	4	5	4
X3	5	5	5	5	5	5	5
X4	5	4	5	4	4	5	5
X5	5	5	5	4	5	5	5
X6	4	4	5	4	5	5	5
X7	5	5	5	5	5	5	5
X8	5	5	5	4	5	5	5
X9	5	5	5	4	4	5	5
r value	0.96	0.96	1.00	0.87	0.93	1.00	0.98

Overall Value $r = 0.96$

Table 3. Validity Items for the Sports Participation Instrument

Item		P C (Test)	P C (reTest)	r table	Criteria
Intrinsic Motivation	Because it gives me pleasure to learn more about my sport.	0.635	0.698	0.266	Valid
	Because I find it enjoyable to discover new performance strategies.	0.653	0.748		Valid
	Because it is very interesting to learn how I can improve.	0.569	0.704		Valid
Integrated Regulation	Because practicing sports reflects the essence of whom I am.	0.808	0.853		Valid
	Because participating in sport is an integral part of my life.	0.770	0.815		Valid
	Because through sport, I am living in line with my deepest principles.	0.822	0.860		Valid
Identified Regulation	Because I have chosen this sport as a way to develop myself.	0.762	0.852		Valid
	Because I found it is a good way to develop aspects of myself that I value.	0.699	0.743		Valid
	Because it is one of the best ways I have chosen to develop other aspects of myself.	0.732	0.779		Valid
Introjected Regulation	Because I would feel bad about myself if I did not take the time to do it.	0.713	0.726		Valid
	Because I feel better about myself when I do.	0.740	0.759		Valid
	Because I would not feel worthwhile if I did not.	0.684	0.691		Valid
External Regulation	Because people I care about would be upset with me if I didn't.	0.465	0.535		Valid
	Because I think others would disapprove of me if I did not.	0.515	0.559		Valid
	Because people around me reward me when I do.	0.506	0.562		Valid
Amotivation	I used to have good reasons for doing sports, but now I am asking myself if I should continue.	0.125	-		Tidak Valid
	So that others will praise me for what I do.	0.138	-		Tidak Valid
	It is not clear to me anymore; I don't really think my place is in sports.	0.497	0.377		Valid

**Figure 1. Translation and validation process**

Examination of Motor Educability and Passing Skills of PETE Freshmen Students

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ABSTRACT

Background. Prospective physical education teachers must have reasonable motor skills and basic techniques in sports movements. **Objectives.** This study aimed to preview the motor educability and passing skills of physical education teaching education (PETE) first-year students. **Methods.** A total of eighty-four male PETE first-year students voluntarily participated. Motor educability was examined using the IOWA Brace Test, and passing skills were examined using the Loughborough Soccer Passing Test (LSPT). **Results.** The IOWA Brace Test shows that 47.6% of first-year students have a good level, and even 51.2% have an excellent level. The results of the LSPT test showed that the average performance time was 97.3 ± 28.0 s, which means a poor passing skill. **Conclusion.** The motor educability was good and excellent; however, the passing skill was poor. There is no correlation between motor educability level and the passing skills present. Further studies will focus on variations of passing learning models to improve the quality of the learning process.

KEYWORDS: *Motor Educability, Passing Skill, Physical Education, Freshmen Students*

INTRODUCTION

Physical education teacher education (PETE) programs are responsible for the preparation of future physical education (PE) teachers (1). Nowadays, PETE programs face many challenges in mastering technology, foreign languages, independent learning skills, professional development, and more (2). Despite those challenges, basic motor skills remain a basic need because they will be role models for their future students (3). PE teachers' understanding and representation of their bodies influence their teaching and act as role models for their students (4). Therefore, a prospective PE teacher needs to have good motor skills.

A person's ability to quickly learn a new motor skill can be expressed in motor education (5). Motor educability tests can accurately analyze the ability to learn motor skills. This can contribute to a better understanding of body movement performance and become practical data for administering PE programs. The level of motor education is influenced by movement experience, age, and gender, which can indicate physical talent and motor intelligence. The instrument known for examining motor educability was the Iowa Brace Test (6).

In addition to motor skills, basic sports movement techniques are also something prospective PE teachers must have. Therefore, in the first year of PETE curricula, students will generally be introduced to some of the coursework in Exercise, Sport, and Health Sciences. The Basic Skills Football course is one of the compulsory

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courses in the Physical Education Study Program Universitas Cenderawasih. The learning outcomes are that students understand the theory and practice of mastering basic techniques in football and how to teach and practice them to students. Measurement and assessment of football-specific techniques were fundamental and challenging. The Loughborough Soccer Passing Test (LSPT) is an instrument that measures the passing skills of individuals. LSPT measures short passing skills and evaluates some football-specific skills such as ball control, decision-making, and dribbling (7,8).

This study examines PETE first-year students' motor educability and passing skills at Universitas Cenderawasih, Jayapura, Indonesia. Motor educability was chosen to assess whether PETE first-year students have the potential to become PE teachers who have reasonable motor skills. Meanwhile, passing skills, as a primary subject matter in the Basic Skill Football course, were chosen to assess the essential technical skills of the PETE first-year student.

MATERIALS AND METHODS

Participants and Procedure. Eighty-four male students, among a total of a hundred and fifty-five students who registered for the Basic Skills Football course, Universitas Cenderawasih, the academic year 2024/2025, voluntarily participated in this study. All participants are first-year students of the Physical Education Study Program Universitas Cenderawasih. The Iowa Brace Test and LSPT were conducted in the first week of lectures before any material was given.

Instrument. In this study, we used a series of 10 stunt-type tests for final year high school boys, which are: One foot-touch head; Forward hand kick; Knee jump to feet; Strok stand; Single squat balance; Grapevine; Three dips; Side kick; Rusian dance; and Jump foot—detail movement description for every specific stunt type reported elsewhere (9).

Figure 1 gives a schematic representation of the Loughborough Soccer Passing Test (LSPT) (7). Participants are asked to pass towards the target board according to the instructions given by Examiner 1. The previously determined target passing sequence is only known to examiner 1. Examiner 2 was to record penalty time points accrued during the trials. Penalty time was awarded for the following errors: 5 s for missing the target entirely or passing the wrong target; 3 s for missing the color target area; 3 s for handling the ball; 2 s for passing the ball from outside of the outer passing area; 2 s for the ball touching any cone; 1 s for every second taken over the allocated 43 seconds to complete the test; whereas 1 s was deducted from the total time if the ball hit the color target.

Data Collection. Data collection for the Iowa Brace test were: Completing the test battery item on the first attempt means 2 points; Completing it on the second attempt means 1 point; Failing to complete the test on the second attempt means 0 points. The sum of the points determined the total result. The individual point totals are assigned the following attributes: 20-17 points: excellent level; 16-13 points: good level; 12-1 points: poor level. Performance data for the LSPT test was added in real-time with the sum of penalty time. All recorded time data were presented as the means $\pm$ standard deviations (SD).

Statistical Analysis. Statistical data were evaluated using Microsoft Excel. Results were evaluated at a 5% significance level ($p < 0.05$).

RESULTS

The motor educability level examined in this study is presented in Figure 1. Overall, PETE first-year students have positive motor educability, where 47.6% of first-year students have a good level, and even more than half of the participants (51,2%) have an excellent level. Only 1.2% or one participant is at the poor level.

The average of performance time, evaluated as test completion time (real time+penalty time), was calculated as 97.3 ± 28.0 s, the real-time average was 61.2 ± 10.4 s, and the penalty time average was 36.1 ± 19.0 s. A graph of the relationship between LSPT performance time and motor educability skills from the participants ($N=84$) was given in Figure 3. There is no correlation between the ability to learn a new motor skill and the basic techniques in sports movements, particularly passing skills.

DISCUSSION

There is a high risk of injuries in first-year PETE students, which may be caused by the fact that in the first year of the PETE program, learning activities are more focused on practical exercises in the field than theoretical learning in the class (10). A fine motor education level will provide a primary need for first-year students to learn the coursework in exercise and sport.

The average LSPT performance time from PETE first-year students was very high compared to the performance of elite and non-elite players (8). Poor passing performance indicates that they have less experience in football and trouble performing the passing technique in small spaces and limited time. Similar

findings were found at high school and university levels (11).

Although there is no direct correlation between motor educability level and passing skill, a fine motor educability level may help students learn a new football skill quickly. Therefore, an appropriate teaching style is needed for them in order to obtain a significant increase in passing skills (12,13). Our further studies will focus on variations of passing learning models to improve the quality of the learning process and increase students' mastery of football passing skills.

CONCLUSION

The motor educability level and passing skills of PETE first-year students at Universitas Cenderawasih were examined. The results show that first-year students have a good and excellent level. The average LSPT performance shows poor passing skills. There is no correlation between motor educability level and passing skills in the present situation. However, a fine motor education level may enable students to learn a new football skill quickly. Further studies will focus on variations of passing learning models to improve the quality of the learning process and increase students' mastery of football passing skills.

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AUTHORS' CONTRIBUTIONS

Study concept and design: Pahala Tua Hutajulu, Johansyah Lubis, Tirto Apriyanto. Acquisition of data: Pahala Tua Hutajulu. Analysis and interpretation of data: Pahala Tua Hutajulu, Drafting the manuscript: Pahala Tua Hutajulu. Critical manuscript revision for important intellectual content: Johansyah Lubis, Tirto Apriyanto. Statistical analysis: Pahala Tua Hutajulu, Johansyah Lubis, Tirto Apriyanto.

CONFLICT OF INTEREST

The authors mention no "Conflict of Interest" in this study.

ETHICAL CONSIDERATION

This research has met the standards of research ethics and has received approval to be a sample of all respondents.

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FINANCIAL DISCLOSURE

The authors have no financial interests related to the material in the manuscript.

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USE There was NO use of artificial intelligence (AI) for preparation, writing, or editing this manuscript.

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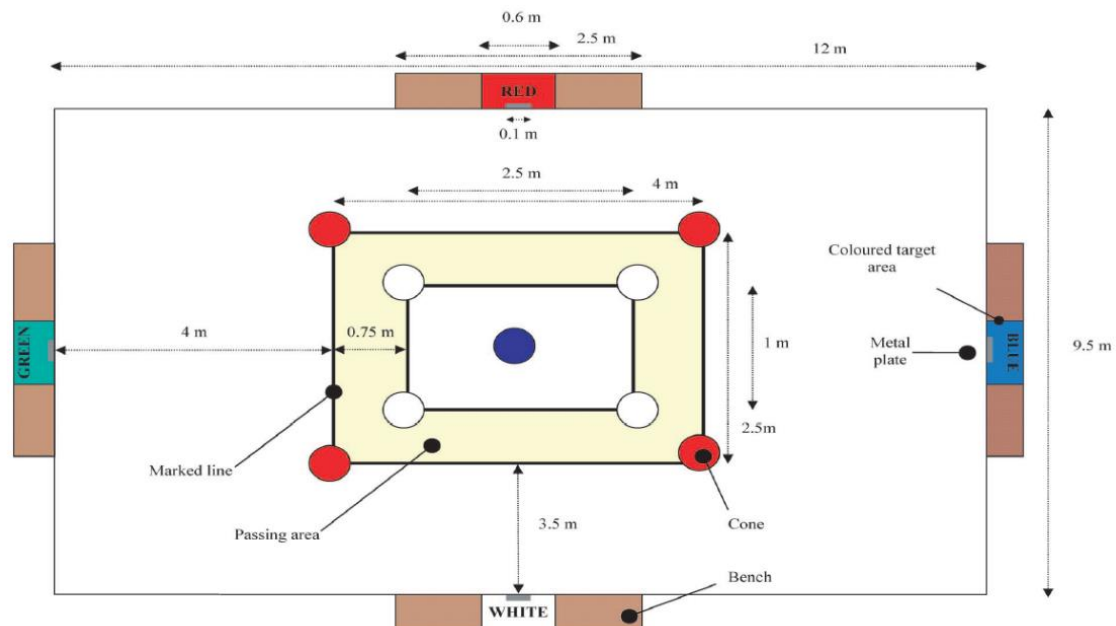


Figure 1. Schematic representation of the Loughborough Soccer Passing Test (LSPT); Copyright from Ali et al. (7)

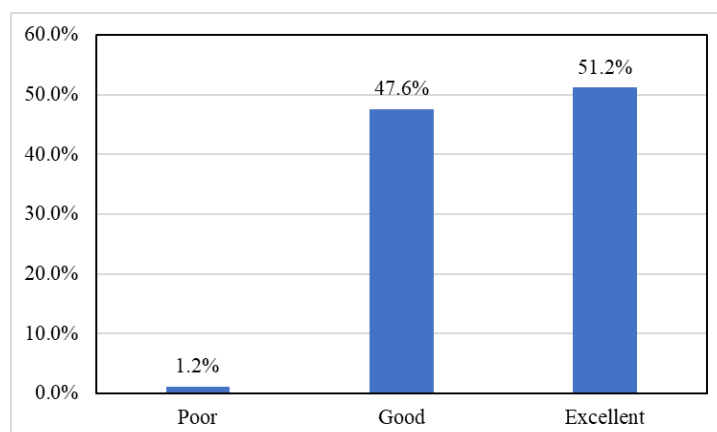


Figure 2. PETE Freshmen student motor educability level

Table 1. Descriptive statistics of LSPT performance time

Variables	N	Maximum	Minimum	Average	SD
Real-time	84	102	44	61.2	10.4
Penalty time	84	107	0	36.1	19.0
Performance time	84	209	51	97.3	28.0

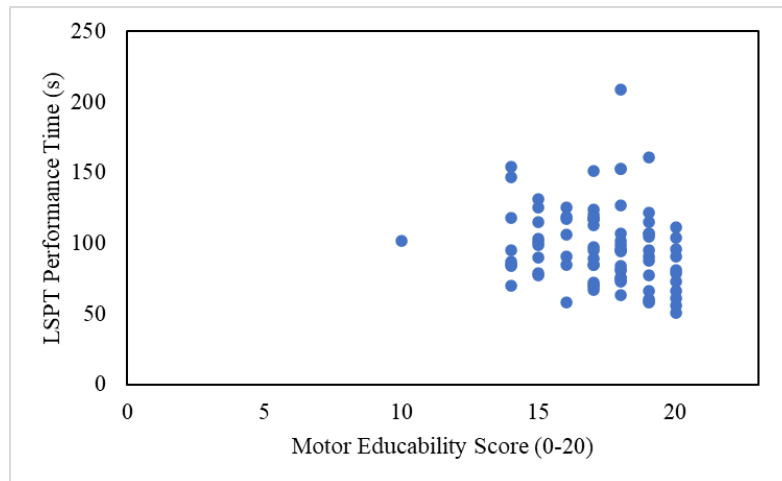


Figure 3. LSPT Performance Time vs Motor Educability Score (N=84)

Development of Higher-Order Thinking Skills Through Badminton Learning

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ABSTRACT

Background. Higher-order thinking skills (HOTS) are needed in the 21st century, especially when students have entered the workforce. With HOTS, students can analyze, evaluate, solve problems, and generate new ideas. Therefore, lecturers need to help develop HOTS in students, one of which is through badminton lectures.

Objectives. This study aimed to test the effectiveness of the integrated learning model (ILM) compared to the direct instruction (DI) model in developing students' HOTS in badminton lectures. **Methods.** This study used a randomized pretest-posttest control group design. Using purposive sampling, the sample in this study amounted to 37 people. This study used HOTS instruments consisting of 15 questions. **Results.** The study results obtained $t_{\text{count}} 2.062 > t_{\text{table}} 2.032$; therefore, the influence given by ILM and DI was significantly different. **Conclusion.** The integrated learning model has a better effect than the direct instruction model in increasing the HOTS of physical education students.

KEYWORDS: *Badminton, HOTS, Integrated Learning, Direct Instruction*

INTRODUCTION

Higher-order thinking skills (HOTS) are the highest level of thinking skills in Bloom's taxonomy as revised by Anderson and consist of the ability to analyze, evaluate, and create (1). Good HOTS mastery is required to face the challenges of the 21st century. Therefore, many countries worldwide have integrated HOTS into their curriculum, including Malaysia, Singapore, America, and England (2). HOTS integration in the global education system aims to develop students' deep conceptual understanding and problem-solving abilities. (3). Through good mastery of HOTS, students can solve problems, make decisions, and connect previous lesson material with today's lesson (4). Because of the importance of HOTS, teachers should implement HOTS into the learning process so that students have high HOTS (5). However, research reports reveal that students' HOTS abilities in Indonesia are generally still low (6).

The low HOTS of students in Indonesia should be a serious concern for all parties in the education system in Indonesia, including lecturers in badminton lectures. Badminton lectures should not only aim to improve playing techniques but can also be used to develop students' HOTS. An effective learning model is needed to develop HOTS (7). In badminton lectures, lecturers often use the direct instruction (DI) model. DI is one of the learning models that lecturers in badminton lectures commonly use. The DI learning process centered on the teacher causes students to tend to be passive, so they are not trained to overcome every problem they encounter, and they will also find it challenging to find solutions. As a result, HOTS development does not occur in the lecture process. Therefore, a student-centered learning model is needed to stimulate students to

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solve problems and find solutions, one of which is using the integrated learning model (ILM). ILM is a learning model oriented to problems that vary and are relevant to each student. Students will be trained to solve problems, find solutions, and generate new ideas. The main goal of integrated learning is to prepare college graduates with comprehensive skills (8).

Several previous studies on increasing HOTS in physical education have been conducted, including research conducted by (9), which has successfully increased HOTS in high school students in Yogyakarta, Indonesia, through implementing the Teaching Games for Understanding Learning model. Not much different from the research, (10) It was also reported that the Teaching Games for Understanding learning model improved HOTS in elementary school students in Yogyakarta, Indonesia. Based on our research, minimal research is known related to enhancing HOTS through physical activity. No study has been found using integrated learning and direct instruction models in badminton lectures to improve students' HOTS. Therefore, this study is important to investigate the effectiveness of the integrated learning model in badminton learning compared to the direct instruction learning model in developing students' HOTS.

MATERIALS AND METHODS

Design and Participants. This study used a randomized pretest-posttest control group design. The interventions included an experimental group (ILM) and a control group (DI). This study was conducted in 14 meetings (including pretest and posttest). The group was determined randomly. The sample involved in this study consisted of 37 people, consisting of 19 ILM (male = 14, female = 5) and DI with a total of 18 people (male = 14, female = 4). The sample was selected using a purposive sampling technique: only those willing to participate in research activities were given treatment and had pretest and posttest data.

Data Collection Tools. Data was collected by asking 15 HOTS-based questions about badminton material. The 15 items met the validity and reliability standards. The test was conducted twice, namely, pre-test and post-test.

Instrument. To measure students' HOTS, we developed an instrument relevant to badminton material consisting of 15 questions. By the levels in Bloom's taxonomy, namely analyzing, evaluating, and creating (see Table 1).

This instrument has undergone a series of processes, including a content validity test, Intraclass Correlation Coefficient (ICC), construct validity test, and reliability test. The results stated that 15 questions met these standards (see Table 2).

Statistical Analysis. Furthermore, to see the differences in the influence of the two learning models, an independent sample t-test statistical analysis was used, and the data analyzed must first meet the standards of normality and homogeneity.

RESULTS

Based on students' Gain (N-Gain) HOTS, the ILM group obtained an average increase of 0.36, median 0.35, mode 0.29, standard deviation 0.23, highest score 0.79, and lowest score -0.06. Meanwhile, the DI group obtained an average increase of 0.15, a median of 0.18, a mode of 0.33, a standard deviation of 0.37, a highest score of 0.87, and a lowest score of -0.85. The data was then tested for normality with Kolmogorov-Smirnov; based on the results of the normality test, the ILM and DI groups both obtained a Sig value of 0.200, thus $\text{Sig} > 0.05$, it can be stated that both data groups have met the normality standard. The next stage is the data homogeneity test (see Table 3).

Based on the homogeneity test, the sig value is $0.120 > 0.05$, so it can be concluded that both data groups have met the homogeneity standard. Then, the data is tested for hypothesis (see Table 4).

Based on the hypothesis testing, the $t_{\text{count}} 2.062 > t_{\text{table}} 2.032$, so it can be concluded that the influence given by the two groups (ILM and DI) is significantly different, and based on the comparison of the means, the ILM group obtained a greater mean compared to the DI group.

DISCUSSION

The study results have shown that ILM is more effective than DI in increasing HOTS. ILM is a student-centered learning model. In its activities, ILM provides opportunities for students to assess, evaluate, solve problems they find, and find new ideas to master badminton playing skills more quickly. The activities of assessing, evaluating, and solving these problems will automatically stimulate students' HOTS so that students' HOTS can develop. ILM offers several advantages in the learning process, such as increasing student motivation, supporting innovative teaching methods, and creating a diverse learning environment (12). In addition, ILM provides flexibility, so students get more realistic work experience (13). In this model, students gain authentic learning experiences to develop their abilities, skills, and self-confidence (14). Therefore, this

model can strengthen cognitive, psychomotor, and affective learning domains, encouraging skill development and professional growth (15). This study's results align with the opinion of (8), who claims that ILM is an effective college learning strategy.

CONCLUSION

The integrated learning model is more effective than direct instruction in improving the HOTS of physical education students. These results confirm that student-centered learning models can stimulate students to think highly. Activities to analyze, evaluate, and solve problems in badminton learning can help improve students' HOTS.

APPLICABLE REMARKS

- Lecturers are advised to use an integrated model to improve students' HOTS and make learning more meaningful.
- It is recommended that lecturers provide guidance according to the needs of each student to get maximum results because, after all, students are not yet fully independent.

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AUTHORS' CONTRIBUTIONS

Study concept and design: Sefri Hardiansyah, Nurlan Kusmaedi. Acquisition of data: Sefri Hardiansyah, Amung Ma'mun Herman Subarjah. Analysis and interpretation of data: Sefri Hardiansyah, Amung Ma'mun. Drafting the manuscript: Sefri Hardiansyah. Critical revision of the manuscript for important intellectual content: Sefri Hardiansyah. Statistical analysis: Sefri Hardiansyah. Administrative, technical, and material support: Sefri Hardiansyah. Study supervision: Sefri Hardiansyah.

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The authors declare that they have no conflicts of interest.

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This study has no financial interests related to the material in the manuscript.

ARTIFICIAL INTELLIGENCE (AI) USE

This study agrees with the journal's policy in this section.

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Table 1. HOTS Indicators

HOTS Cognitive Domain	Indicator	Number of Items
C4: Analyze	Analytical skills consist of the ability to solve problems and identify relationships from the information presented (1)	5
C5: Evaluate	Evaluation skills consist of students' abilities to assess and validate a concept based on specific criteria (11)	4
C6: Creating	Creative ability consists of students' ability to produce new ideas and creative solutions to complex problems (1)	6

Table 2. Instrument Validity and Reliability Test

	r	r _{table}	Decision
Content Validity	0.82 – 1.00	0.72	Valid
ICC	0.82	0.72	Reliable
Construct Validity	0.32 – 0.70	0.32	Valid
Reliability Test (Cronbach's Alpha)	0.80	0.32	Reliable

Table 3. Results of the Homogeneity Test

Group	F	Sig	α
ILM DI	2.543	0.120	0.05

Table 4. Hypothesis testing results

Group	Average N-Gain	t _{count}	t _{table}
ILM	0.36	2.062	2.032
DI	0.15		

Exploring The Physical Activity in Camping Tourism: A Confirmatory Factor Analysis of Tourist Experiences

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ABSTRACT

Background. Research on camping tourism, especially tourist experiences, remains limited, offering valuable insights for facility management. **Objectives.** This study aims to identify the dominant factors shaping the camping experience and WOM and examine the impact of the camping experience on WOM. **Methods.** The research uses confirmatory factor analysis (CFA) and structural equation modeling (SEM) to analyze data from 400 respondents who visited camping sites in Bandung Regency. Measurement indicators based on camping experience and WOM constructs were used to assess the strength and influence of each factor. **Results.** The findings show that "personal growth and renewal" and "WOM intensity" are the most influential factors in shaping the camping experience and WOM. Additionally, the camping experience has a significant positive effect on WOM. **Conclusions.** The results suggest that service providers should enhance engaging experiences to encourage positive WOM, attract more visitors, and ensure long-term sustainability in the camping tourism sector.

KEYWORDS: *Camping Experience, Word-Of-Mouth, Adventure Tourism, Camping Tourism, Marketing, Tourism*

INTRODUCTION

Physical activities enhance well-being, fitness, and mental health, offering physical and psychological benefits [1]. Outdoor recreation, including hiking, cycling, and camping, provides opportunities to enjoy nature while active [2]. Camping tourism, in particular, is a unique form of nature-based tourism that allows travelers to connect with nature through temporary accommodations like tents or RVs, fostering personal growth, renewal, and harmony with the environment.

Camping tourism, a type of special interest, nature-based tourism, relies on the natural environment and involves flexible, temporary accommodations like tents and RV [3]. It has become a significant part of the tourism industry [3] and is recognized as an emerging sector [4]. Trends in camping tourism now emphasize unique nature experiences and social interactions, with some segments offering amenities similar to hotels [5]. Campers frequently return to the same sites, contributing to domestic tourism cycles. Activities include hiking, cooking, photography, and fishing [3]. The COVID-19 pandemic significantly impacted tourism, demanding adaptive recovery strategies to counter reduced mobility and economic challenges.

Modern travelers do not only seek satisfaction from the functional characteristics of a product/service; they are also

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looking for extraordinary experiences [6] that are enjoyable, creative, and social [7]. Exceptional consumer experiences can create value for companies [8], offering unique value to customers that is difficult for competitors to replicate [9]. They seek memorable experiences [10] that can impact consumer memories [11], satisfaction [12], and recommendation behavior [9]. Offering unique and engaging experiences is crucial for gaining a competitive advantage [13]. Commodities, products, and services alone are insufficient for long-term benefits; they must include experiences [14]. Camping tourism provides an immersive experience that enhances perceptions and satisfaction through personal growth, renewal, and harmony with nature, fostering a memorable sense of accomplishment and connection [15].

Word-of-mouth (WOM) significantly influences destination reputation and tourist decisions, with positive WOM as a key driver through personal recommendations. WOM intensity, frequency and strength of shared experiences are crucial in camping tourism. A positive camping experience boosts tourists' likelihood of engaging in WOM, attracting new visitors and enhancing destination sustainability. Thus, fostering enriching experiences promotes a cycle of positive WOM essential for the camping tourism industry [14].

Research on camping tourism, especially tourist experiences, remains limited, offering valuable insights for facility management [3]. Studies suggest that camping experiences, rather than external influences, shape self-concept. For instance, a study on Greek summer camping found that core-consumption experience impacts nostalgia and WOM intensity [15]. Destination choice depends on relevance and preferences, with motivation influencing experience. Given the limited focus on camping experiences, this study aims to identify key factors shaping the tourist experience and its impact on WOM.

MATERIALS AND METHODS

Research design. This quantitative, cross-sectional study explores the impact of camping experiences on WOM among tourists, with data collected from respondents who visited camping sites in Bandung.

Respondents. The study involves 400 tourists who camped at three popular Bandung destinations: Kampung Cai Ranca Upas, Ranca Cangkuang, and Batu Kuda Manglayang. Stratified random sampling was used for proportional distribution, followed by purposive sampling to select eligible respondents.

Research Instruments. Data was collected through a structured questionnaire distributed via Google Forms. The camping experience variable was measured using an adaptation of the scale from [15], while WOM was measured using dimensions developed by [14].

Statistical Analysis. Data analysis used Confirmatory Factor Analysis (CFA) to verify factor loadings and the Structural Equation Model (SEM) with AMOS 24 to assess relationships and test hypotheses on the effect of camping experiences on WOM.

RESULTS

The model fit testing showed that while Cmin/df (3.271) and TLI (0.827) did not meet the ideal thresholds, CFI, GFI, and AGFI exceeded 0.90, and Pclose (0.107) was above 0.05. RMSEA (0.076) and SRMR (0.026) were also below 0.08. The model is considered fit, accurately estimating the population covariance matrix with minimal differences from the sample covariance matrix.

The local fit testing (Table 2) showed that each indicator's standard estimate was above the threshold (0.5). Indicating that the proposed model successfully measures the validity and reliability of each construct indicator. The variable construct estimates also had a variance extracted above 0.5 and construct reliability values above 0.7.

The statistical assumption testing results (Table 3) showed that the data follows a normal bivariate and multivariate distribution, with skewness <2—values within ± 2.58 . The AVE squared correlation values for each construct were below the square root of the AVE, indicating sufficient discriminant validity for measuring the camping experience and WOM constructs. The HTMT values were also below the threshold (<0.85), showing that the measurement model has adequate and discriminant validity, making the data valid and reliable for analysis.

The CFA results (Table 2) show that the factor weights for each dimension of the camping experience are 0.875 (87.5%) for "personal growth and renewal" and 0.615 and 0.748 (61.5% and 74.8%) for "harmony with nature" and "communitas." Respectively, with significance levels below 0.05. For WOM, the factor weights for the dimensions of Positive WOM, Negative WOM, and WOM intensity were 0.591, 0.642, and 0.996. Respectively, with significance levels below 0.05, Table 3 also indicates that the camping experience (X) has a path coefficient estimate to WOM (Y) of 0.691, with an R-square value of 47.7%. This relationship is further illustrated in Figure 1 above.

DISCUSSION

CFA results show that personal growth and renewal are the most influential dimensions of the camping experience, as tourists often gain new skills, like learning to start a campfire. This contrasts with [15], who

found personal growth less impactful. This difference may stem from the recent growth of camping tourism in Indonesia post-COVID-19, offering skill-development opportunities to new campers. Data analysis reveals that WOM intensity dominates the WOM construct, contrasting with those who found PWOM as the most dominant dimension. This difference may be due to tourists sharing experiences with friends or colleagues more frequently. Structural Equation Modelling reveals that the camping experience positively affects WOM communication, supporting previous studies that link intense customer experiences to increased WOM activity and revisit intentions [14], [15]. Similarly, it found that experience significantly impacts WOM communication.

CONCLUSION

This study shows that personal growth and renewal are the most dominant factors shaping the camping experience [15], while WOM intensity plays a key role in forming WOM. It also confirms that the camping experience positively influences WOM, suggesting that camping service providers should create memorable experiences to encourage recommendations. However, the study has limitations, including challenges in questionnaire distribution, as not all tourists participated despite online distribution and time constraints hindering the process. The limited literature on camping tourism also made finding relevant references difficult, pointing to the need for further research in other adventure tourism areas like rafting or hiking.

APPLICABLE REMARKS

Outdoor tourism, such as camping, is an alternative to enhancing different tourism experiences. Currently, camping is one of the alternatives families often use, both the general public and schools. So, in addition to providing outdoor activity experiences, it will also increase tourist visits.

ETHICAL CLEARANCE

This study adheres to ethical guidelines and does not violate any ethical standards.

AUTHORS' CONTRIBUTIONS

Study concept and design: Oce Ridwanudin, Vanessa Gaffar. Acquisition of data: Oce Ridwanudin. Analysis and interpretation of data: Vanessa Gaffar, Rivaldi Arissaputra. Drafting the manuscript: Oce Ridwanudin, Vanessa Gaffar, Eko Purnomo. Critical manuscript revision for important intellectual content: Rivaldi Arissaputra, Lili Adi Wibowo. Statistical analysis: Oce Ridwanudin.

CONFLICT OF INTEREST

The authors mention no "Conflict of Interest" in this study.

ETHICAL CONSIDERATION

This research has met the standards of research ethics and has received approval to be a sample of all respondents.

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The authors have no financial interests related to the material in the manuscript.

ARTIFICIAL INTELLIGENCE (AI)

USE There was NO use of artificial intelligence (AI) for preparation, writing, or editing this manuscript.

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Table 1: Model Fit Measurement

Measure	estimate	Criteria	Test Results
CMIN	19.628		
DF	6.000		
CMIN/DF	3.271	<2	Not fit
CFI	0.987	>0.90	Fit
SRMR	0.026	<0.08	Fit
RMSEA	0.076	<0.08	Fit
Pclose	0.107	>0.05	Fit
TLI	0.827	>0.90	Fit
GFI	0.984	>0.90	Fit
AGFI	0.943	>0.943	Fit

Data processed

Table 2: Model Validity Measures and Standard Regression Weight

Measurement Equation	λ	Cr	p
PP $\leftarrow$ X	0.875		
KO $\leftarrow$ X	0.748	13.272	***
KA $\leftarrow$ X	0.615	10.661	***
Construct Reliability (CR)	0.799		
Average Variant Extracted (AVE)	0.584		
Y3 $\leftarrow$ Y	0.591		
Y1 $\leftarrow$ Y	0.642	12.783	***
Y2 $\leftarrow$ Y	0.996	10.661	***
Construct Reliability (CR)	0.794		
Average Variant Extracted (AVE)	0.568		
Discriminant Validity			
Validity Measures		HTMT Analysis	
MaxR(H)	Y	X	
0.992	0.765	Y	
0.837	0.691***	0.753	X
Estimasi Parameter Model Struktural			
	RW	SRW	SE
Y $\leftarrow$ X	0.223	0.691	0.27
	CR	P	R ²
	8.211	***	0.477

Data processed

Table 3: Statistical Assumption Test Results

Statistical Assumptions	M	Cr	Mahalanobis Distance			Determinant of Covariant Matrix
			Maks	Min	χ^2	
Normality	0.704	7.15	-	-	-	-
Outliers	-	-	19.809	7.527	22.457	-
Multikolinieritas	-	-	-	-	-	3393.913

Data processed

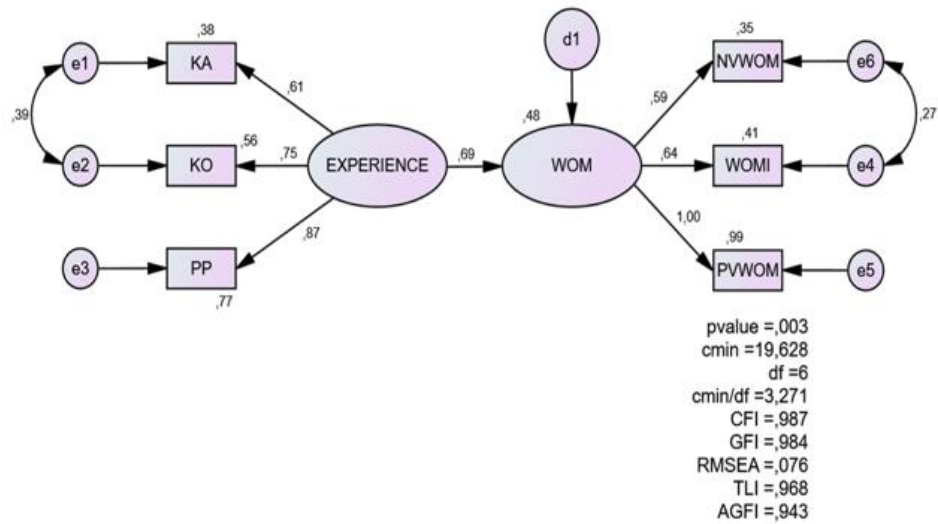


Figure 1: Measurement Estimation Model of Camping Experience on WOM

The Effectiveness of Aquatic Exercise as An Intervention to Improve Cardiovascular Capacity in Pre-elderly

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ABSTRACT

Background. Aquatic training is an excellent substitute for conventional cardiovascular workouts because of its minimal stress on joints, which promotes strength, balance, and general health. **Objectives.** This study aims to assess how well water exercise can increase pre-elderly people's cardiovascular capability. **Methods.** The research sample comprised 15 pre-elderly people who satisfied the inclusion criteria, and the methodology was experimental with a one-group pre-test and post-test design. For six weeks, each participant participated in 16 sessions of an aquatic training program that gradually increased in intensity to suit their physical conditions. The 6-Minute Walk Test (6MWT), which measures cardiovascular endurance, was used to measure participants' cardiovascular capacity as pre-test data prior to the start of the intervention. The same test was administered as post-test data following the conclusion of the intervention. **Results.** With an average increase in participants' mileage of 18,86%, the results demonstrated a significant increase in cardiovascular capacity following the intervention. The paired sample t-test data analysis revealed a significant value ($p < 0.05$), suggesting that water exercise helps the pre-elderly group's cardiovascular capability. **Conclusions.** Accordingly, aquatic exercise can be recommended as a safe and effective training program to improve cardiovascular health pre-elderly and as an alternative form of exercise for those with low mobility.

KEYWORDS: *Aquatic Exercise, Cardiovascular, Pre Elderly*

INTRODUCTION

Longer life expectancies are to blame for the growing number of old and pre-elderly people around the globe(1). However, health risks are associated with this tendency, especially concerning cardiovascular capacity(2). Cardiovascular function frequently deteriorates in pre-elderly people, increasing their chance of developing chronic illnesses, including hypertension and coronary heart disease, which also affects their physical stamina and mobility(3). In order to avoid aging, effective interventions are necessary to preserve independence and quality of life(4).

Because of its unique qualities, aquatic exercise is considered a healthy and safe pastime for elders(5). Because water buoyancy eases the strain on muscles and joints, individuals with physical limitations can participate in aerobic workouts with little danger of damage(6). Aquatic aerobic training improves cardiovascular capacity, strengthens muscles, and improves balance(7).

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In order to lower the risk of heart disease and enhance older individuals' quality of life, cardiovascular health maintenance is essential(8). Aquatic training is an excellent substitute for conventional cardiovascular workouts because of its minimal stress on joints, which promotes strength, balance, and general health(9). This study investigates how well-water exercise can improve cardiovascular function in pre-elderly individuals.

MATERIALS AND METHODS

The efficiency of water exercise in enhancing cardiovascular capacity in pre-elderly individuals was assessed in this study using a one-group pre-test post-test experimental design. Purposive sampling was used to choose 15 pre-elderly people aged 45 to 59 who made up the study sample. Participants who did not have compromising medical conditions, such as acute heart illness or severe mobility impairment, were eligible to participate.

Participants in the six-week aquatic exercise program worked out three times a week for 45–60 minutes, doing warm-up, core, and cool-down activities(10). Core exercises that used running, water walking, and other aerobic exercises to increase cardiovascular endurance. The 6-Minute Walk Test (6MWT), which measures the distance traveled in six minutes, was used to evaluate cardiovascular capacity both before (pre-test) and after (post-test) the 16 sessions. A paired sample t-test was used to identify significant changes in the data and ethical approval was obtained. This program offered safe, moderate exercise to improve general fitness and cardiovascular capacity(11).

RESULTS

Participants' cardiovascular capacity significantly increased following six weeks of water exercise. In the 6-Minute Walk Test (6MWT), the average distance traveled increased by 18.86%, from 6250 meters before the test to 7450 meters after. A significant difference between the pre-and post-test findings was confirmed by statistical analysis using the paired sample t-test, which produced a p-value <0.05. Despite age-related physical restrictions, each participant improved independently, with several demonstrating mileage improvements of over 15%. Participants also reported feeling better about their health, having stronger muscles, and having better balance, which suggests that water exercise had a good effect on cardiovascular endurance and pre-elderly people's quality of life. The results are shown in detail in table 2.

After engaging in water exercise, the elderly's cardiovascular capacity significantly improved, according to the paired sample t-test. With a mean difference of 72.33 meters, the pre-test and post-test mean distances were 416.67 and 496.67 meters, respectively. Statistical significance is indicated by the p-value < 0.001 and the t-value of 47.19. The following table displays the data results in detail.

DISCUSSION

According to the study's findings, water exercise significantly increased the distance covered during the 6-Minute Walk Test (6MWT), demonstrating its effectiveness in enhancing cardiovascular capacity in pre-elderly individuals. This rise implies that water exercise can enhance lung and cardiovascular endurance, critical for senior citizens' well-being. Because water reduces joint resistance, older persons can exercise more safely and without the risk of damage that comes with land-based exercise(12).

Furthermore, qualitative questionnaires have shown that the enhanced cardiovascular function significantly enhances participants' quality of life. Enhancements in muscle strength, balance, and mobility comfort were also observed, confirming earlier research suggesting that aquatic exercise may offer advantages beyond cardiovascular enhancements (13).

More research with larger samples is required to support these findings and comprehend the long-term effects of this intervention on pre-elderly individuals, as this study only involved 15 participants.

CONCLUSION

Aquatic exercise efficiently increases cardiovascular capacity in pre-elderly individuals, as seen by the significant improvement in 6MWT distance. The advantages are improved quality of life, balance, and muscle strength (14). Aquatic exercise is the best choice for enhancing cardiovascular health in this age group because it is low-impact and easy on the joints (15).

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AUTHORS' CONTRIBUTIONS

Study concept and design: Andri Gemaini, Yanuar Kiram, Anton Komaini. Acquisition of data: Syahrastani. Analysis and interpretation of data: Gusril, Bafirman. Drafting the manuscript: Arnedral, Armaita.

Critical revision of the manuscript for important intellectual content: Andri Gemaini. Statistical analysis: Husnul Khatimah, Aulia Rahmad.

CONFLICT OF INTEREST

The researcher attests that there are no conflicts of interest in this study.

ETHICAL CONSIDERATION

This study has been approved as a representative sample of all respondents and has complied with research ethics guidelines.

FUNDING/SUPPORT

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THE SPONSOR'S ROLE

The public entities that provide money have no say in how the study is planned and carried out, how the data is gathered, managed, and analyzed, or how the article is prepared, reviewed, and approved.

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Table 1: Aquatic Exercise Program for Pre Elderly

Session	Exercise Type	Duration	Description
1-3	Warm-up: Fast walking in water, Arm movements	10 minutes	Fast walking in water up to waist height, varying arm movements
	Main Exercise: Water jogging, Side steps	25 minutes	Water jogging (5 minutes), Side steps (3 minutes), Leg lifts
	Cool-down: Stretching exercises	10 minutes	Stretching upper and lower body muscles
4-6	Warm-up: Fast walking, Arm strokes	10 minutes	Variations of fast walking, arm strokes forward and sideways
	Main Exercise: Water jogging, Lunges, High knees	30 minutes	Water jogging (5 minutes), Lunges (4 minutes), High knees (4 minutes)
	Cool-down: Light stretching	10 minutes	Stretching legs and arms
7-9	Warm-up: Fast walking, Light jumps in water	10 minutes	Fast walking and light jumps in the water
	Main Exercise: Water jogging, Side kicks, Intervals	30 minutes	Fast water jogging (5 minutes), Side kicks (4 minutes), Intervals (6 minutes)
	Cool-down: Stretching exercises	10 minutes	Stretching body and legs
10-12	Warm-up: Fast walking, Light jumps	10 minutes	Variations of fast walking and light jumps
	Main Exercise: Water jogging, Squats, Lunges	30 minutes	Water jogging (7 minutes), Squats (5 minutes), Lunges (5 minutes)
	Cool-down: Stretching exercises	10 minutes	Stretching upper and lower body muscles
13-15	Warm-up: Fast walking, Light jumps	10 minutes	Variations of fast walking and light jumps
	Main Exercise: Water jogging, Intervals, Squats	35 minutes	Fast water jogging (5 minutes), Intervals (7 minutes), Squats (5 minutes)
	Cool-down: Stretching and relaxation	10 minutes	Stretching and relaxation in the water
16	Warm-up: Light walking, Light stretching	10 minutes	Light stretching exercises in water
	Main Exercise: Combination of previous exercises	30 minutes	Combination of previous exercises and progress evaluation
	Cool-down: Stretching and evaluation	15 minutes	Stretching, progress evaluation, and feedback

Table 2. Results of Effectiveness Of Aquatic Exercise in Elderly

No.	Participant Name	Age (Years)	Pre-Test Distance (meters)	Post-Test Distance (meters)	Increase (meters)	% Increase
1	Participant 1	46	400	460	60	15%
2	Participant 2	47	420	490	70	16.67%
3	Participant 3	45	380	450	70	18.42%
4	Participant 4	48	390	470	80	20.51%
5	Participant 5	49	410	490	80	19.51%
6	Participant 6	46	415	485	70	16.87%
7	Participant 7	47	430	510	80	18.60%
8	Participant 8	50	400	470	70	17.50%
9	Participant 9	45	385	450	65	16.88%
10	Participant 10	48	420	490	70	16.67%
11	Participant 11	47	400	475	75	18.75%
12	Participant 12	49	405	480	75	18.52%
13	Participant 13	46	390	470	80	20.51%
14	Participant 14	47	400	470	70	17.50%
15	Participant 15	50	410	480	70	17.07%
Total			6,250	7,450	1,200	18.86%

Table 3. Results of T-value (Effectiveness Of Aquatic Exercise in Elderly)

Group	Pre-Test Mean (±SD)	Post-Test Mean (±SD)	Mean Difference (±SD)	t-value	df	p-value
Cardiovascular Capacity	416.67 (±11.79)	496.67 (±7.99)	72.33 (±5.94)	47.19	14	<0.001

The Development of A Basic Motor Skill Training Model: Swimming Based on Water Games For Preschoolers

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ABSTRACT

Background. Providing a model for preschoolers' fundamental water-based swimming motor skills is interesting and helpful in assisting kids to become better swimmers. **Objectives.** This study aims to develop a more dynamic, game-based learning model by addressing the dearth of training techniques for enhancing kids' swimming skills. **Methods.** The model was developed using the ADDIE model for analysis, design, development, implementation, and evaluation. Analysis of the training program, the materials, and the characteristics of the youngsters were all covered. A practicality test was undertaken by twelve kindergarten teachers following validation by a team of seven experts. **Results.** The model's high Aiken scale score of 0.81 validated its validity. An average score of 85.6% on the Guilford scale proved its efficacy. The model's efficacy was further reinforced by the fact that 15 preschoolers' swimming motor abilities significantly improved, as shown by a T value of 10.601, higher than the T table value of 1.75. **Conclusions.** These results imply that the created learning model considerably improves preschoolers' foundational swimming motor skills.

KEYWORDS: *Motor Skills, Swimming, Water Games, Preschool*

INTRODUCTION

Preschoolers can learn the fundamentals of swimming motor skills through enjoyable and captivating water play, which also helps them overcome their fear of the water and get to know it (1). It is commonly acknowledged in early education that play-based techniques increase children's attention and excitement. In swimming, water play cultivates a child's love of the water while boosting confidence, balance, and coordination (2).

Traditional swimming classes can be intimidating for young children since they frequently entail intricate instructions and demand a great deal of focus. To address this, a better training model adapted to toddlers' developmental needs is required. When teaching swimming motor skills, a water play-based approach enhances learning and complements kids' cognitive and motor development (3).

Prior research has demonstrated the beneficial effects of water play on basic swimming abilities such as breathing, balance, and coordination (4). The advantages of water play in teaching swimming foundations are illustrated by activities like "Hola Hole," where kids practice floating, and "Kincir Air," which uses hand and

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foot motions similar to swimming to retrieve a ball. This method lays the groundwork for future physical pursuits by helping kids develop their motor skills and teaching them how to swim (5).

MATERIALS AND METHODS

Type of Research. The Research and Development (R&D) approach is used in this work, and the ADDIE model is used for design. The main goal is to create a teaching approach that uses fun water activities to improve preschoolers' fundamental swimming motor abilities(6).

Research Methods. There are several steps in the research process:

1. Needs Analysis Stage: Determining preschoolers' requirements for developing swimming motor skills.
2. Model Development Stage: Using the analysis as a guide, design and build the model.
3. Validation Stage: The Aiken V Scale evaluates the model's validity; scores of 0.70 or higher indicate validity.
4. Stage of the Practicality Test: The Guilford Scale assesses the model's practicality; a score in the Practical or Very Practical range indicates that it is feasible to employ.
5. Efficiency Test Stage: Preschoolers' gains in fundamental swimming motor abilities are used to gauge the model's efficacy. Notable improvements demonstrate the model's effectiveness.

Participants in the Research. The study focuses on preschoolers aged four to six with no foundational swimming skills. These individuals were chosen to evaluate the model's effect on early swimming skills.

Techniques for Collecting Information. Two main methods are used to gather data:

1. Questionnaires: These are given to experts for the model's validity test and swimming instructors for the practicality test.
2. Observational Analysis: The model's efficacy is assessed using statistical findings, precisely gains in kids' swimming motor abilities.

Examination of the Results. Following the completion of every stage of the study, the results are interpreted as follows:

1. Validity: The model is deemed valid if the Aiken V value for each item is ≥ 0.70 .
2. Practicality: If the model is in the Guilford Scale's Practical or Very Practical category, it is considered practical.
3. Effectiveness: The model is considered adequate if statistical analysis demonstrates a noteworthy improvement in the children's swimming motor skills.

RESULTS

Seven validators examined the learning model for preschoolers' basic swimming motor abilities based on water activities. The "Kincir Air," "Color Crab," "Frog," "Spinning Ball," "Water Filling," "Bubble," "Hola Hole," "Hola Ball," "Throw Ball," and "Treasure" activities were among the model components that achieved high or strong scores, according to expert validation results based on Aiken's scale. The model's overall validity rating of 0.81 showed a high degree of validity. These findings support the model's robustness and suitability for teaching children swimming motor skills.

Twelve educators evaluated the water-game-based learning strategy for basic swimming motor abilities during the practicality stage. Based on personal experience, their comments evaluated the model's applicability and efficacy in actual learning situations. The following table displays the findings of the practicality evaluation.

The assessment results indicate that the observed teachers regard the water play-based learning model for basic swimming motor skills as very useful. The model is user-friendly and successful in preschool, with an average score of 85.6% for all assessed aspects. This implies the program is prepared for broad use and can significantly enhance preschoolers' foundational swimming motor skills.

The model's ability to improve preschoolers' basic swimming motor abilities was evaluated after a positive practicality review. A test of preschool swimming skills was administered to thirty participants, who were divided into fifteen intervention groups and fifteen control groups. Progress was assessed using pre-and post-tests, and the Shapiro-Wilk normality test and SPSS 26 confirmed a normal data distribution ($p = 0.094$). These results demonstrate a regular distribution of data and thoroughly evaluate the model's effectiveness in enhancing fundamental swimming abilities through water play activities.

The table of results from the exercise program effectiveness shows significant differences in paired t-tests ($p < 0.05$). The following can be described in Table 4.

It is clear from the pretest and posttest data that this training strategy works well for enhancing preschoolers' foundational swimming motor skills.

DISCUSSION

Experts evaluated each component as relevant using the Aiken V Scale, confirming the model's content validity. Age-appropriate activities support toddlers' motor development by emphasizing basic movements, including breathing, balance, and coordination(7). This play-based approach better meets preschoolers' physical and social-emotional requirements than sophisticated methods, supporting the hypothesis of early motor development(8).

According to the practicality test, this model was classified as "Very Practical." The model was simple for teachers and swimming instructors to use in the preschool learning environment. Furthermore, the games in this model are highly adaptable and may be changed to suit specific requirements and environmental factors, including the pool size or the number of kids taking part(9). The effectiveness test revealed notable gains in fundamental swimming motor abilities, such as breathing, strength, balance, and coordination(10). This demonstrates how the water play included in this model can help children with their motor development(11). For preschoolers, balance and coordination are crucial foundational abilities that will help them acquire more advanced swimming methods later in life(12).

CONCLUSION

With an emphasis on basic water motor skills and water activities, the researchers created a reliable and helpful model for toddlers(13). It satisfies content validity requirements and aligns with preschoolers' motor development, as the Aiken V Scale confirmed. The model's efficient development of fundamental motor abilities improves children's breathing, strength, balance, and coordination (14)(15).

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Study concept and design: Andri Gemaini, Yanuar Kiram, Anton Komaini. Acquisition of data: Syahrastrani. Analysis and interpretation of data: Gusril, Bafirman. Drafting the manuscript: Meirizal Usra, Naluri Denay. Critical revision of the manuscript for important intellectual content: Andri Gemaini. Statistical analysis: Dwi Happy Anggia Sari, Aulia Rahmad.

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The authors mention no "Conflict of Interest" in this study.

ETHICAL CONSIDERATION

This study complies with research ethics requirements and has been approved as a representative sample of all respondents.

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Table 1. Results of Validation of Water Game-Based Swimming Basic Motor Skills Training Model

The Development of a Water Game-Based Swimming Basic Motor Skills Training Model																				
	Item 1		Item 2		Item 3		Item 4		Item 5		Item 6		Item 7		Item 8		Item 9		Item 10	
Validator	Score	s	Score	s	Score	s	Score	s	Score	s	Score	s	Score	s	Score	s	Score	s	Score	s
1	4	3	3	2	3,7	2,7	3,9	2,9	3	2	3,3	2,3	3,7	3,7	3,7	2,7	3,6	2,6	3,4	2,4
2	4	3	3	2	3,8	2,8	4	3	3	2	3	2	3,8	2,8	3,8	2,8	3,7	2,7	3,5	2,5
3	3	2	4	3	3,8	2,8	3	2	3	2	3,3	2,3	3,8	2,8	3,8	2,8	3,7	2,7	3,3	2,3
4	3	2	3	2	3,8	2,8	3	2	3	2	3	2	3,8	2,8	3,5	2,5	3,7	2,7	3,5	2,5
5	3	2	3,1	2,1	3,7	2,7	3	2	3	2	3,4	2,4	3,7	2,7	3,5	2,5	3,7	2,7	3,5	2,5
6	3	2	3,1	2,1	3,6	2,6	3	2	3	2	3	2	3,6	2,6	3	2	3,7	2,7	3,3	2,3
7	4	3	4	3	4	3	3	2	4	3	3	2	4	3	3,9	2,9	3,7	2,7	3,3	2,3
Σs	17		16,2		19,4		15,9		14,7		17,2		19,4		18,2		18,8		15,4	
V	0,81		0,77		0,92		0,76		0,70		0,80		0,92		0,87		0,90		0,80	

Table 2. Practicality Test Results of Water Game-Based Swimming Basic Motor Skills Training

No	Observer	Score	Presentation (%)
1	Observer 1	340	85
2	Observer 2	330	82,5
3	Observer 3	300	75
4	Observer 4	319	79,5
5	Observer 5	315	78,5
6	Observer 6	379	94,75
7	Observer 7	340	85
8	Observer 8	363	90,75
9	Observer 9	370	92,5
10	Observer 10	328	82
11	Observer 11	364	91
12	Observer 12	359	89,75
Score		4107	Good/Practice
Average		85,6	

Table 3. Results of the normality test for water games

Data	Group	Shapiro-Wilk	
		N	p
Water Games (Pre-Test)	G1	15	0.054
	G2	15	0.094
Water Games (Post-Test)	G1	15	0.019
	G2	15	0.254

Table 4. Result of Water Games Program Effectiveness

Different Test Method	Group	p-value
Paired T-test	G1 (Pre-Test and Post-Test)	0.769
	G2 (Pre-Test and Post-Test)	0.000*

Implementation of Indonesian Football Philosophy (Filanesia) in Developing Endurance Training Model Based Holistic

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ABSTRACT

Background. Low endurance will make it difficult for players to compete in competitive football matches. Therefore, a training model is needed to increase endurance so players can play optimally during the match.

Objectives. This study aims to produce a holistic endurance training model that implements the Indonesian football philosophy (Filanesia). **Methods.** The method used in this study is research and development (R&D). The number of samples involved in this study was 185 people divided into two groups: small and large. Data collection techniques in this study were through observation and interviews. The data collection instruments in this study were a list of questions and questionnaires. **Results.** Based on the data analysis and expert validation, 24 variations of exercises were produced. Meanwhile, small and large group trial results obtained an average value of 82,54% and 86,49%. **Conclusion.** This study concludes that the holistic-based endurance training model is feasible to use.

KEYWORDS: *Model Development, Endurance, Holistic, Filanesia, Football*

INTRODUCTION

Football is a high-intensity sport that requires speed, strength, coordination, endurance, and other abilities to play at high intensity during the match (1). The average distance covered by a player in one match is 10-12 km (2)—quite a lot of activity and quite a long distance cause players to need good endurance. Endurance is the body's ability to carry out activities for a long time without experiencing fatigue, accompanied by fast recovery (3). Good endurance will help players to be able to play optimally for 2x45 minutes. In football, we can determine the endurance level through the VO_{2max} capacity. The average oxygen uptake for international football teams ranges from 55 - 68 ml/kg/minute (4).

With the high need for endurance and VO_{2max} in football games, coaches need to train and develop the endurance of football players. The problem we often see is that endurance training is primarily isolated, monotonous, not varied, and does not use a ball. Based on these problems, it is necessary to make improvements in training the physical condition of players, especially endurance. Therefore, researchers developed a new training model that differs from existing models. A training model under the philosophy of Indonesian football (Filanesia) is a holistic training method and uses a ball. Filanesia is a curriculum designed to advance Indonesian football. Filanesia is designed based on the characteristics and culture of Indonesian football itself (5,6).

Holistic training is a new method not yet widely known by football coaches (7). Holistic training improves physical condition and comprehensively improves the athlete's technical, tactical, and psychological skills

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(6,8,9). The advantage of holistic training is that it can simultaneously improve physical, technical, tactical and mental components (10). A holistic training method is one in which training is not isolated into technical-physical-mental training but is holistically integrated (11,12). Every soccer training session always creates a series of communication-decision-executions. The characteristic of this endurance training is that it is carried out with a ball and is not isolated (separately). In addition to increasing player endurance, this model can improve soccer players' technical, tactical, and mental skills together (holistic).

Based on the description above, this study aims to produce a holistic endurance training model by implementing the Indonesian football philosophy (Filanesia).

MATERIALS AND METHODS

The method used in this study is research and development (R&D), using the Borg and Gall approach (13). The Borg and Gall approach is modified into four steps, namely 1) preliminary study, 2) design of the model to be developed, 3) validation, evaluation, and revision of the model, and 4) implementation of the model. The subjects in this study were 185 U-18 soccer players spread across several SSBs and clubs. The data collection technique in this study was through observation and interviews. Observations were conducted at the subject's training location, while interviews were conducted with players and coaches. The data collection instruments in this study were a list of questions and a questionnaire. Data analysis techniques include all activities of clarifying, analyzing, utilizing, and drawing conclusions from all data that has been collected. The data in this study are quantitative data and qualitative data.

RESULTS

This study aims to develop an endurance training model by implementing the philosophy of Indonesian football. The preliminary study results obtained several conclusions that the training carried out so far has not used various forms of endurance training. So, a holistic endurance training model was designed to implement Indonesian football's philosophy (filanesia). The early stages of design consisted of 27 variations of training. This model was then discussed and validated by three football experts with coaching licenses and experience as coaches. After being validated by the experts, three training variations were issued and 24 variations remained to be continued to the next stage. Then, small-group and large-group trials were carried out. Here are the results of the trials.

Based on the small and large group trial results, the average values obtained were 82,54% and 86,49%. From these results, it can be concluded that this training model is feasible.

DISCUSSION

From the results of the data analysis, the implementation of filanesia in developing a holistic endurance training model is feasible. This feasibility is based on the results of small-group trials and large-group trials. The results of quantitative data analysis obtained an average value of 82.54% from small-group trials and 86.49% from large-group trials. The results obtained are inseparable from the modifications made by the researcher to the model that has been prepared. Modifications are made to the intensity of training, training volume, number of sets, and recovery in training. However, the modifications made are still based on the principles of endurance training in football.

Journals Based on the research results, holistic endurance training is very suitable to be used as a training method to improve the endurance of soccer players. Holistic training is a new method not yet widely known by soccer coaches. This training method does not do training separately but trains comprehensively without being separated during the training process (13). Holistic training combines all aspects of football, such as technique, physical, tactics, and mentality (14). Holistic training integrates sports skills such as technical, tactical, and physical skills in one training session and also integrates life skills (11). Holistic training can improve physical and technical abilities simultaneously (7).

Holistic training that is done continuously will undoubtedly increase the endurance of football players significantly. Good endurance is needed in football, so it is necessary to know the players' endurance level. Increased endurance will improve player performance in matches such as distance covered, intensity, number of sprints, and player involved with the ball (15). Endurance training with the ball will provide an update in endurance training in football. Many benefits and advantages are obtained if physical condition training is done with the ball. Therefore, coaches must provide physical training, especially endurance, using the ball as a medium. However, this training and maybe the coach can modify or manipulate the new training form so that more training forms are available. This will undoubtedly add to the references for endurance training forms for football coaches.

CONCLUSION

Based on the research results and discussions described above, it can be concluded that the holistic endurance training model that implements the philosophy of Indonesian football (filanesia) is valid and suitable for use to improve the endurance of football players, especially young players.

APPLICABLE REMARKS

- This research is very suitable for improving young soccer players' endurance. Implementing filanesia will help increase players' understanding of Indonesian football philosophy.

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AUTHORS' CONTRIBUTIONS

Study concept and design: Ridho Bahtra, data acquisition: Aldo Naza Putra. Analysis and interpretation of data: Nugroho Susanto. Drafting the manuscript: Ridho Bahtra, Aldo Naza Putra. Critical revision of the manuscript for important intellectual content: Ridho Bahtra. Statistical analysis: Nugroho Susanto.

CONFLICT OF INTEREST

The authors mention no “Conflict of Interest” in this study.

ETHICAL CONSIDERATION

This research has met the standards of research ethics and has received approval to be a sample of all respondents.

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The authors have no financial interests related to the material in the manuscript.

ARTIFICIAL INTELLIGENCE (AI)

USE There was NO use of artificial intelligence (AI) for preparation, writing, or editing this manuscript.

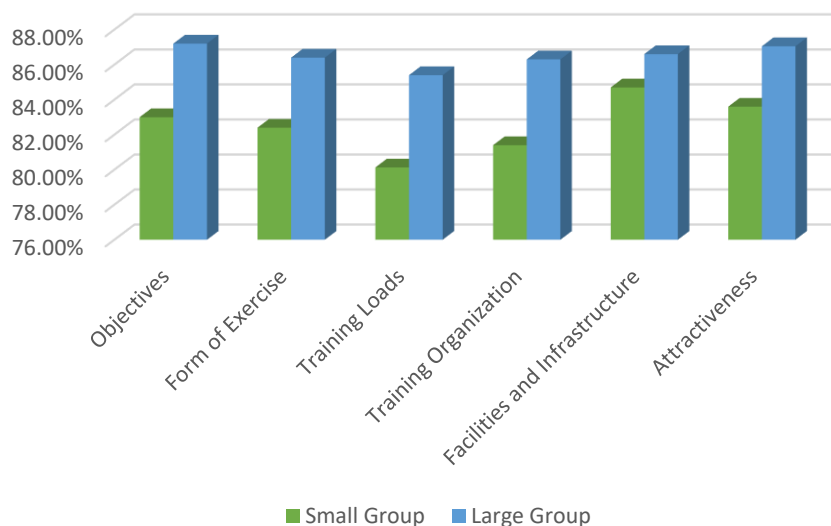
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Table 2. Results of Small Group Trials and Large Group Trials

Aspect	Small Group Trial		Large Group Trial	
	Result	Category	Result	Category
Objectives	83,00%	Good/Feasible	87,20%	Good/Feasible
Form of Exercise	82,40%	Good/Feasible	86,40%	Good/Feasible
Training Loads	80,13%	Good/Feasible	85,40%	Good/Feasible
Training Organization	81,40%	Good/Feasible	86,30%	Good/Feasible
Facilities and Infrastructure	84,70%	Good/Feasible	86,60%	Good/Feasible
Attractiveness	83,60%	Good/Feasible	87,05%	Good/Feasible



Histogram 1. Results of Small Group Trials and Large Group Trials

Implementing Physical Education, Sports, and Health Learning in Elementary Schools (Inclusion): Qualitative Analysis on Teachers' Self-Efficacy

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ABSTRACT

Background. Inclusive schools provide educational services for children with special needs to obtain proper education. **Objectives.** This study aims to find qualitative data on the self-efficacy of Physical Education, Sports, and Health teachers in Inclusive Elementary Schools to inform university policies for preparing Sports Education bachelor's degree graduates from the Faculty of Sport Science. **Methods.** This qualitative research uses a phenomenological approach, allowing researchers to observe phenomena broadly and deeply. Data collection involved Google Forms and in-depth interviews, followed by data reduction, classification, display, and conclusion drawing. **Results.** The analysis shows that teacher self-efficacy positively correlates with their ability to design and implement inclusive learning. Factors influencing self-efficacy include teaching experience, training attended, and support from colleagues and school management. **Conclusion.** These findings are expected to provide insights into developing more effective learning programs to improve the quality of physical education, sports, and health learning in inclusive elementary school environments.

KEYWORDS: *Physical Education, Inclusion, Elementary School Teachers*

INTRODUCTION

Inclusive schools provide educational services for children with special needs to obtain proper education. One challenge impeding the implementation of inclusive education is the incapacity of teachers to manage students with special needs in conventional classrooms (1). Teachers' proficiency and collaboration between the government and schools are essential to implementing inclusive cooperation between schools and parents (2). Furthermore, the causal factor is the pressure of testing and evaluation in inclusive education, which may not cover important aspects such as students' understanding, abilities, and behavior. This study aims to find qualitative data on the self-efficacy of Physical Education, Sports, and Health teachers in inclusive elementary

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schools to inform university policies for preparing Sports Education bachelor's degree graduates from the Faculty of Sports Science.

The methods by which children with disabilities continue their education alongside their peers who are typically growing in general education classrooms serve as the foundation for the special education practice known as inclusion (3). Inclusive education must be under the basic principles of inclusive schools (4). The basic principle of inclusive schools is that all students learn together regardless of the difficulties or differences that may exist in themselves (5). Perceived sufficiency in instructional and adaptive skills knowledge for the inclusion of students with disabilities in inclusive, practical physical education sessions was expressed by student-teachers from both institutions (6). Youngsters with strong self-esteem typically believe they are valued, allowing them to accept their flaws while appreciating who they are (7). Meanwhile, kids with low self-esteem believe they are less valued and that their flaws influence how they see themselves (8).

Children who are accepted well by the people around them have a favorable view of themselves and feel more respected, enabling them to develop their potential and achieve success based on their strengths (9). Placing children with special needs in inclusive settings also benefits their social abilities (10). Social competence is developed by children with special needs learning to interact with normal people. Students are shown real-life situations in the classroom (11). Social interaction teaches the students to imitate strategies, improve problem-solving skills, acquire better life skills, and reduce explosive behavior (12).

In addition, related to the benefits obtained from inclusive schools for children with special needs, challenges must be faced when implementing fully inclusive schools (13). These challenges come from both inside and outside the school. Developing an educational model for teachers is one alternative to reduce the challenges in implementing inclusive schools (14). Teachers can become central figures in making changes by providing materials or training for children with special needs. Commitment, knowledge, and support from regular class teachers are needed to increase their awareness in developing inclusive schools. (15).

MATERIALS AND METHOD

The research model used is qualitative research with a phenomenological approach, meaning that this research is multimodal in the focus of the problems studied, including interpretive and naturalistic approaches to the problems found. Participants in this study were 23 physical education, sports, and health teachers who teach at Inclusive Elementary Schools in Koto Tengah District, Padang City. Data was collected using Google Forms and interviews by asking several questions that teachers could fill in, covering educational background, teaching experience, competencies possessed, and problems found while teaching in inclusive schools. Data analysis steps are data collection, data reduction, describing data presentation, drawing conclusions, and verifying data.

RESULTS

Based on the results of the data analysis obtained, firstly, the understanding of physical education, sports, and health teachers showed a good understanding of the principles of inclusive education, but there are still challenges in implementing it in the classroom. Secondly, the self-efficacy of physical education, sports, and health teachers shows that the level of teacher self-efficacy is positively correlated with their ability to implement inclusive teaching methods. Teachers who feel confident tend to be more innovative and flexible in teaching. Thirdly, the obstacles faced by some teachers include the lack of special training on inclusive education, limited resources, and lack of support from the school. Fourth, the teaching strategies teachers use are diverse, or they use various strategies to meet student needs, such as adapting physical activities and using assistive devices. Fourthly, the teaching strategies teachers use are diverse and include various strategies to meet student needs, such as adapting physical activities and using assistive devices.

Moreover, these strategies enrich the learning experience for all students. Based on the data collected, several indicators were produced: (1) teacher background, (2) understanding of inclusion, (3) inclusive learning planning, (4) implementation of inclusive learning, (5) inclusive learning methods, and (6) impact of inclusive learning.

The educational background of the physical education, sports, and health teachers at Inclusive Elementary Schools is, on average, that of graduates of Strata 1 Sports Education and Strata 1 Sports Coaching Education. Some have graduated from Strata 2. The teaching experience of all teachers has been more than 2 years, and in general, they are the only physical education, sports, and health teachers who teach at the school.

DISCUSSION

Implementing inclusive learning in elementary schools involves several important aspects so that all students, including those with special needs, can learn well. Inclusive learning methods in inclusive elementary

schools aim to meet the needs of all students, including those with special needs. Here are some of these impacts: 1) improved social skills: students learn to interact with different peers, which increases empathy and tolerance; 2) developed academic skills: diverse teaching methods can help all students, including those with learning disabilities; 3) increased self-esteem: students with special needs often feel more accepted and valued, which increases their self-confidence; 4) welcoming learning environment: inclusive learning creates a more supportive and collaborative atmosphere in the classroom; 5) increased awareness and understanding: all students, teachers, and parents become more aware of diversity and inclusion; and 6) preparation for life in society: students learn to work together in a diverse environment, preparing them for life on the broader society. By implementing the principles of inclusion, schools can create a better environment for all students, encouraging positive growth and development.

CONCLUSION

The conclusion of the results of this study includes several key points: 1) the role of teachers on self-efficacy dramatically influences the effectiveness of learning, especially in the context of inclusive education where various student needs must be met; 2) challenges and strategies: teachers face various challenges, such as differences in student abilities and lack of facilities. However, they use various strategies to overcome these obstacles; 3) the importance of training: continuous training is essential to improve teachers' abilities and confidence in teaching students with special needs; 4) positive impacts: exemplary implementation of physical education, sports, and health can improve students' physical and social skills, as well as build self-confidence and inclusion among students with different backgrounds. Therefore, this article emphasizes the importance of support and professional development for physical education, sports, and health teachers in improving the quality of inclusive education in elementary schools.

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This research has met the standards of research ethics and has received approval to be a sample of all respondents.

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Trends of Water Sports in Tourism Research Publications: Bibliometric Analysis

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ABSTRACT

Background. Bibliometric analysis study of published water sports research subjects in tourism, where water sports are becoming a new trend in tourist attractions. **Objectives.** to see the trend of the number of publications, journal publications, network visualization, overlay visualization, and density visualization. **Methods.** This study is based on an Internet search using the Dimensions application with VOSviewer software, version 1.6.20. The flowchart is used as a reporting item for systematic observation and meta-analysis (PRISMA), with stage 1 (identification), stage 2 (screening), stage 3 (study eligibility), and Scopus database taken from 2014 to 2023. **Results.** Publications on water sports in tourism increase every year, and then network visualization emerges from the research domain, namely water sports related to adventure tourism, but water sports are not related to tourism potential. Overlay visualization to see the trend of research titles related to water sports provides an analysis that yellow implies research trends. In addition, density visualization displays a visualization of weight and high-density levels seen around the yellow dots; on the other hand, low weight and density are around the blue dots, which means that the topic has still been used little in previous studies. **Conclusion.** From the results of the bibliometric analysis using these keywords, researchers can identify information regarding trends and innovations in future water sports research topics in the field of tourism.

KEYWORDS: *Water Sports, Tourism, Bibliometrics, Publication*

INTRODUCTION

Globally, tourism business has become a trend in sustainable development practices (1–3). Integration of sustainable practices in the tourism industry has become an important concern in recent years, driven by the increasing paradigm shift in awareness of tourism activities' environmental, social, and economic impacts (4). Sports tourism is a sports industry that makes water sports one of the attractions of tourism attractions, which aims to increase tourist interest in doing physical and recreational activities, so sports tourism is one way to develop sustainable tourism (5–9). Therefore, water sports attractions are an effective and attractive means to arouse tourist interest.

Sports and tourism are two things that combine different disciplines by creating a focus on new interests, where the relationship between sports and tourism shows that two things synergize and reciprocate. At present, there is no doubt that the increasing interest of tourists in sports tourism has become a socio-cultural phenomenon. Sports activities or events are the main reason for traveling (4). Systematic, structured, and

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massive evaluations must be carried out to reflect meta-analysis in tourism research on water sports. However, the analysis studies by other researchers previously differed significantly, that the results presented at different times were due to the lack of coherence in research related to water sports. Therefore, researchers want to review global sports tourism and its relationship to the accompanying fields.

MATERIALS AND METHODS

A research method by analyzing documents that allows researchers to filter words or phrases into content-related categories. Bibliometric analysis can compile ideas to describe and present visually and verbally between publications and identify research trends in a field. The data was obtained from publications on Scopus, which were extracted via the page <https://app.dimensions.ai/> and collected on September 14, 2024.

Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) method with the topic and keywords of water sports in tourism. The PRISMA method Stage 1 (Identification) section includes a box to record the number of records identified through the search of published databases in the data range from 2014 to 2023, and searching on the title and abstract with a total of 761,755 records detected that considered the term water sports. Stage 2 (screening) resulted in 750,172 records, and the publication type “article” was selected so that 20,852 records were excluded. Then, Stage 3 (included) resulted in a final sample of 7,917 articles. Next, this final sample was analyzed using VOSviewer to create and view bibliometric maps. VOSviewer visualizes research topics and cluster analysis to identify scientific trends based on related issues. The PRISMA flow diagram can be presented in Figure 1.

RESULTS

Main Information. Describes the bibliometric analysis on water sports in tourism extracted from <https://app.dimensions.ai/> in the range of years from 2014 to 2023. The results and discussion of the analysis of water sports in tourism are described, focusing on the number of publications, publication journals, network visualization, overlay visualization, and density visualization.

Number of publications. The search for scientific article publications on the topic of water sports in tourism from 2014 to 2023 resulted in 761,755, of which in 2015, the number was the most minor, namely 603 publications, and from 2018 to 2021, it increased from year to year exponentially, but in 2022 it decreased again with a lot of 1,576 publications. Thus, water sports are a topic of interest to research. Presented in Figure 2.

Publication Journals. The number of publications based on the keyword topic water sports in tourism that occupy the five most extensive journals can be grouped. The Journal Sustainability is ranked first based on journal sources containing the keyword water sports in tourism, with 721 articles. Thus, the most relevant journal coverage for the topic of water sports is sustainability, and this is presented in Figure 1.3.

Network visualization. VOSviewer provides a network visualization map for co-occurrence, with 154 items, 8 clusters, 2341 links, and a total link strength of 3214. Furthermore, the 154 items are grouped into 8 clusters consisting of cluster 1 (33 items), cluster 3 (22 items), cluster 6 (16 items), cluster 7 (10 items), cluster 8 (10 items). This is presented in Figure 1.4. Two terms connected by a line indicate they appear together in a title and abstract. Conversely, two terms not connected by a line indicate that they never appear together in a title and abstract (33). Water sports are related to adventure tourism but are not connected with potential tourism. Thus, there is a novelty for further research on water sports associated with potential tourism.

Overlay visualization. VOSviewer provides an overlay visualization map for co-occurrence to see the trend of research titles, with 154 terms providing analysis that the yellow color implies current research interest. Thus, the current research trend on water sports is the yellow term. For example, fishing, rafting, outdoor recreation, and economic benefits are presented in Figure 5.

Density visualization. In addition, VOSviewer displays a density visualization map for the co-occurrence of these 154 terms presented on the topic of water sports, showing the visualization of the level of research density. High-density items are seen around the yellow dots, meaning the topic has been widely used in previous studies, such as those on COVID-19. Conversely, low density is around the blue dots, meaning that the topic has rarely been used in previous studies, such as sports events, travelers, and international tourism. Thus, the following research topic is suggested to be a topic that has a low-density visualization category, which can be seen in Figure 6.

DISCUSSION

Water sports can also support economic development in coastal areas. The concept of water sports should be narrowed down to those who passively participate in all types of sporting events and become actual participants of the event; for researchers, bibliometric analysis helps in identifying emerging areas and future

directions of the research domain with the help of visualization tools in developing research directions as a step in sustainable development, bibliometric analysis can handle large amounts of unstructured data from scientific databases and provide factual and objective information in the form of metrics presented.

CONCLUSION

This paper provides a comprehensive bibliometric analysis of water sports in tourism publications registered in the Scopus database from 2014 to 2023. The publication rate of scientific articles shows significant development. The network visualization map for co-occurrence has 154 items, 8 clusters, 2341 links, and a total link strength of 3214. Overlay visualization to see the trend of research titles related to water sports in tourism with 154 terms provides an analysis of research trends. Furthermore, the density visualization map for co-occurrence shows the visualization of high-density research levels and low-density research, which is recommended as a topic with a low-density category density visualization. The analysis of water sports in tourism keywords of interest to research in this study provides insight into the development of publications since the paper was first registered in the Scopus database. However, this study has limitations where theoretical document information is only based on its title, and the Scopus database updates new publications occasionally. In addition, this bibliometric analysis only extracts scientific data from the Scopus research database. The future may include other databases for a broader understanding of information theory studies.

APPLICABLE REMARKS

- Research on the analysis of water sports in tourism is exciting because it provides information on the development of publications since the publication first appeared in the Scopus database.
- However, this study has some limitations because the information on the theoretical documents is only based on the title of the publication, and the Scopus database updates the publication from time to time.

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Sri Rizki Handayani contributed to the study design, data analysis, and writing the initial draft. Roni Andri Pramita assisted in data collection, analysis, and revising the manuscript. Waskito Aji Suryo Putro supported the data analysis and interpretation of results. Rustamadji contributed to the methodology, data collection, and manuscript revision. Satria Lintang Rachmadana was involved in data collection and provided feedback on the manuscript. Hayudi contributed to the design and analysis of the study and reviewed the manuscript. Aldilla Yulia Wiellys Sutikno assisted in data collection, analysis, and manuscript editing. Leo Pratama contributed to interpreting the results and critically revised the manuscript.

CONFLICT OF INTEREST

The authors mention no "Conflict of Interest" in this study.

ETHICAL CONSIDERATION

This research has met the standards of research ethics and has received approval to be a sample of all respondents.

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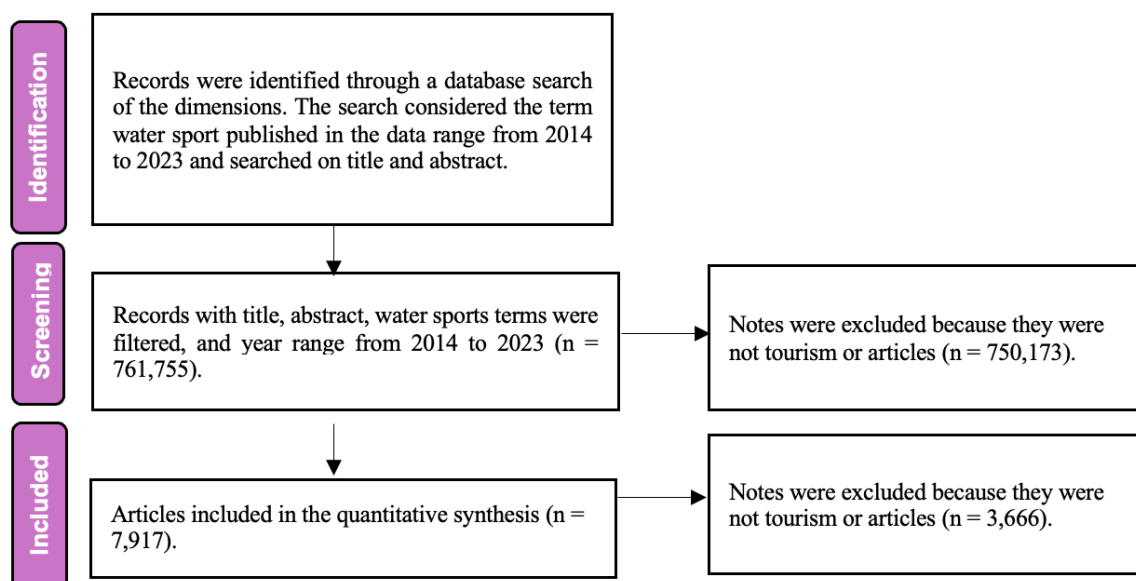
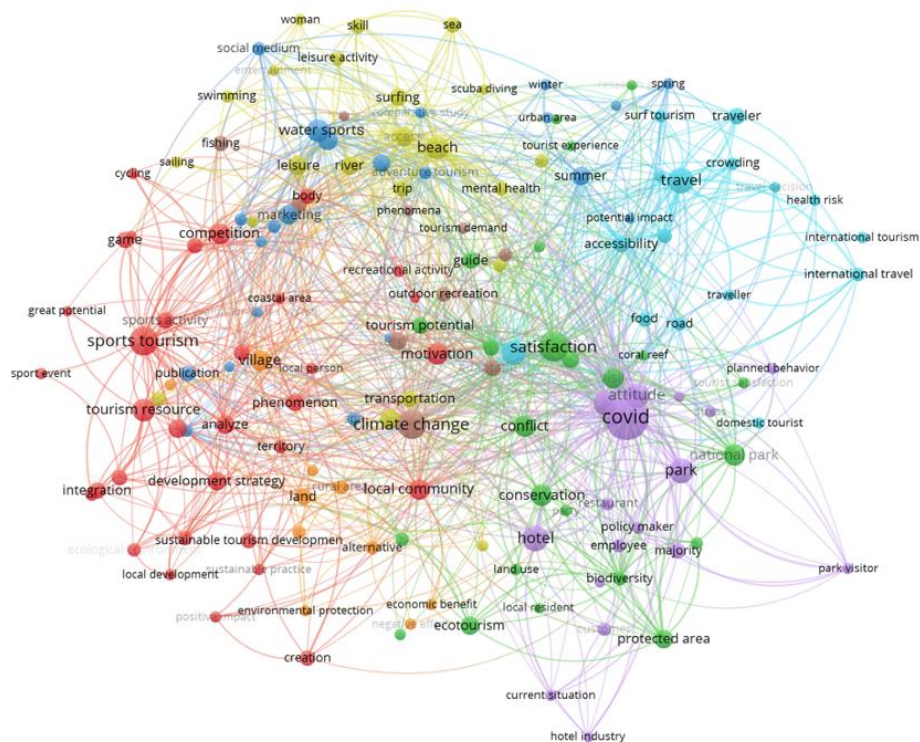
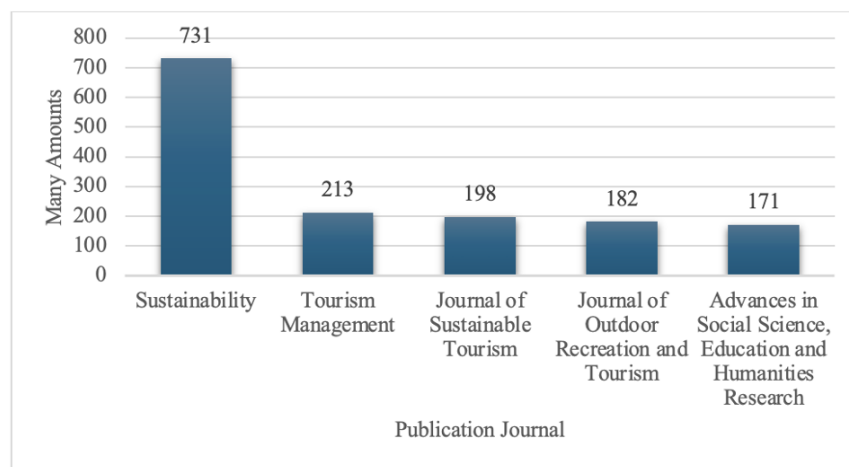
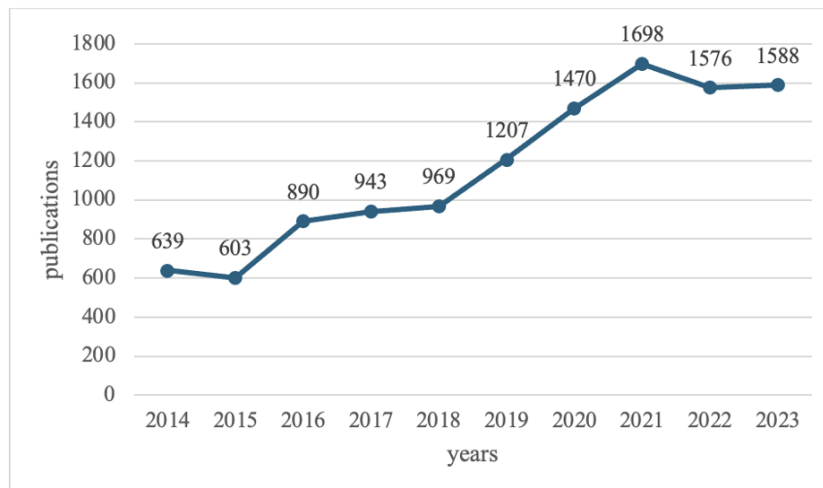


Figure 1. Diagram PRISMA flow



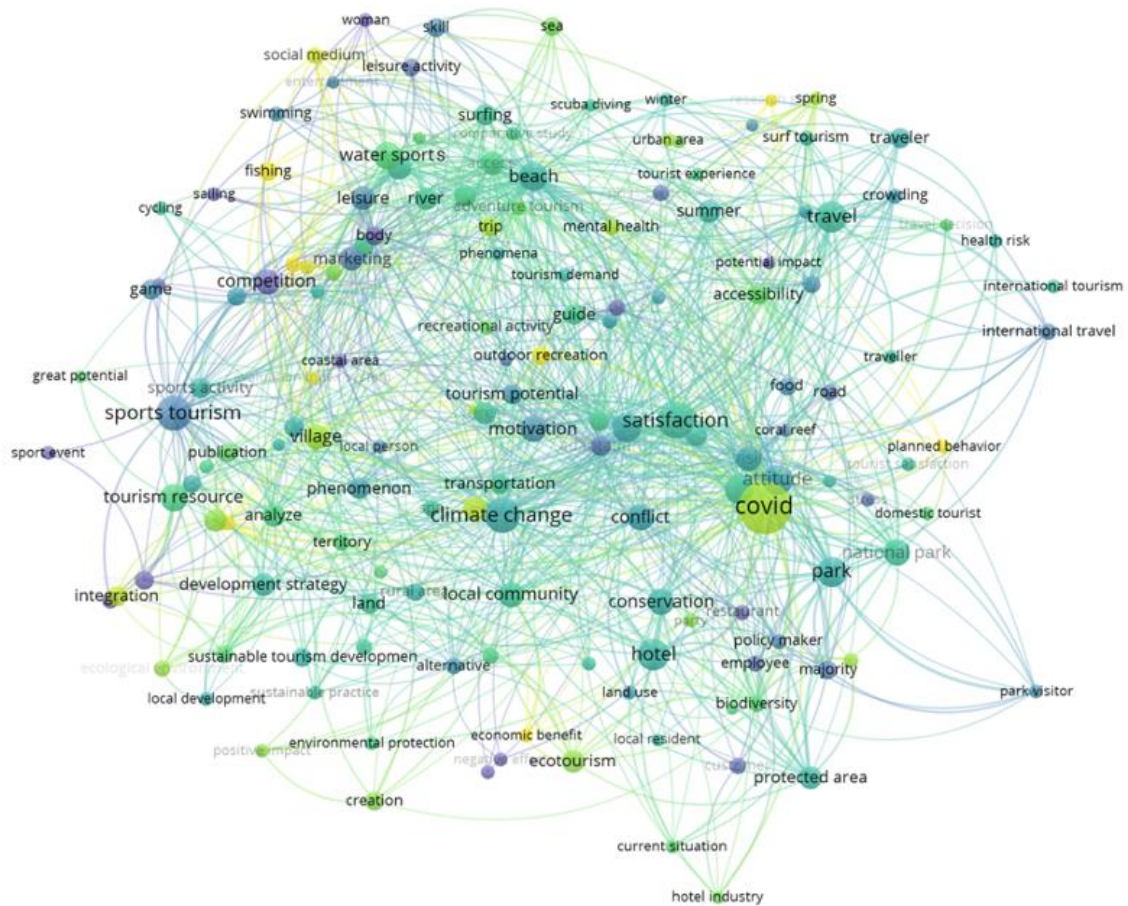


Figure 5. Overlay visualization of water sports in tourism

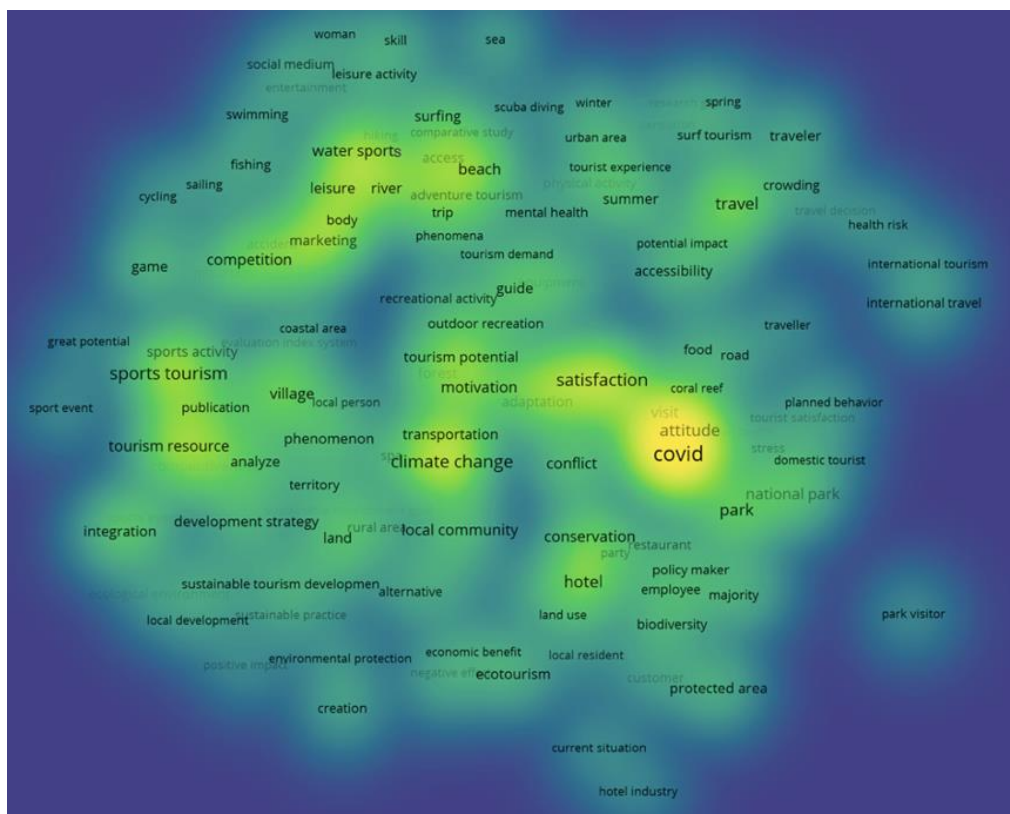


Figure 6. Density visualization on the Topic of water sports in tourism

The Role of Massage and Exercise Therapy as Manual Therapy in Patients with Patellar Tendinopathy: A Systematic Review

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ABSTRACT

Background. Patellar tendinopathy (PT) is a tendon injury that affects the patellar tendon and is characterized by pain during loading, localized just below the patella. **Objectives.** This study aims to analyze the most effective massage and exercise therapy treatments for patients with PT. It seeks to provide new insights into PT management by focusing on optimal therapeutic interventions through massage and exercise. **Methods.** A systematic review was conducted across several databases, including PubMed, Google Scholar, CINAHL, UpToDate, Cochrane Reviews, and SPORTDiscus. Fifteen studies meeting the inclusion criteria were selected: (1) investigation of experimental therapies for PT and (2) use of the Victorian Institute of Sports Assessment for the Patella (VISA-P) scale to measure symptom severity. The methodological quality of these studies was assessed using the Coleman Score, while Begg's and Egger's tests were applied to identify potential bias. **Results.** The 15 selected studies demonstrated high methodological quality per the Coleman Score, with no indication of significant bias. Improvements in symptom duration were noted based on VISA-P scores, with significant results ($P \leq 0.05$) reported for various treatment protocols. **Conclusion.** Eccentric training emerged as the most effective exercise therapy for PT; however, it is recommended to combine it with other therapies, such as progressive tendon exercises, which have demonstrated more significant effect sizes for PT management. Effective massage treatments for PT include (1) transverse friction massage, (2) fascial manipulation, and (3) deep friction massage, each contributing to recovery. Further research is warranted to explore the combined effects of massage and exercise therapy in enhancing recovery for PT patients.

KEYWORDS: *Massage, Exercise Therapy, Patellar Tendinopathy*

INTRODUCTION

The patellar tendon connects the lower part of the patella to the tibial tuberosity. The patella is classified as a large sesamoid bone, a type of bone connected by two tendons (1). Another example of a sesamoid bone is the pisiform carpal, situated between the tendons of the flexor carpi ulnaris. The patellar tendon originates from the lower end of the patella and attaches to the tibial tuberosity.

Patellar tendinopathy is an injury to the distal, inferior portion of the patellar tendon where it connects to the tibia (2). Pain in patellar tendinopathy is caused by micro-tears in the tendon, particularly during extension movements, due to the contraction of the quadriceps muscle (3). Knee flexion pain results from stretching the injured or torn tendon, and patellar tendinopathy is strongly associated with sports involving frequent jumping movements. Excessive patellar tendon loading, especially in activities requiring forceful knee extension, can

exacerbate this condition.

Recent systematic reviews indicate that patellar tendinopathy, often termed "jumper's knee," affects approximately 12% of elite athletes across various sports, with the prevalence reaching about 40% among volleyball and basketball play (4). This rate contrasts with tendinopathy of the lateral forearm extensor muscles, which affects 1% to 3% of the general population and 9% to 35% of tennis players (2).

Primary causes of patellar tendinopathy include (1) overuse, particularly with running or jumping on hard surfaces in sports such as basketball and volleyball; (2) inadequate warm-up, leading to overstretching of the quadriceps and tendon strain; (3) misalignment in the pelvis, knee, or ankle; (4) frequent impact or repetitive strain; (5) rapid increases in training intensity and frequency; (6) low thigh strength; and (7) improper knee positioning, such as patellar misalignment that places additional strain on the tendon (5). Massage therapy is recognized as a beneficial intervention in patellar tendinopathy rehabilitation.

Massage is a scientifically based therapeutic intervention that systematically manipulates the skin and underlying tissues (6). Additionally, it offers therapeutic benefits such as improved blood flow, joint realignment, reflexology, and relaxation, all of which support healing by reducing muscle tension, enhancing flexibility, and increasing strength (7).

Recommended exercises for rehabilitating patellar tendinopathy include (1) performing thorough warm-ups before exercise, (2) straight leg raises with gradual weight increases, (3) "out-straight" leg exercises, (4) lifting the leg straight off the ground, and (5) performing wall sits using a ball. These exercises strengthen surrounding muscles and improve tendon resilience, supporting an effective recovery. It is essential to recognize that knee conditions similar to patellar tendinopathy, such as Larsen-Johansson disease, fat pad inflammation, and Osgood-Schlatter disease, can complicate diagnosis, making accurate identification critical. Given the prolonged rehabilitation required for this injury, optimal recovery may take several weeks to months. Patellar tendinitis is a primary precursor to patellar tendon rupture, underscoring the importance of appropriate exercise interventions to prevent tendon rupture.

Given these theoretical considerations and findings, a detailed examination of therapeutic interventions for patellar tendinopathy, including massage therapy and rehabilitative exercise, is essential. Additionally, a review of current exercise recommendations for effective recovery is warranted.

MATERIALS AND METHODS

This systematic review followed the PRISMA QUORUM guidelines to standardize the selection and analysis of manuscripts. The primary search was conducted in the PubMed database (from 1985 to June 20, 2021) using an advanced search with the terms "patellar tendon" AND "tendonitis" OR "tendinopathy" AND "massage" AND "exercise therapy" (see Figure 1). Additional systematic searches were performed in CINAHL, UpToDate, Google Scholar, Cochrane Reviews, and SPORTDiscus. Titles and abstracts were screened according to predefined inclusion criteria.

Following a search strategy involving medical subject headings (MeSH) in Medline and subsequent review using SPORTDiscus, Scopus, and Google Scholar, nine studies met the inclusion criteria and were selected for this review.

This review evaluated treatment outcomes using the VISA-P questionnaire, a validated and reliable instrument for measuring symptom changes, assessing treatment efficacy, and determining treatment success. The VISA-P questionnaire effectively identifies symptoms, evaluates functional movement, and assesses the ability to return to individual sports activities. VISA-P scores range from 0 to 100, with each version language validated by the respective authors.

RESULTS

Table 1 includes the studies on the role of massage and exercise therapy as manual therapy in patients with patellar tendinopathy.

DISCUSSIONS

The studies by Kushartanti and Ambardini and Chaves et al. (8,10) evaluate various massage techniques, including deep tissue massage (DTM) and soft tissue massage, for managing chronic ankle injuries and patellar tendinopathy. Results indicate that DTM significantly reduces pain, whereas soft tissue massage improves ankle function, suggesting that each technique is complementary in injury management. Further investigation by Chaves et al. (10) into deep friction massage (DFM) demonstrated that applying a pressure of 1.12 ± 0.37 kg/cm² to the patellar tendon can induce macroscopic deformation, supporting DFM's role in tissue mobilization and regeneration, which is relevant in rehabilitation settings.

Systematic reviews by Joseph et al. (15) assess invasive and non-invasive tendinopathy treatments. Joseph

et al. (15) highlight the need for randomized comparative studies to evaluate the efficacy of deep friction massage.

Additionally, conservative treatments such as eccentric exercises and shockwave therapy are recommended, with surgery reserved as a secondary option for resistant cases. These reviews consolidate effective treatment strategies and highlight the need for further research on comparative treatment effectiveness. A study by Breda et al. (3) compared progressive tendon-loading exercises (PTLE) with eccentric exercise therapy (EET), finding PTLE to be a more effective intervention for enhancing sports performance and patient satisfaction among individuals with patellar tendinopathy.

Similarly, it advocates eccentric squat-based therapy and other progressive exercise interventions as effective strategies in PT rehabilitation, emphasizing the critical role of targeted exercises in promoting tendon health and supporting recovery from injury.

CONCLUSION

An integrated, multi-dimensional approach—including physical, psychological, and methodological considerations—is essential for effectively managing and rehabilitating tendinopathy and chronic injuries. Eccentric training emerges as the most effective exercise for treating patellar tendinopathy (PT); however, it should ideally be combined with other therapeutic approaches. For example, progressive tendon exercises have demonstrated greater effectiveness when applied to patients with PT. Massage therapies for PT include (1) transverse friction massage, (2) fascial manipulation, and (3) deep friction massage, all of which can facilitate PT recovery.

Consequently, further research is necessary to investigate the benefits of combining massage techniques with exercise therapy to enhance recovery outcomes in PT patients.

APPLICABLE REMARKS

- This study offers valuable guidance for future research on treatment options for patellar tendinopathy, emphasizing both massage techniques and exercise interventions in patient recovery.

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AUTHORS' CONTRIBUTIONS

Study concept and design: Muhamad Sazeli Rifki and Ilham. Data acquisition: Donal Syafrianto. Data analysis and interpretation: Bekir Erhan Orhan. Manuscript drafting: Ilham and Vlad Adrian Geantă.

CONFLICT OF INTEREST

The authors mention no “Conflict of Interest” in this study.

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ARTIFICIAL INTELLIGENCE (AI) USE

There was NO use of artificial intelligence (AI) for preparation, writing, or editing this manuscript.

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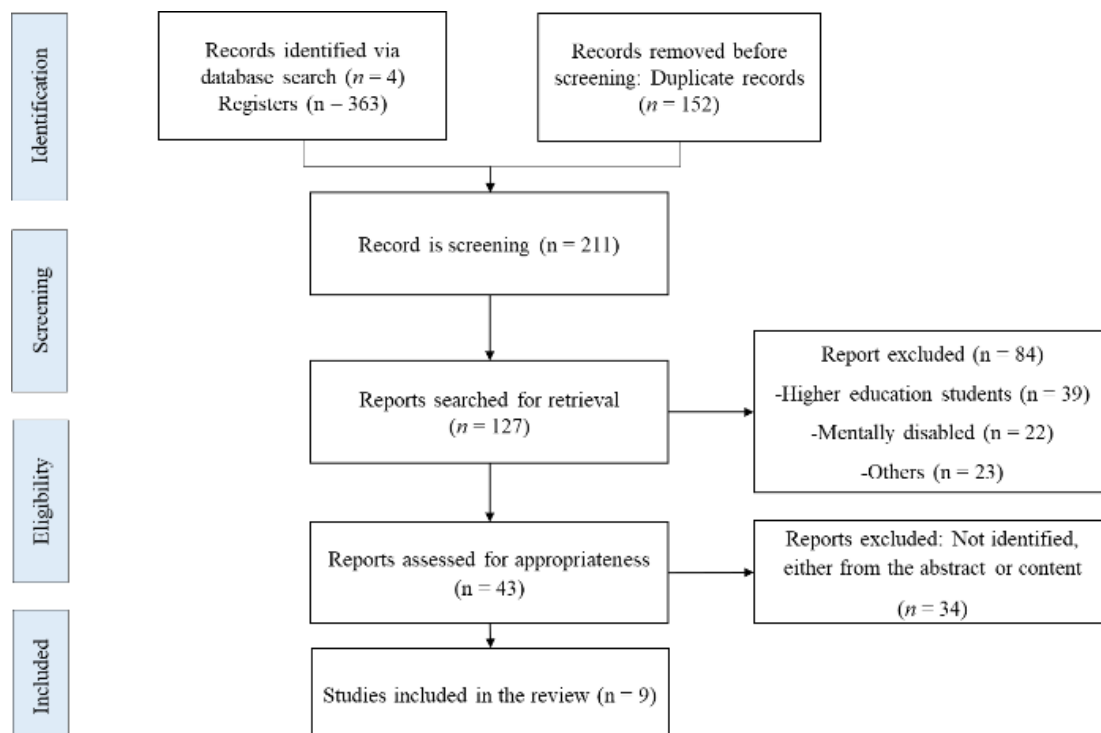


Figure 1. PRISMA flowchart of the article selection process

Table 1. The studies on the role of massage and exercise therapy as manual therapy in patients with patellar tendinopathy

Authors' Name	Title	Material and Methods	Results
(8) Kushartanti & Ambardini	Deep Tissue Massage and Soft Tissue Release in The management of Chronic Ankle Injury	Experimental design with 40 participants (20 men, 20 women) with chronic ankle injuries. Pain was assessed pre- and post-treatment using the Visual Analog Scale (VAS); ankle function was assessed using the Adapted Foot and Ankle Ability Measure (FAAM). The treatment duration was seven weeks.	Deep tissue massage reduced pain in chronic ankle injuries, while soft tissue release improved ankle function recovery.
(9) A. de Vries et al.	Effect of Patellar Strap and Sports Tape on Pain in Patellar Tendinopathy: A Randomized Controlled Trial	Randomized controlled trial with 97 athletes with patellar tendinopathy (61% male; mean age = 27.0 years; mean VISA-P score = 58.5). The control group received no treatment. Pain levels were measured with VAS.	Orthosis, including placebo tape, reduced pain in PT during sports in the short term. Significant VAS pain reduction in sports tape (7 mm, $P = 0.04$) and placebo group (6 mm, $P = 0.04$); VAS score two hours post-sport dropped significantly in patellar strap, sports tape, and placebo groups.
(10) Chaves et al.	Deep Friction Massage and the Minimum Skin Pressure Required to Promote a Macroscopic Deformation of the Patellar Tendon	Descriptive laboratory study with 18 participants. The pressure was applied to the skin over the patellar tendon with an ultrasound probe; the statistical significance level was set at $\alpha = 0.05$.	The average pressure required for patellar tendon deformation was $1.12 \pm 0.37 \text{ kg/cm}^2$ —no significant relationship with participant characteristics.
(3) Breda et al.	Effectiveness of progressive tendon-loading exercise therapy in patients with patellar tendinopathy: a randomized clinical trial	A randomized controlled trial with 76 participants diagnosed with PT was randomized to either progressive tendon-loading exercise (PTLE) or eccentric exercise therapy (EET). Outcomes were measured after 24 weeks using the VISA-P scale.	PTLE showed more remarkable improvement than EET, suggesting PTLE is an effective treatment for PT. The study noted that additional exercises may enhance muscle strength and joint function.
(11) Slagers et al.	Psychological factors during rehabilitation of patients with Achilles or patellar tendinopathy: a cross-sectional study	Cross-sectional study using an online survey. Participants: 119 patients (mean age = 44 years) with Achilles or patellar tendinopathy. Psychological factors were analyzed through multivariate regression, controlling for confounders.	Psychological impairments were associated with severity and recovery in tendinopathy. Psychological readiness, kinesiphobia, and catastrophizing thoughts correlated with function and participation outcomes.
(12) Ardern et al	A systematic review of the psychological factors associated with returning to sport following injury	A systematic review of quantitative studies from earliest entries to March 2012, including athletes with injuries, return-to-sport rates, and at least one psychological variable. The risk of bias was assessed with a quality checklist.	Self-determination theory factors—autonomy, competence, and relatedness—were linked to return-to-sport rates. Motivation, confidence, and low fear were positively associated with a faster return to preinjury levels.
(13) (de Vries, A, et al)	The impact of patellar tendinopathy on sports and work performance in active athletes	Randomized controlled trial with 77 active athletes with PT (50 men; mean age = 28.1 years; mean VISA-P score = 56.4). Measured with Work Ability Index and Quantity and Quality questionnaire.	55% reported decreased sports performance, 16% noted reduced work capacity, and 36% indicated lower productivity. The study highlights the significant impact of PT on sports and work, emphasizing the need for preventive strategies.
(14) Sprague et al.	Pain-guided activity modification during treatment for patellar tendinopathy: a feasibility and pilot randomized clinical trial	Unblinded, two-arm randomized pilot study in Newark, DE. Participants (ages 16–40) with PT were assigned to pain-guided (PGA) or pain-free (PFA) activity groups, following a modified heavy-slow resistance protocol. Outcomes included compliance, retention, and clinical assessments at baseline, 6, and 12 weeks. Function and quadriceps muscle performance	In a ~ 13-month period, 108 individuals were screened, 47/108 (43.5%) were eligible for participation, and 15/47 (32.0%) of those were enrolled (9 PGA, 6 PFA). The recruitment rate was 1.15 participants/month. The mean $\pm$ SD compliance with treatment was PGA: $86.1 \pm 13.0\%$ and PFA: $67.1 \pm 30.7\%$. There was one missed evaluation session and two adverse events, which were not due to study interventions. Changes exceeding the most minor detectable change were observed for at least one outcome in each domain of tendon health.
(9) (de Vries, A, et al)	Effect of patellar strap and sports tape on pain in patellar tendinopathy: A randomized controlled trial	Randomized controlled trial with 97 athletes with PT (61% male, mean age = 27.0 years, mean VISA-P score = 58.5). The control group received no treatment. Pain was assessed using VAS.	Significant VAS pain reduction in the patellar strap group (14 mm, $P = 0.04$) and sports tape group (13 mm, $P = 0.04$) during the single-leg decline squat test compared to control. VAS pain reduction was also noted post-sport in the orthosis and placebo groups.

The Psychological Aspects and Swimming Performance: A Systematic Literature Review

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ABSTRACT

Background. Mental obstacles affect athletes' competition anxiety and attention. Stress elimination, mental toughness, and peer support increase athletes' confidence and performance. **Objectives.** This study reviewed numerous research investigations on psychological aspects determining swimming performance. **Methods.** In order to do a systematic literature review, this study collected and analyzed research data from scientific publications on psychological aspects associated with swimming ability. In order to find trends in the psychological elements related to swimming, the gathered data underwent descriptive analysis. **Results.** Behavioral variables are essential to athletic success since preperformance activities increase swimmers' control of emotion but not motor efficiency or self-efficacy. Because teenage athletes suffer from anxiety, sports psychologists are needed. Resilience motivates Paralympic athletes, and personality factors predict performance in individual sports. Elite swimmers encounter rivalry anxiety and team psychologically in a coordinated manner. **Conclusion.** Emotional management and pre-performance workouts might enhance athletes' psychological preparation for competition. Youth athletes can overcome stress and anxiety with sports psychologists, and resilience training may inspire Paralympic players. Addressing competitive nervousness and personalizing training can improve performance.

KEYWORDS: *Psychological Factors, Swimming Performance, Mental Resilience, Cognitive Skills, Stress Management*

INTRODUCTION

Coping with psychological factors like stress, anxiety, and resilience in athletes, along with social support systems, plays an important role in the overall performance of competitive swimmers and affects their physiological responses to swim training. Research indicates that off-season low stress is related to peak performance, whereas competitive season high stress is linked with slow swim speeds and increased tension (1). Moreover, increased cognitive and somatic anxiety can severely influence heart rate variability (HRV), subsequently affecting autonomic nervous system activity and performance. Various psychological interventions targeting anxiety have been demonstrated to enhance HRV, possibly benefiting performance(2). Resiliency is an important moderator of stress and performance, such that greater levels of resilience are enhanced. In addition to resilience as a modulator of the cortisol awakening response (3).

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It found that sport devaluation (the belief that one's sport is not very important), self-perceived performance accomplishments, stress in general, and emotional exhaustion were the most significant, with psychological factors influencing performance declining overtime during the competitive season. These factors also emphasize their important influence on athletes regarding psychological well-being and performance (4). The athlete's performance was also associated with their emotional state (5). This study aims to generate a systematic literature review on psychological factors and swimming performance.

MATERIALS AND METHODS

The method used in this study is a systematic literature study that collects and analyzes various scientific sources. The data collection process is done by searching for articles from Scopus and PubMed. The search string used for both databases was "Swimming" AND "psychological intervention" OR "Sport psychology" OR "Mental toughness in swimming" OR "Visualization in swimming" OR "Athlete mental preparation," which includes original article published in the last five years, studies evaluating the effects of psychological intervention on enhancing swimmer performance. After collection, articles that met those criteria were analyzed descriptively to identify consistent patterns and findings regarding improving swimming performance in psychological intervention. Figure 1 illustrates the article selection process employed in this study.

RESULTS

Table 1 presents a critical appraisal analysis of six selected journals.

DISCUSSION

Psychological and medical factors affect swimmer performance. This analysis underlines mental toughness, stress management, and relaxation as crucial to competitive performance. Swimming demands psychological resilience to handle intensive competition and instruction, manage performance anxiety, and remain focused using graphical representation, constructive self-talk, and meditation (12). Increased mental and physical stress diminishes swimming and how they perform, corresponding to study. Performance can be maximized by managing emotions and feelings of stress since low stress promotes anaerobic performance, and high sympathetic modulation improves aerobic performance (13).

Relaxation, adequate rest, and control of emotions help athletes recover and perform well. A two-week taper boosts contentment and swimming performance, as demonstrated by studies (14). psychology also affects swimming performance, demonstrated by a 34% rise in mental behavior when using the Cohen & Williamson Test and a 37.5% increase on the Cohen Perceived Stress Test, focusing on the importance of mental adaptation in training (15).

CONCLUSION

This research project examines the psychological aspects of sports accomplishment. A pre-performance practice in swimmers boosted emotional regulation but not motor effectiveness or self-efficacy. Sports psychologists believe anxiety impairs youth-performing athletes. Paralympic other companies were motivated by resilience, but personality affected performance. Elite swimmers needed help with competition anxiety and psychological synchronization in team success.

APPLICABLE REMARKS

- Implement emotional control and pre-performance routines to improve athletes' focus and stress reduction throughout training.
- Implement sports psychology specialists into youth empowerment initiatives to address problems with behavior like anxiety.
- Modification training should be used for Paralympic athletes to encourage participation and reduce performance anxiety among professional swimmers.

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AUTHORS' CONTRIBUTIONS

Study concept and design: Eval Edmizal, Jeki Haryanto. Acquisition of data: Jeki Haryanto. Analysis and interpretation of data: Eval Edmizal. Drafting the manuscript: Jeki Haryanto. Critical revision of the manuscript for important intellectual content: Bekir Erhan Orhan. Statistical analysis: Vlad Adrian Geanta.

Administrative, technical, and material support: Japhet Ndayisenga. Study supervision: Eval Edmizal, Jeki Haryanto

CONFLICT OF INTEREST

The authors mention no "Conflict of Interest" in this study.

ETHICAL CONSIDERATION

This review adheres to ethical standards by including only studies that were ethically approved and publicly accessible. All information from previously published research adhered to relevant ethical guidelines was synthesized.

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ROLE OF THE SPONSOR

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The authors have no financial interests related to the material in the manuscript.

ARTIFICIAL INTELLIGENCE (AI) USE

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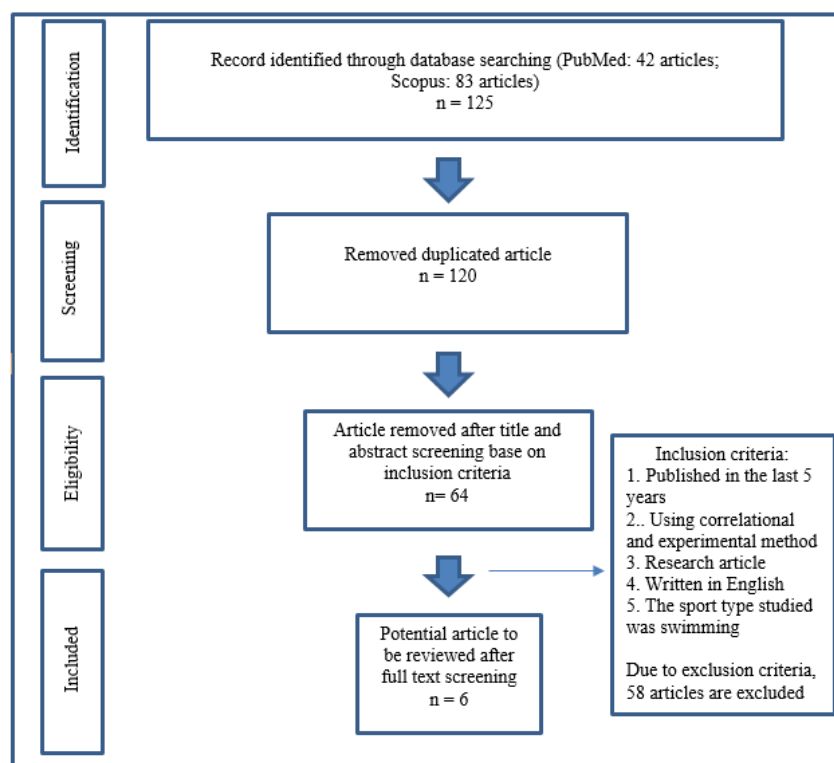


Figure 1. PRISMA flowchart of the article selection process

Table 1. Literature Review Summary of Results

Researchers	Article Title	Research Results
(6)	Effect of preperformance Routine on Advanced Swimmers' performance and motor Efficiency, self-efficacy, and idiosyncratic Emotions	A systematic preperformance routine (PPR) was tested on advanced swimmers' speed, motor efficiency, self-efficacy, and emotional regulation. Though it did not increase speed, motor efficiency, or self-efficacy, the organized PPR did improve emotional regulation, making it useful for emotional preparation before competition.
(7)	Psychological Barriers to Young Athletes and the Importance of Sports psychologist in Youth Sports	The study found that competition anxiety, worry, and self-doubt can cause young athletes to quit or suffer performance-disrupting injuries. It emphasizes the need to include sports psychology in youth sports development programs since sports psychologists help youth athletes overcome these problems.
(8)	1. The role of resilience on motivation among Brazilian athletics and swimming parathletes	Resilience positively connects with Paralympic competitors' autonomy and regulated motivation due to external, introjected, recognizable, integrated, and internal norms. Path analysis revealed that resilience moderately influenced internal, introjected, and external incentives, explaining 16%, 11%, and 11% of motivational regulations.
(9)	2. Personality profile of individual sports champions	According to the study, champion swimmers demonstrate decreased neuroticism and increased extroversion, pleasantness, and conscientiousness. These findings suggest that sports-shaped personality factors may affect individual sports success.
(10)	3. Creative Togetherness. A Joint-Methods Analysis of Collaborative Artistic Performance	This study suggested that team members alternate between being connected and disconnected in innovative communication. Swimmers and external evaluators recognize these as connected variations because they might influence steady joint performances.
(11)	4. The influence of competitive anxiety on Chinese elite swimmers 5.	Although intellectual and psychological strain did not enhance the top swimming' performance during preparation, confidence did. Competitive anxiety treatment could enhance training performance.

The Impact of Training Methods and Coordination on Dribbling Skills: A Case Study of the Football Club

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ABSTRACT

Background. Many players at the football club of Universitas Negeri Padang struggle with dribbling skills. Practical training methods, including drill exercises, small-sided games (SSG), and coordination, may influence skill development. **Objectives.** This study aimed to (1) compare dribbling skills between drill and SSG methods, (2) assess the impact of low vs. high coordination, and (3) explore the interaction between training methods and coordination. **Methods.** A quasi-experimental design was used with 32 participants (9-12) from the university's football club. The TGMD test measured coordination and a dribbling performance test was used. Data were analyzed using a 2x2 factorial ANOVA. **Results.** The study found significant differences in dribbling skills between drill and SSG methods ($p < 0.05$), as well as between low and high coordination groups ($p < 0.05$). Players with high coordination trained with SSG performed better than those trained with drills. **Conclusion.** SSG was more effective than drills in improving dribbling skills, particularly for players with lower coordination.

KEYWORDS: *Training Method, Coordination, Dribbling Skills, Football*

INTRODUCTION

Basic technical skills, such as dribbling, are fundamental abilities every football player must possess to compete effectively in matches (1). One of the primary goals in football is to score as many goals as possible against the opponent's goal, and players with strong technical skills will be better equipped to help their team achieve this goal (2). Players will struggle to defend well or score goals without adequate technical skills. Every player must continually develop key skills: passing, dribbling, shooting, and heading.

Dribbling is a critical skill in football, allowing players to control the ball, create space, and bypass opponents (3). Additionally, football performance is influenced by various physical factors such as speed, endurance, agility, coordination, strength, and balance, as well as perceptual and cognitive skills (4). One important aspect of developing technical skills is movement coordination, which refers to performing motor tasks efficiently and quickly. Low coordination can hinder the development of motor skills and may affect a child's academic performance, participation in physical activities, and social interactions (5).

In addition to mastering basic technical skills and physical conditioning, applying effective and efficient training methods tailored to the players' characteristics is crucial. Using outdated or unsuitable training methods can impact player progress (6). Two approaches are often applied among the various training methods commonly used: drill methods and small-sided games (SSG). Drill methods are typically used to enhance skills

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through repetitive practice, while small-sided games provide a fun, game-like environment that simulates real match situations, allowing players to develop technical, tactical, and physical aspects simultaneously.

MATERIALS AND METHODS

This study examines the impact of training strategies and coordination abilities on dribbling skills, focusing on football players at Universitas Negeri Padang. In the implementation of the study, the sample was divided into four groups based on their coordination abilities and the type of training strategy applied: 1) High Movement Coordination with SSG Training Strategy (A1B1, n=8), 2) High Movement Coordination with Drill Training Strategy (A2B1, n=8), 3) Low Movement Coordination with SSG Training Strategy (A2B1, n=8), and 4) Low Movement Coordination with Drill Training Strategy (A2B2, n=8). The study aimed to investigate how different levels of coordination, combined with different training methods (SSG vs. drills), influence the development of dribbling skills. The findings highlight the crucial role of coordination abilities and the type of training method in enhancing dribbling performance, providing valuable insights for improving training strategies at the Universitas Negeri Medan football club.

RESULTS

The results of this research show the influence of training strategies and coordination abilities on the dribbling skills of the University Club. In its implementation, this study divided the sample into four groups consisting of: high movement coordination ssg training strategy group (A1B1, n=8), high movement coordination drill training strategy group (A2B1, n=8), movement coordination ssg training strategy group low (A2B1, n=8), low motor coordination drill training strategy group (A2B2, n=8). Below is a summary of the research data researchers conducted (Table 1). The researcher also provides a synopsis of the study hypothesis test (Table 2).

DISCUSSION

The research indicates that small-sided games (SSG) and drill training methods impact dribbling skills, but their effectiveness can vary depending on a player's coordination ability. Dribbling is a fundamental technique in football, involving using the foot to move the ball and navigate the pitch. A player's proficiency in dribbling allows them to control the ball, evade opponents, and create space. Performance in football relies on a combination of technical, tactical, and physiological factors (7). Effective training programs must address these aspects, emphasizing developing technical skills like dribbling (8).

Good coordination is crucial for mastering dribbling techniques, and players with higher coordination generally perform better in complex tasks. Coordination involves the ability to execute movements efficiently and is linked to future success in sports. Small-sided games provide both technical and physiological training stimuli, helping young players improve their dribbling and tactical awareness. However, for children with low coordination, drill-based training, which emphasizes repetition and refinement of specific skills, may be more effective in improving dribbling technique.

APPLICABLE REMARKS

- This study suggests that coaches at Universitas Negeri Padang should tailor training methods based on players' coordination levels.
- Small-sided games (SSG) are effective for high-coordination players, while drill-based exercises are better for those with low coordination. A balanced approach can optimize dribbling skills and overall player development.

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AUTHORS' CONTRIBUTIONS

Andre Igoresky contributed to the research concept, methodology, data curation, and writing of the initial draft of the article. Andre Igoresky focuses on research concepts, data analysis, and article writing and revision. Nugroho Susanto also contributed to developing methodologies, formal analysis, and validation of research results. Yogi Andria conducts data collection, investigation, and initial draft writing. Indri Wulandari is responsible for data analysis, visualization, and article revision. Aldo Naza Putra plays a role in methodology,

software development, and validation. Mardepi Saputra is involved in initial drafting, data curation, and software development. Mario Febrian leads project administration, supervision, and article writing and revision. Andre Igoresky contributed to the concept of research, supervision, and article writing and revision.

CONFLICT OF INTEREST

The authors mention no "Conflict of Interest" in this study.

ETHICAL CONSIDERATION

This research has met the standards of research ethics and has received approval to be a sample of all respondents.

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No institution, organization, or person supported this study. **ROLE OF THE SPONSOR** The funding organizations are public institutions and have no role in the design and conduct of the study, collection, management, and analysis of the data or preparation, review, and approval of the manuscript.

FINANCIAL DISCLOSURE

The authors have no financial interests related to the material in the manuscript.

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Table 1. Data summary on the dribbling technical skills and motor coordination

Group	Dribbling mean ± SD	Motor Coordination mean ± SD
A1B1	20.33 ± 1.77	12.23 ± 1.74
A2B1	25.86 ± 1.77	11.15 ± 1.14
A1B2	22.21 ± 1.29	12.73 ± 1.29
A2B2	20.39 ± 1.79	12.35 ± 1.24

Table 2. An overview of the study's findings

Group	Qvalue	Qtable
A1 > A2	6.97	3.88
B1 > B2	6.13	
A1B1 > A2B1	14.87	
A2B2 > A1B2	6.77	

Needs Analysis for a Character Education Management Model Based on Teams Games Tournament (TGT) in Volleyball Learning at MTsN Padang

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ABSTRACT

Background. of the problem of this research reveals several issues related to the needs analysis for a character education management model based on Team Games Tournaments (TGT) in volleyball learning. **Objectives.** (1) The teachers' developed learning model lacks variation, thus needing a character education management model based on Team Games Tournaments (TGT) to shape students' character. (2) Currently, teaching-learning materials are inadequate in helping students construct their knowledge. (3) Students tend to be passive in their learning and have not constructed their knowledge. (4) Physical education teachers use teaching-learning materials developed without specific models or strategies. (5) There is still limited Development of models and teaching-learning materials. **Methods.** Development research or R&D is used. This study employs two techniques: qualitative descriptive analysis and quantitative descriptive analysis. Qualitative data consists of descriptions from teacher and student response questionnaires. The instruments used in this study include observation results and questionnaires. Experts from Universitas Negeri Padang validated the questionnaires, and supervisors and promoters provided guidance. Based on the validation results from the validators, the questionnaire is deemed suitable for use, with several suggestions for improvement. **Results.** of the teacher response questionnaire on the needs analysis for the character education management model based on Team Games Tournaments (TGT) in volleyball learning at MTsN Padang scored 89.40, qualifying as strongly agree for Development. **Conclusions.** The overall results of the student response questionnaire on the character education management model based on Team Games Tournaments (TGT) in volleyball learning at MTsN Padang scored 86.65, and they also qualified as strongly agree. Therefore, it can be concluded that the response results indicate support for the character education management model based on Team Games Tournaments (TGT) in volleyball learning at MTsN Padang.

KEYWORDS: *Character Education Management Model, Team Games Tournament (TGT), Volleyball*

INTRODUCTION

Education fosters the Development of emotional and social intelligence, helping students manage emotions, empathize, and communicate effectively. In contrast, character education, which instills values, ethics, and morals, plays a crucial role in preparing students to make wise decisions and embody positive behaviors, with teachers playing a key role in managing and nurturing students' character development in cognitive, affective, and psychomotor domains (1,2).

The character education management model based on Team Games Tournaments (TGT) in volleyball learning at MTsN Padang is designed to enhance students' volleyball skills and instill essential character

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values, such as responsibility, teamwork, and discipline, by integrating cooperative learning and game-based activities to foster positive behaviors and collaborative learning environments (3,4).

MATERIALS AND METHODS

This study uses a research and development (R&D) method with the ADDIE (Analysis, Design, Development, Implementation, Evaluation) model to develop and validate educational products through a character education management model, which begins with a needs analysis at the analysis stage.

RESULTS AND DISCUSSION

This section discusses the findings from the initial product development, product trials, revisions, and final product.

1. Initial Product Development Results. This research used the ADDIE model (Analyze, Design, Develop, Implement, Evaluate) to develop a character education management model based on Team Games Tournaments (TGT) for volleyball lessons for 8th-grade students at MTsN Padang, ensuring an effective development process:

a) **Results of the Teacher and Student Needs Analysis Questionnaire.** The questionnaire response from teachers and students regarding the Development of a character education management model based on Team Games Tournaments (TGT) in volleyball lessons for 8th-grade students at MTsN Padang was analyzed during the initial needs analysis, with data collected via validated questionnaires, revised based on expert feedback, and used to assess the suitability of the model and tools for creating an effective learning environment (6,7).

(1) **Results of Teacher Questionnaire.** The questionnaire given to teachers included three assessment components: 18 statements on honest character education management and the use of learning resources (statements 1-18), 12 statements on responsible character education management and the use of learning media (statements 19-30), and 13 statements on cooperative character education management and the use of teaching methods (statements 31-43).

(a) **Management of Honest Character Education and Learning Resources.** The 18 questionnaire items on honest character education management and the use of learning resources assess how teachers manage the education process to instill honesty in students through effective planning, implementation, and evaluation, ensuring that all aspects of education, including curriculum, teaching methods, school environment, and teacher role models, support character formation (8,9).

(b) **Management of Responsible Character Education and Use of Learning Media.** The questionnaire items regarding the management of responsible character education and the use of learning media aim to assess how responsible character education is managed and how learning media is utilized effectively in the education process to foster responsibility in students. This education encourages students to develop a responsible attitude in all aspects of life, including learning, academic tasks, and social interactions. The following are the questionnaire results related to the management of responsible character education and the use of learning media in teaching volleyball in sports education (10,11).

(c) **Management of Cooperative Character Education and Use of Learning Methods.** The questionnaire evaluates how cooperative character education and learning methods foster cooperation in the learning environment, with teachers playing a key role in promoting effective communication, conflict resolution, and mutual support, particularly in volleyball instruction (12–14).

(2) **Results of Student Questionnaire.** The questionnaire administered to students includes 34 statements across three assessment components: 10 statements on honest character education management and learning resources, 13 on responsible character education management and learning media, and 11 on cooperative character education management and learning methods.

(a) **Management of Honest Character Education and Use of Learning Resources.** The statements on managing honest character education and utilizing learning resources focus on effectively organizing the educational process to foster honesty in students through planned, executed, and assessed initiatives, ensuring that the curriculum, teaching methods, school environment, and teacher role models support this Development.

(b) **Management of Responsible Character Education and Use of Learning Media.** The questionnaire assesses how effectively responsible character education and learning media are used to cultivate student responsibility, focusing on their academic, social, and sports responsibilities, particularly in volleyball learning.

(c) **Management of Cooperative Character and Use of Learning Methods.** The questionnaire results evaluate the management of cooperative character education and the learning methods used in volleyball

instruction, focusing on how teachers and schools foster cooperation through effective communication, conflict resolution, and a culture of mutual support within the learning environment.

CONCLUSION

The questionnaire was validated by expert lecturers from Padang State University, with guidance from a supervisor or promoter. According to the validation results, the questionnaire was deemed suitable for use, with several suggestions incorporated to improve and enhance sections that were not yet appropriate. Overall, the responses from teachers regarding the needs profile of the character education management model based on Teams Games Tournament (TGT) in volleyball instruction at MTsN Padang yielded a score of 89.40, indicating substantial agreement for its Development. Similarly, student responses to the profile of the TGT-based character education management model in volleyball learning resulted in a score of 86.65, also reflecting strong agreement. Thus, it can be concluded that the feedback regarding the TGT-based character education management model in volleyball instruction at MTsN Padang is significantly positive.

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This research article can be carried out well thanks to the help of various parties. Therefore, the researchers would like to express their deepest gratitude, especially to the campus, Padang State University.

APPLICABLE REMARKS

- Implementing a Character Education Management Model based on Teams Games Tournament (TGT) in volleyball learning at MTsN Padang can enhance students' teamwork, discipline, and sportsmanship while fostering holistic character development.

AUTHORS' CONTRIBUTIONS

Research concept and design: Nikmatullaili. Data acquisition: Sufyarma Marsidin. Data analysis and interpretation: Enjoy. Compiled the script: Fiky Zarya. Critical revision of the manuscript for important intellectual content: Yahya. Statistical analysis: Fiky Zarya. Administrative, technical, and material support: Yahya. Study supervisor: Nikmatullaili.

CONFLICT OF INTEREST

The authors mention no "Conflict of Interest" in this study.

ETHICAL CONSIDERATION

This is a systematic review of research, so the implementation does not involve humans directly.

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FINANCIAL DISCLOSURE

The authors have no financial interests related to the material in the manuscript.

ARTIFICIAL INTELLIGENCE (AI)

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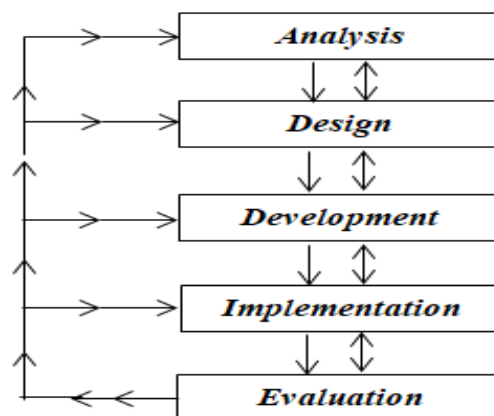


Figure 1. Steps of the ADDIE Model (Source; Molenda, 2003)

Table 1. Management of Honest Character Education and the Use of Learning Resources

No	Indicator 1	Average Score	%	Category
1	Management of Honest Character Education and the Use of Learning Resources	824	88.03	SA
Average Score		824	88.03	SA

Table 2. Results of the Questionnaire Analysis on the Management of Responsible Character Education and the Use of Learning Media

No	Indicator 2	Score	%	Category
1	Management of Responsible Character Education and Use of Learning Media	563	90.22	SA
Average Score		563	90.22	SA

Table 3. Results of the Questionnaire Analysis on the Management of Cooperative Character Education and the Use of Learning Methods

No	Indicator 3	Score	%	Category
1	Management of Cooperative Character Education and Use of Learning Methods	518	76.63	A
Average Score		518	76.63	A

Table 4. Results of Questionnaire Analysis on Management of Honest Character Education and the Use of Learning Resources

No	Indicator 1	Average Score	%	Category
1	Management of Honest Character Education and Use of Learning Resources	5900	84.77	SA
Average Score		5900	84.77	SA

Table 5. Results of Questionnaire Analysis on Management of Responsible Character Education and the Use of Learning Media

No	Indicator 2	Score	%	Category
1	Management of Responsible Character Education and the Use of Learning Media	7785	86.04	SA
Average Score		7785	86.04	SS

Table 6. Results of Questionnaire Analysis on Management of Cooperative Character Education and the Use of Learning Methods

No	Indicator 3	Score	%	Category
1	Management of Cooperative Character Education and the Use of Learning Methods	6694	87.43	SA
Average Score		6694	87.43	SA

Olympic Gold in Seconds: Vedderiq Leonardo and the Science of Speed Climbing

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ABSTRACT

Background. Speed climbing was introduced as a new addition to the Olympic sports after its introduction in the combined upper-climbing event during the Tokyo Olympics 2020. **Objectives.** The study focuses on identifying physiological and performance-specific factors essential for elite speed climbers in the build-up to the Paris 2024 Olympics. **Methods.** A descriptive case study method was adopted, and the primary data collection instruments, systematically conducted in iteration or lapse, were sampled using the athletes' techniques, movement patterns, and technologies used by the most outstanding competitors. **Results.** The results demonstrated that elite male climbers exhibited more excellent strength-to-bodyweight ratios, explosive strength of both upper and lower limbs, and the most efficient movements and transfer of training with anaerobic power emphasis. **Conclusion.** In the research, the factors of sport, modern tools, and biological advancement are discussed and presented to make progress and victory in the promising Olympic branch of sport.

KEYWORDS: *Speed Climbing, Performance Analysis, Olympic Preparation*

INTRODUCTION

The inclusion of Speed Climbing as an independent event in the Paris 2024 Olympics makes it the first of its kind since the combination events in the Tokyo 2020 Olympics (1–3). This new format allows athletes to demonstrate their power and accuracy (4–6), the core objective of Indonesian veteran Vedderiq Leonardo, who competes for the Gold medal. This article focuses on the strategies employed by top competitors in speed climbing at the Olympics through training integration and physiological and advanced techniques. This article targets the case of Leonardo, who, in the readers' eyes, shows how Indonesia applies great training and sophisticated technology to its athletes to ensure high chances of success in this exciting competition.

MATERIALS AND METHODS

This study examines the participation criteria for speed climbing using a qualitative case study method (7) towards the 2024 Paris Olympics. It shall assess performance times, volume, and frequency of training and sports science to establish what is known. Primary information will be obtained from media articles and sports websites that deal with critiques and the latest developments in speed climbing. The analysis emphasizes top sports figures' experiences and the training style prescribed to athletes concerning motion tracking and force sensor technologies.

RESULTS

At the Paris 2024 Olympics, the elite speed climbers' physiological and performance characteristics are

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remarkable. Unlike the Tokyo Games, which included speed climbing as part of a combined event, in Paris, speed climbing is an event of its own, allowing athletes to utilize their full potential. Vedderiq Leonardo of Indonesia is expected to win the gold medal due to his considerable training and flawless technique. Elite male speed climbers tend to have greater body weight and lower body fat percentage than other recreational climbers. Together, these two components improve their strength-to-weight ratios, and in speed climbing, every ounce counts. It shows that the best speed climbers have exceptional upper body strength required for explosive wall contact. Their lower body parts are also explosive, allowing for quick height gain. They also have specific training designs to gain strength while efficiently gaining large quantities of anaerobic work capacity. This enables climbers to produce large force quickly, which is necessary for attacking a 5-degree sloped, 15-meter wall as fast as possible.

Thus, male climbers employed 14 handholds during climbs, while female climbers employed 15. This implies that both genders can use the available handholds efficiently despite their different climbing techniques. A male athlete generally employed about 3 to 4 hands-on holds to maximize grip strength, while females employed an average of 5 per hold, adjusting to the parameters of the wall. Additionally, male and female athletes used 5-7 of the 11 available footholds, further reiterating the need for climbing techniques to improve speed and efficiency in endeavors. Such athletic attributes were visible in Vedderiq Leonardo, who recorded a fantastic time of 2.49 seconds during training for the Paris 2024 Olympics. This results from many hours of careful and stringent practice and efficient utilization of technology in climbing. Advanced training resources, like motion capture and force sensors, enable a performer like Leonardo to break down his methods in detail. These technologies enhance climbers' performance by providing valuable information about grip levels, the body's distribution and movement, and body movements that enable climbers to save their strength.

The anaerobic ATP-PC energy system is of the utmost importance in speed climbing, usually lasting from 3 to 10 seconds. This system is necessary for competitive climbing so that athletes can execute rapid bursts of energy. After attaining maximum energy during a climb, climbers need approximately two minutes of rest to recover before the next climb. Therefore, the training of elite speed climbers is centered on anaerobic power development and rapid recovery techniques to enable athletes to perform across all events in a competition. As speed climbing is further developed, it is anticipated that the application of scientific training and modern techniques add more value to the performance of elite athletes. Athletes who compete at an elite level in speed climbing must be hypertrophy, explosive, and technically very accurate, which addresses Indonesia's strategic priorities for the Olympics. There is an anticipation of breaking world records and winning Olympic medals in the 2024 Olympics, mainly targeting athletes like Vedderiq Leonardo, who has a great passion for success and has a combination of hard work and scientific training to excel in speed climbing.

DISCUSSION

The first Olympic performance of speed climbing at Paris 2024 is both a possibility and a situation of concern. Visibility improvement helps enhance investment and increase participation, as Indonesian Vedderiq Leonardo demonstrated during his active performance, capturing potential young climbers' attention. Different innovative techniques and tools, including motion tracking and force sensing devices, are essential in enhancing rapid force production and application (8–10). However, other social implications that are harmful should be taken into account, including the concern that people are likely to sustain injuries from rapid movements, which are attributed to an increase in the sporting culture within the community (11–13), inequalities in the distribution of training facilities, and athletes facing performance anxiety issues. There are also concerns about the Olympic cycles and how to keep the interest in speed climbing focused on the discipline and accelerate its growth over the years; thus, the promotion of discipline and engagement of the fans have to improve.

CONCLUSION

Recognizing speed climbing as an individual event in the forthcoming Paris 2024 Olympics is a great leap for the sport, calling for systematic training and modern tools among elite athletes. The victory of Vedderiq Leonardo is indicative of the increasing popularity of speed climbing in Indonesia and Africa. However, limitations, such as injuries and insufficient infrastructure, must be overcome to achieve sustainability. Focusing on athlete well-being and the modern style of training improves the results. Speed climbing will be an elite sport with the help of athletes, coaches, and sports organizations.

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APPLICABLE REMARKS

- Vedderiq Leonardo's quest for Olympic gold in speed climbing showcases how sports science enhances performance.
- Through advanced training, biomechanics, and precision techniques, athletes optimize power and agility to master this intense, time-critical sport, redefining human limits.

AUTHORS' CONTRIBUTIONS

Research concept and design: Ardo Okilanda. Data acquisition: Anisa Soliha Mia. Data analysis and interpretation: Arisman. Compiled the script: Doni Priawan. Critical revision of the manuscript for important intellectual content: Irpan Nopriansah. Statistical analysis: Anisa Soliha Mia. Administrative, technical, and material support: Ardo Okilanda. Study supervisor: Doni Priawan.

CONFLICT OF INTEREST

The authors mention no "Conflict of Interest" in this study.

ETHICAL CONSIDERATION

This is a systematic review of research, so the implementation does not involve humans directly.

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How Training Methods Affect Gender Differences in Forehand Performance in Junior Tennis

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ABSTRACT

Background. The importance of forehand in junior tennis. While commonly used training methods such as ball machines and manual feeding exist, the influence of gender on their effectiveness remains largely unexplored. **Objectives.** This study examines the effects of ball machines versus manual feeding on forehand accuracy, power, and consistency in junior tennis players aged 14-16, with special consideration given to gender differences. **Methods.** Twenty players (10 boys and 10 girls) were randomly assigned to ball machine and manual feeding. Participants completed forehand drills for four weeks, and performance variables (accuracy, speed, consistency) were evaluated with high-speed video analysis and court sensors. Descriptive statistics were conducted, followed by statistical analysis (independent samples t-tests and ANOVA). **Results.** Both sexes exhibited greater accuracy, power, and consistency when hitting with a ball machine compared to manual feeding; females displayed significantly more overall consistency in the manual setting than males. Indeed, gender × training method interaction was found to be significant. **Conclusion.** The ball machine and manual feeding methods were discussed, and a mix of both feeding styles should be used to enhance forehand development in junior tennis players, considering gender-based responses to different techniques.

KEYWORDS: *Junior Tennis, Forehand Development, Training Methods*

INTRODUCTION

A superb forehand is essential to do well in junior tennis, and tools to practice the stroke are plentiful—ball machines and manual feeding (1,2). Ball machines provide consistent repetition and steady-speed adjustment, while manual feeding allows for adjusting a player's specific needs in real time (3–5). However, as outlined previously, motor skill development differences, especially between the genders, may affect how effectively players respond to each method when developing junior athletes (6,7). Despite this, little research has investigated the effects of ball machines and manual feeding on forehands across genders for junior tennis players. This study aimed to fill that gap by examining individual differences in response to these training techniques, specifically focusing on the effects of gendered responses to such a popular method, which could contribute towards the Development of much-needed individualized coaching in youth tennis.

MATERIALS AND METHODS

This study was designed as a comparative experiment (8) with 20 junior tennis players (10 boys and 10 girls) aged between (14–16). Participants were randomly allocated into two training groups: ball machine or manual feeding. Over four weeks, each group participated in bi-weekly sessions whereby the drills were

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identical (i.e., forehand drills emphasizing accuracy, power, and consistency). Performance metrics for forehands were measured using high-speed video analysis of court sensors. Statistical analyses were performed to compare the effectiveness of each training method for each gender, which provides information regarding how either approach aids in forehand skill performance between sexes within this age range.

RESULTS

This study compared the accuracy, power, and consistency of forehand as affected by the training method (ball machine vs. manual feeding) among junior tennis players whilst differentiating by gender. Statistical analyses were performed (independent samples t-tests and ANOVA) to assess significant differences between groups. The findings are summarized in tables, showing mean values, standard deviations, and t-values demonstrating the significance of training methods and gender differences in forehand performance.

Accuracy scores illustrated the significant difference between training methods and gender. Boys showed a significant difference in mean accuracy scores, with the ball machine ($M = 78.3\%$) outperforming manual feeding ($M = 74.8\%$), independent samples t-test $p < 0.05$ $p < 0.05$ $p < 0.05$. In girls, the ball machine group also proved significantly more accurate than the manual feeding group (76.5% vs 71.9%, $P = 0.034$; Table 2).

These results indicate that the ball machine offers a precision benefit for boys and girls, possibly due to its predictable, repetitive delivery, aiding players in developing accuracy with more consistency. For power, the boys in the ball machine group had significantly faster shot speeds (102.1 km/h) compared to those in the manual feeding group (98.5 km/h) ($p < 0.05$ $p < 0.05$ $p < 0.05$). For girls, power with the ball machine (96.7 km/h) was also greater than manual feeding (93.2 km/h), but to a lesser degree (Table 3).

The results of this study demonstrate that the ball machine can increase shot power, likely due in part to the synchronous ball trajectory, which allows for optimal timing and energy transfer. The group receiving balls from a ball machine scored significantly more consistently than the manual feeding group (average 82.4% vs 79.3%). For example, girls trained by ball machines scored 80.6% in consistency vs. 77.1% for those trained manually. Significant results were obtained for each comparison ($p < 0.05$, Table 4).

The higher consistency level of the ball machine in both boys and girls indicates that feeding drills performed at predictable, constant intervals from a ball machine may allow young players to score themselves into an optimal neutral practice zone with forehand, whereby they can develop consistent rhythm and thus increase their performance. ANOVA was performed to analyze the interaction between gender and training method on overall performance measures (accuracy, power, and consistency). The results revealed significant interaction effects ($p < 0.01$), indicating that gender affected outcomes depending on the training method (see Table 5).

The finding indicates that gender may influence the effects of training methods on forehand outcome, as boys improved more in maximum power and consistency levels using the ball machine. In contrast, girls feeding balls from both methods resulted in similar improvement but much more significant improvement within manual feeding on consistency level. This is a specific example of why training that considers gender-specific responses to different training methods will improve the performance outcomes of females.

DISCUSSION

The results from this research exemplify the strengths and weaknesses of both ball machine and manual feeding forehand training methods within a junior tennis setting. Consistency in ball delivery on a machine facilitates consistent timing and rhythm and better shot accuracy, power, and consistency (9) for boys and girls. Ball machines have a mechanical quality that allows players to tune up their technique with minimal variability. In addition, the increase in forehand powers seen here is consistent with (10) that a predictable ball trajectory leads to optimal energy transfer. Results for girls indicated that manual feeding allowed for more personalized and flexible interaction, which may provide improved performance in consistency. Still, it demands additional time and energy from the coach, which might prevent its scalability in larger training groups (11,12). Hence, perhaps an optimal system for player development is a balance between the two approaches concerning their context.

CONCLUSION

The present study shows that ball machines and manual feeding can effectively enhance the forehand performance of both male and female junior tennis players, but each feeding method has more significant advantages for one gender or another. Ball machine training improved boys' and girls' accuracy, power, and consistency on the forehand, but manual feeding increased only girls' consistency on this stroke. Despite their limitations, these findings would show a blended approach that could provide the most holistic development for different types of players. Coaches may wish to combine the two for maximum skill development as it applies to junior tennis.

APPLICABLE REMARKS

- The findings of this study suggest that a blended training approach using both ball machine and manual feeding methods is most effective for developing forehand performance in junior tennis players.
- While both methods improve accuracy, power, and consistency, boys showed more significant improvement in power and consistency with the ball machine, whereas girls benefited more from manual feeding, particularly in consistency.
- Coaches should consider incorporating both training techniques, adapting them to each player's needs and gender-specific responses to maximize skill development and performance in junior tennis.

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AUTHORS' CONTRIBUTIONS

Hazrina Amni: Conceptualization, Methodology, Data collection, Writing – original draft. Sumaryanti: Data analysis, Writing – review editing, Supervision. Novita Intan Arovah: Data collection, Investigation, Writing – original draft. Indri Wulandari: Formal analysis, Visualization, Writing – review editing, Supervision.

CONFLICT OF INTEREST

The authors mention no "Conflict of Interest" in this study.

ETHICAL CONSIDERATION

This research has met the standards of research ethics and has received approval to be a sample of all respondents.

FUNDING/SUPPORT

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FINANCIAL DISCLOSURE

The authors have no financial interests related to the material in the manuscript.

ARTIFICIAL INTELLIGENCE (AI)

USE There was NO use of artificial intelligence (AI) for preparation, Writing, or editing this manuscript.

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Table 1. Descriptive Statistics

Metric	Gender	Ball Machine (Mean ± SD)	Manual Feeding (Mean ± SD)
Accuracy (%)	Boys	78.3 ± 5.4	74.8 ± 6.2
	Girls	76.5 ± 6.1	71.9 ± 7.3
Power (km/h)	Boys	102.1 ± 7.4	98.5 ± 6.9
	Girls	96.7 ± 5.9	93.2 ± 6.4
Consistency (%)	Boys	82.4 ± 4.7	79.3 ± 5.6
	Girls	80.6 ± 5.2	77.1 ± 6.0

Table 2. Accuracy

Group	Mean Difference	t-value	p-value
Boys	3.5	2.24	0.032
Girls	4.6	2.59	0.018

Table 3. Power

Group	Mean Difference	t-value	p-value
Boys	3.6	2.81	0.010
Girls	3.5	2.41	0.021

Table 4. Consistency

Group	Mean Difference	t-value	p-value
Boys	3.1	2.09	0.043
Girls	3.5	2.29	0.028

Table 5. Interaction effects (Gender X Training Method)

Metric	F-value	p-value
Accuracy	4.31	0.024
Power	5.02	0.017
Consistency	3.89	0.036

Applied Sciences and the Future of Education: A Literature Review of Improving Physical Health in the Face of Global Challenges

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ABSTRACT

Background. Applied sciences play an important role in shaping the future of education, particularly in the face of evolving global challenges. **Objectives.** This article explores how the applied science approach can provide practical solutions to improving the quality of education and its relevance to the world of work and technological developments. The background of this research departs from the urgency of adapting the education system to global changes such as digitalization, automation, and sustainability issues. **Methods.** This study was carried out through the literature review method by analyzing scientific articles, reports, and policy documents related to applied science in education. Literature sources are selected based on relevance to the central theme, including research from international and local journals in the last 10 years. The analysis focuses on three main aspects: the implementation of applied science in the curriculum, its impact on learning outcomes, and the challenges in its application. **Results.** The study results show that integrating applied science into the educational and physical health curriculum can improve students' practical skills, strengthen problem-solving skills, and prepare graduates to face the world of work challenges. However, several obstacles were found, such as lack of facilities, limited competence of educators, and resistance to system changes. **Conclusions.** Research confirms that applied science has great potential in supporting the transformation of education with physical health towards a more adaptive and innovative system.

KEYWORDS: *Applied Science, Global Challenges, Education, Physical Health*

INTRODUCTION

Education, as the main foundation of human development, is important in facing increasingly complex global challenges (1). In this context, applied science is one of the strategic approaches to answering the needs of society with research-based and innovation-based solutions. One aspect that has received special attention is the improvement of physical health, which not only contributes to the quality of life of individuals but also plays an important role in supporting productivity and socio-economic sustainability. Through a comprehensive literature review, this article aims to identify the role of applied science in developing educational strategies that can improve people's physical health, thereby making a real contribution to overcoming various global challenges that are being faced (2).

Research in applied sciences has driven innovations in education to improve physical health, such as technology integration, physical activity-based curriculum, and holistic approaches (3). This strategy

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effectively addresses global challenges such as sedentary lifestyles and non-communicable diseases. However, local implementation and adaptation gaps remain challenging, so a more inclusive and contextual evidence-based approach is needed (4).

The novelty of this study lies in an integrative approach that connects applied science with educational strategies to improve physical health in the face of global challenges (5). Not only reviewing the latest innovations, this study offers a new perspective by evaluating the implementation of evidence-based programs in various local contexts. This approach aims to identify more inclusive, adaptive, and relevant strategies so that they can provide sustainable solutions to respond to the physical health needs of people globally.

MATERIALS AND METHODS

The method used in this study is a literature review with a systematic approach to identify, analyze, and synthesize the latest research related to the application of applied science in improving physical health through education. The data sources were drawn from relevant scientific journals, books, and reports published in the last five years, using specific keywords such as "applied science," "physical health education," and "global challenges." The collected data is then analyzed thematically to reveal trends, innovations, and gaps in research and implementation. The results of this analysis are the basis for formulating strategic recommendations relevant to the community's needs at the global and local levels.

RESULTS

Table 1 includes studies on improving physical health in the face of global challenges in applied sciences and the future of education.

DISCUSSION

The study results show that applied science significantly develops educational strategies to improve physical health. Various innovations, such as app-based technology for fitness, age-tailored health education programs, and cross-disciplinary approaches, have proven effective in increasing people's awareness and healthy behaviors that integrate mental and physical health (11). However, the successful implementation of these programs is highly dependent on policy support, adequate infrastructure, and active participation from various stakeholders. At the global level, community-based interventions and collaborations between educational institutions have positively reduced the risk of non-communicable diseases and improved people's quality of life (12).

However, the study also found gaps in program adaptation in various regions, especially in developing countries facing limited resources and technological access (13). In addition, an overly generalist approach without considering cultural, economic, and geographical differences often reduces the program's effectiveness. Therefore, more contextual and inclusive strategies are needed, such as developing local-based curricula and increasing the capacity of educators to integrate physical health into the learning process. Thus, collaboration between the government, educational institutions, and the community is the key to ensuring the sustainability of applied science-based health education programs.

CONCLUSION

This study concludes that applied science has great potential in supporting the improvement of physical health through an evidence-based educational approach. Innovations like technology integration, community-based programs, and cross-disciplinary approaches have effectively addressed global challenges such as sedentary lifestyles and non-communicable diseases. However, adaptive and contextual strategies considering local, cultural, and resource differences are needed to achieve optimal results. Therefore, cross-sectoral collaboration and the Development of supportive policies are important steps in ensuring the sustainability and relevance of health-based education programs in the future.

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APPLICABLE REMARKS

- Applied sciences play a pivotal role in shaping the future of education by providing innovative strategies to improve physical health, addressing global challenges, and promoting sustainable well-being.

AUTHORS' CONTRIBUTIONS

Research concept and design: Rose Rahmidani. Data acquisition: Yasri. Data analysis and interpretation:

Abna Hidayati. Compiled the script: Fiky Zarya. Critical revision of the manuscript for important intellectual content: Rose Rahmidani. Statistical analysis: Yasri. Administrative, technical, and material support: Rose Rahmidani. Study supervisor: Yasri.

CONFLICT OF INTEREST

The authors mention no "Conflict of Interest" in this study.

ETHICAL CONSIDERATION

This is a systematic review of research, so the implementation does not involve humans directly.

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FINANCIAL DISCLOSURE

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ARTIFICIAL INTELLIGENCE (AI)

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Table 1. Literature Review Summary of Results

Researchers	Article Title	Research Results
(6)	A Comprehensive Review of Cogenerative Dialogue in Science Education	The presented findings shed light on the current state of research and provide direction for future investigations, highlighting trends and distinctive features in various facets of cogenerative dialogue-related studies. Specifically, we offer suggestions for research in Korean science education contexts and, more broadly, in the Asia-Pacific region.
(7)	Employing user-centered design and education sciences to inform training of diabetes survival skills	Learning complex tasks, such as diabetes survival skills, requires time, repetition, and continued support. Combining a user-centered design approach to uncover learning needs and identify relevant adult learning and education principles could inform the design of more user-centered, feasible, effective, and sustainable diabetes survival skills training for telehealth delivery.
(8)	The hybrid education competence of educators in the social, healthcare, and health science fields: a cross-sectional study	This study showed that educators need the most support in digital and ethical competencies for hybrid education.
(9)	Towards transformative experiential learning in science- and technology-based entrepreneurship education for sustainable technological innovation	This study provides the first evidence that dedicated attention to critical reflection is crucial in designing the experiential learning process for science- and technology-based entrepreneurship and sustainability education.
(10)	A systematic review of operations research and management science modeling techniques in the study of higher education institutions	Based on a systematic literature review, this study sheds light on using quantitative OR/MS modeling techniques in the OR/MS and higher education literature.

The Mental Toughness of Student-Athletes at Senior High School: A Descriptive Study Based on Gender, Participation, and Type of Sport

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ABSTRACT

Background. Mental toughness is one of the psychological qualities crucial to a student-athlete's success in high school because student-athletes face the demands of sports, complex academic obligations, and social lives. **Methods.** The study participants were student-athletes from Senior High School in Bengkulu City. The total participants were 37 student-athletes, with a distribution of 25 males and 12 females. This research was conducted from July to August 2024. It is descriptive quantitative. The research design for this study is a cross-sectional survey. The instrument used to collect data is the Mental Toughness Questionnaire (MTQ-18). Data analysis uses descriptive statistics, such as the ideal mean, standard deviation, and frequency distribution. **Results.** Male student-athletes have higher mental toughness scores than female athletes. Student-athletes who participate in individual sports have higher mental toughness scores than team sports. Based on the type of sport they participate in, student-athletes from karate have the highest mental toughness scores, and student-athletes from soccer have the lowest. **Conclusions.** The mental toughness levels of student-athletes at Senior High School in Bengkulu City were mainly moderate.

KEYWORDS: *Mental Toughness, Student-Athletes, Senior High School*

INTRODUCTION

Mental toughness refers to an individual's ability to remain focused, resilient, and determined in facing challenges, setbacks, and high-pressure situations (1). Mental toughness is often viewed as a critical factor in achieving peak performance, allowing athletes to overcome physical and mental obstacles, maintain self-confidence, and remain committed to their goals (2). As sports become competitive, coaches and sports psychologists increasingly emphasize the importance of developing mental toughness to complement physical training.

Understanding the level of mental toughness of student-athletes is critical to their overall well-being and performance in sports (3). Mental toughness plays a crucial role in how student-athletes handle the pressure of competition, balance academic responsibilities, and cope with the physical and emotional demands of training. Prioritizing mental toughness can lead to improved outcomes, such as increased confidence, reduced burnout, and a more positive sports experience (4). Previous research has examined the relationship between mental toughness and sports performance, highlighting how resilience, self-confidence, and focus contribute to

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athletic success (5). However, research on mental toughness in student-athletes in specific regions is limited. This gap in the literature makes it difficult to understand how cultural, environmental, or institutional differences may influence the Development of mental toughness in student-athletes. Additionally, research in specific regions can provide valuable insight into how local training methods, educational systems, and community supports influence student athletes' mental toughness. Addressing this gap is essential to tailor interventions and support systems that meet the unique needs of student-athletes in diverse settings.

More research is needed on the mental toughness of student-athletes at Senior High School in Bengkulu City. This gap provides an opportunity to contribute to the existing literature by examining how these students develop and utilize mental toughness in their athletic pursuits. Investigating this area could provide valuable insights into the unique challenges and factors that influence the mental toughness of student-athletes, offering data that could inform more targeted support and development programs. Additionally, such research could serve as a foundation for a broader study in the region, helping to fill the gap in local research on this critical psychological attribute.

This study aimed to determine the mental toughness of student-athletes at Senior High schools in Bengkulu City. The primary objective was to describe and determine student-athletes' mental toughness levels and their differences based on several variables, namely gender, participation, and sport.

MATERIALS AND METHODS

The study participants were student-athletes from Senior High School in Bengkulu City. The total participants were 37 student-athletes, with a distribution of 25 males and 12 females. This research was conducted from July to August 2024. It is descriptive quantitative. The research design for this study is a cross-sectional survey. The instrument used to collect data is the Mental Toughness Questionnaire (MTQ-18). Research data analysis uses descriptive statistics, such as the ideal mean, standard deviation, and frequency distribution, to describe mental toughness.

RESULTS

Table 2 shows the frequency distribution of mental toughness levels. None of the student-athletes in this study demonstrated a very high mental toughness. None of the athletes in the sample consistently demonstrated the highest level of mental toughness as measured by the questionnaire. Most student-athletes fell into the "High" mental toughness category. These athletes tend to have strong psychological resilience, which allows them to deal effectively with competitive pressure and challenges. Their mental toughness was above average, indicating they were generally well-equipped to deal with adversity in sports. The majority of student-athletes demonstrated moderate mental toughness.

DISCUSSION

The results of this study generally show that student-athletes have a level of mental toughness in the moderate category. Student-athletes who are mentally tough can manage stress, bounce back from setbacks, and remain disciplined in their training and studies (6). They are resilient in the face of injury or failure, adaptable to changing conditions, and committed to long-term goals. Mental toughness is essential to balancing the dual demands of sports and academics, allowing student-athletes to thrive in both areas (7).

Both male and female student-athletes in this study had moderate mental toughness. The suboptimal level of mental toughness of student-athletes is caused by many factors, including suboptimal external support systems, psychological disorders, sociocultural factors, emotional maturity, and injury (8). Most student-athletes are in the process of personal, physical, and psychological Development (9). Mental toughness often develops over time through experience, and younger athletes may not have fully developed their resilience, coping mechanisms, and emotional regulation skills (10).

In this study, student-athletes from individual sports are more outstanding than that of team sports athletes. Athletes in individual sports, such as tennis, swimming, fencing, and track and field, often show higher mental toughness. Student-athletes in team sports such as basketball, futsal, football, and volleyball tend to develop mental toughness in group dynamics (11). Martial arts sports like karate, taekwondo, and pencak silat, demand a unique mental toughness that revolves around managing aggression, fear, and physical confrontation (12). These athletes must stay calm in live, high-pressure scenarios when facing opponents in one-on-one competition. They must also develop the mental resilience to deal with pain and physical injury while maintaining focus and strategy.

CONCLUSION

The mental toughness levels of student-athletes at Senior High School in Bengkulu City were mostly in the

moderate to high range. However, there is still room for improvement, particularly in increasing the resilience levels of athletes from moderate to high and providing targeted support for those with lower scores. By addressing these areas, coaches and educators can help student-athletes maximize their potential on and off the field. Developmental stage, experiences, external support, coping skills, and the pressures of balancing academic and athletic responsibilities all significantly shape their mental toughness.

APPLICABLE REMARKS

- To develop the mental toughness of student-athletes.

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AUTHORS' CONTRIBUTIONS

Concept and design of the study: Yahya Eko Nopiyanto. Data acquisition: Adhadi Kurniawan. Data analysis and interpretation: Bayu Insanistyo. Compiled the script: Kurniati Rahayuni. Critical revision of the manuscript for important intellectual content: Yahya Eko Nopiyanto. Statistical analysis: Yahya Eko Nopiyanto. Administrative, technical, and material support: Adhadi Kurniawan, Study Supervision: Bayu Insanistyo.

CONFLICT OF INTEREST

The authors mention no "Conflict of Interest" in this study.

ETHICAL CONSIDERATION

This research has met the standards of research ethics and has received approval to be a sample of all respondents.

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Table 1. Formula of Categories

Interval	Level
$> (Mi + 1.8 SD) - (Mi + 3 SD)$	Very High
$> (Mi + 0.6 SD) - (Mi + 1.8 SD)$	High
$> (Mi - 0.6SD) - (Mi + 0.6 SD)$	Moderate
$> (Mi - 1.8 SD) - (Mi - 0.6SD)$	Low
$(Mi - 3SD) - (Mi - 1.8 SD)$	Very Low

Table 2. Level of Mental Toughness

Interval	Frequency	Level
> 75-90	0	Very High
> 60-75	14	High
> 45-60	22	Moderate
> 30-45	1	Low
15-30	0	Very Low

Table 3. Descriptive Data Based on Gender and Type of Sport

Gender	Mean	Std. dev	Min	Max
Male	58.75	7.39	43	72
Female	58.62	6.65	50	72
Participation	Mean	Std. dev	Min	Max
Individual	59.42	6.84	49	72
Team	51.00	6.06	43	57
Type of sports	Mean	Std. dev	Min	Max
<i>Pencak silat</i>	55.00	0.71	56	56
Karate	64.75	6.02	57	70
Tennis	64.00	-	64	64
Swimming	59.15	7.83	49	71
Athletics	61.33	11.02	50	72
Tae Kwon Do	58.00	6.25	53	65
Volleyball	54.00	-	54	54
Futsal	53.50	4.95	50	57
Football	43	-	43	43
Fencing	55	-	55	55
Basketball	57	-	57	57

The Development of Motor Perception Assessment Instrument for 5-6 Years Children Based on Artificial Intelligence Using Body Posture Detection

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ABSTRACT

Background. Traditional methods for evaluating motor perception involve subjective observations, leading to inconsistent results. This study aims to develop a motor perception instrument based on artificial intelligence (AI) with image processing techniques and the YOLO (You Only Look Once) algorithm. **Methods.** This type of research is research and development, which refers to the 4D. The study involved children aged 5–6 years, and the data collected was used to validate the accuracy and reliability of the AI-based assessment tool. **Results.** The results showed that the AI-powered instrument improved the accuracy of motor skill assessment and provided valuable insights for educators and parents to identify potential developmental delays or areas for improvement. This study contributes to early childhood education and artificial intelligence by offering a novel approach to motor perception assessment. **Conclusions.** This study opens up opportunities for further integration of AI technology into child development tools and highlights the potential of automated systems to improve accuracy in early diagnostics. The scalability and usability of the system in various educational settings can be explored in future research.

KEYWORDS: *Motor Perception, Artificial Intelligence, Posture Detection, Children Aged 5-6 Years*

INTRODUCTION

Children between the ages of 5 and 6 experience an essential stage in motor skills, transitioning from basic movements to more complex actions requiring coordination, balance, and spatial awareness (1). Motor perception assessment in early childhood is essential to understanding children's developmental progress and identifying potential delays or disorders that may require intervention (2).

Assessing children's motor skills can present various challenges for teachers due to the diverse nature of these skills and the complexity of evaluating them accurately (3). Based on a preliminary study conducted in Bengkulu City, it was found that teachers needed to implement motor perception assessment systematically. This is due to the teacher's understanding of the motor perception assessment instrument. Several factors cause the need for teacher understanding. First, the complexity of the motor perception instrument is considered too difficult to understand and not relevant to the school environment. Second, the instrument could be more

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effective and efficient, resulting in a lot of wasted time and energy. Third, teachers need more facilities, infrastructure, and assistants to implement assessments. Fourth, teachers are not interested in assessing and monitoring children's motor skills development.

Various studies on the motor perception of children aged 5-6 years have been conducted by multiple researchers (4,5). Based on the existing motor perceptual instruments, there are still areas for improvement, namely that the assessment is still conventional. Conventional assessments are prone to subjectivity and variability between assessors. Therefore, this study aims to develop a motor perception instrument based on artificial intelligence (AI) with image processing techniques and the YOLO (You Only Look Once) algorithm. The product specification in this study is an AI-based motor perception instrument for children aged 5-6 years old with image processing and the YOLO algorithm. YOLO algorithm to analyze basic motor movements in children's recorded videos.

MATERIALS AND METHODS

Participants. This study's participants were children aged 5-6 from public elementary school 82 Bengkulu City. Five experts in the field of physical education assessed the development of the instrument in the study.

Research Design. This type of research is research and development, which refers to the 4D.

Statistical Analysis

Content Validity. The Content Validity Ratio (CVR) formula is as follows: $CVR = (N_e - N/2)/N/2$. The instrument can be valid based on decision-making if the minimum CVR value with a significance level of 0.05 is 0.60 obtained from five experts (6).

Validity Criteria. The instrument can be considered valid based on decision-making if the calculated r-value is greater than the table r value of 0.361 (7).

Reliability. The decision-making criteria are that the instrument is considered reliable if Cronbach's alpha value is > 0.60 .

Descriptive. Product evaluation uses descriptive percentages to assess the instrument's suitability for physical and pre-service physical education teachers. Percentage calculations are also applied in large-scale trials. The Very Good (8-9), Good (6 -7), Moderate (4-5), Poor (2-3), and Very Poor (0-1) scales were used to measure motor perception.

RESULTS

Five experts in the field of physical education assessed the development of the instrument in the study.

DISCUSSION

The results of this study revealed that the instrument developed was declared valid and reliable and could measure the motor perception of children aged 5 to 6 years. The YOLO algorithm has several advantages for analyzing motor movements in children aged 5-6. YOLO is known for its speed in real-time detecting objects (8). This is very useful because children at this age often move quickly and dynamically. YOLO can detect multiple objects in one video frame. In motor movement analysis, this algorithm can simultaneously detect more than one part of the child's body, even if they move independently. This helps provide a more comprehensive and accurate analysis of the child's motor coordination. Although known for its speed, YOLO still provides good accuracy in detecting objects, including human body parts and their movements (9). Thus, motor movements such as walking, running, or jumping can be precisely identified and measured. This is important in measuring fine and gross motor development in early childhood.

YOLO can recognize similar objects or patterns, even in various lighting conditions, angles, or positions (10). This is especially important when analyzing children's motor movements that may be performed in different environments or under various conditions. The algorithm will still detect the child's movements despite the variations in the movements (11). YOLO is designed to use computing resources (12) efficiently. This makes it possible to run it on devices with limited computing power, such as cameras or mobile devices often used to monitor children. YOLO is an open-source algorithm widely developed for multiple applications, including developing education and health systems (13). Thus, this algorithm can be easily integrated into applications to monitor children's motor development or interactive learning programs. Using YOLO to analyze motor movements allows monitoring without direct intervention so children can move naturally without feeling pressured. This is important because, at an early age, children may not show accurate movements if they feel over-monitored.

This study is not free from limitations, such as the accuracy of AI and body posture detection, which can be affected by the hardware quality (e.g., camera, sensor) and software algorithms used. The developed tool has been tested on children aged 5-6 years to limit its application to a diverse child population. In addition,

implementing AI-based assessment tools requires expertise in setting up and operating the system. Inconsistencies in training and operation by educators can lead to variations in results.

CONCLUSION

The study demonstrates the potential for integrating AI technology into early childhood motor skill assessment. By leveraging posture detection, this AI-based tool offers an objective method for evaluating motor perception in early childhood, which has traditionally relied on subjective observations.

APPLICABLE REMARKS

- We are measuring the motor perception of children aged 5 to 6 years.

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AUTHORS' CONTRIBUTIONS

Concept and design of the study: Dian Pujianto. Data acquisition: Yahya Eko Nopiyanto. Data analysis and interpretation: Jeri Harliangga. Compiled the script: Cahyo Wibowo. Critical revision of the manuscript for important intellectual content: Yahya Eko Nopiyanto. Statistical analysis: Yahya Eko Nopiyanto. Administrative, technical, and material support: Adhadi Kurniawan, Study Supervision: Cahyo Wibowo.

CONFLICT OF INTEREST

The authors mention no "Conflict of Interest" in this study.

ETHICAL CONSIDERATION

This research has met the standards of research ethics and has received approval to be a sample of all respondents.

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ARTIFICIAL INTELLIGENCE (AI)

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Table 1. The result of Expert Validation

Indicators	Minimum CVR Value	CVR Value	Description
Walk forward	1	1	Valid
Walk backwards	1	1	Valid
Step left	1	1	Valid
Step right	1	1	Valid
Walk sideways to the left by crossing the right leg over the left leg	0.6	1	Valid
Walk sideways to the right by crossing the left leg over the right leg	0.6	1	Valid
Tiptoeing with the left foot	1	1	Valid
Tiptoeing with the right foot	1	1	Valid
Do movements 1-8 while carrying a volleyball	0.6	1	Valid

Table 2. The result of Criteria Validation

Indicator	r xy	r table	Description
Walk forward	0.676	0.27	Valid
Walk backwards	0.693	0.27	Valid
Step left	0.732	0.27	Valid
Step right	0.637	0.27	Valid
Walk sideways to the left by crossing the right leg over the left leg	0.603	0.27	Valid
Walk sideways to the right by crossing the left leg over the right leg	0.600	0.27	Valid
Tiptoeing with the left foot	0.367	0.27	Valid
Tiptoeing with the right foot	0.408	0.27	Valid
do movements 1-8 while carrying a volleyball	0.814	0.27	Valid

Table 3. The result of the Reliable Test

Indicator	α	Description
Walk forward	.77	Reliable
Walk backwards	.77	Reliable
Step left	.76	Reliable
Step right	.78	Reliable
Walk sideways to the left by crossing the right leg over the left leg	.78	Reliable
Walk sideways to the right by crossing the left leg over the right leg	.78	Reliable
Tiptoeing with the left foot	.81	Reliable
Tiptoeing with the right foot	.81	Reliable
Do movements 1-8 while carrying a volleyball	.74	Reliable

Table 4. The Results of Motor Perception Using Product

Criteria	Frequency	Percentage
Very Good	2	7.69 %
Good	7	26.92 %
Sufficient	11	42.31 %
Poor	4	15.38 %
Very Poor	2	7.69 %

When Love Meets Football: Unpacking the Deep Bonds of Sabah FC Supporters

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ABSTRACT

Background. Football team love represents fans' strong emotional bond and loyalty towards their football clubs. This affection goes beyond game-day support, reflecting a deep connection with the team's values, history, and culture. Understanding the factors influencing this emotional attachment, especially in the context of the Malaysia Super League, is crucial for fostering lasting fan engagement. **Objectives.** To investigate the antecedent variables, such as self-expression, satisfaction with performance, and relationship satisfaction, that influence football team love among supporters of Sabah Football Club. **Methods.** A survey was conducted with 370 Sabah FC supporters aged 18 and older during a Malaysian Football League match at Stadium Likas, Kota Kinabalu. Respondents completed questionnaires assessing self-expression, satisfaction with performance, relationship satisfaction, and brand love. The reliability and validity of the scales were confirmed with Cronbach's Alpha values ranging from 0.78 to 0.86. **Results.** The study found that self-expression, satisfaction with performance, and relationship satisfaction significantly impacted football team love. These factors were critical in enhancing fan loyalty and emotional attachment to Sabah Football Club. **Conclusion.** Football clubs should focus on factors like self-expression, performance satisfaction, and relationship satisfaction to strengthen fan support. Future research could explore the team's image and the emotional dynamics between fans and clubs, using quantitative and qualitative methods for a deeper understanding.

KEYWORDS: *Football, Malaysia, Supporters, Behavior, Love*

INTRODUCTION

The evolution of sports marketing has led to the creating of an innovative business model (1) designed to enhance public interest in sports while establishing conditions conducive to revenue and sponsorship generation, ultimately benefiting clubs financially. With football's rapid expansion, it has become a global industry with a diverse fan base that marketing and service firms must address (2). Two thousand fourteen global club revenues significantly increased, surpassing several nations' GDP (3). A Deloitte study 2016 reported that brand management generated over 140 million Euros for 40 teams worldwide. In sports, particularly football, the emotional investment of consumers solidifies brands and creates unique bonds between teams and their followers (4). For football teams, emotional engagement reaches deeper dimensions, embedding fans' cognitive and emotional perspectives. In the 21st century, sporting organizations can utilize various branding strategies to expand their businesses and fan bases (5). To stand out from competitors, sports

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teams and athletes employ brands that combine name, design, and image (6).

Belonging to a group, such as a sports team, has positively impacted an individual's sense of self and community belonging (7). Supporting a team often aligns with the desire to belong to a group while maintaining one's unique identity (8). This emotional investment in maintaining meaningful connections with others is critical. Among these concepts, "brand love" has been extensively studied. Love shapes perspectives, sets emotional boundaries, and motivates individuals to take risks and accept the consequences, fostering long-lasting connections (9). Brand love is an "emotional bond that goes beyond reason," indicating deep investment and passion for the brand (10). Loving a brand involves an intense connection that surpasses rationality (11). Love and enthusiasm for a team unite clubs and their followers. Consequently, brand loyalty is a prominent topic in sports consumer behavior research, especially in football [9]. Fans' dedication to their clubs enhances the effectiveness of marketing activities in reaching their target audience, compared to traditional demographic segmentation methods. Improving stadium security and comfort can strengthen the bonds between teams and fans.

In summary, cherished brands create significant and enduring connections with consumers by eliciting positive emotions. Successful brands command premium prices, attract more supporters, and foster greater loyalty than their competitors (12). The Super League is Malaysia's premier football competition, with stadium attendance rising from 623,387 in 2022 to 724,526 in 2023, with an additional eight matches per club (13). Sabah Football Team, based in Kota Kinabalu, Sabah, is one of 13 Malaysian professional football teams. Known as Sabah FC since the 2021 season, their home games at Stadium Likas, with a 35,000 capacity, saw 87,194 attendees over the last nine matches. While the primary focus is often on the game, the football team and club are branding that supporters, sponsors, and members identify with.

Sabah FC is a brand that transcends the usual bond between football teams and supporters, fostering emotional connections characterized by loyalty, honesty, dependability, longevity, and commitment. Managing a professional football team like Sabah FC is expensive, with millions spent on recruiting top players, paying salaries, stadium upkeep, and other expenses. The team brand is one of the most vital assets of a football organization, providing identity, uniqueness, motivation for purchases, marketing and advertising benefits, and instilling pride in staff.

MATERIALS AND METHODS

This study explored the impact of antecedent factors—self-expression, satisfaction with performance, and satisfaction with the relationship—on football team love among Sabah FC supporters in the Malaysia Super League. The objectives were to identify the relationship between these factors and football team love and to examine their effects. Three hypotheses were tested: H1 - Self-expression positively affects football team love, H2 - Satisfaction with performance positively affects football team love, and H3 - Satisfaction with the relationship positively affects football team love. A quantitative approach using a cross-sectional survey and convenience sampling was employed, collecting data from 370 supporters during a home game at Stadium Likas. The survey measured self-expression, performance satisfaction, relationship satisfaction, and brand love using a 7-point Likert scale. Data analysis used Structural Equation Modeling (SEM) with AMOS 28. The results showed that self-expression, performance satisfaction, and relationship satisfaction significantly influence football team love, highlighting their importance in strengthening fan engagement and loyalty.

RESULTS

Table 1 shows 756 responders; of them, 75.13 % were men, and 24.87 % were women. 50.26 were unmarried compared to 49.74% who were married. A quarter of respondents (25%) were under the age of 25, followed by 37% of respondents who were between the ages of 25 and 34, 27% of respondents who were between the ages of 35 and 44, 9.26% of respondents who were between the ages of 45 and 54, and 1.98% of respondents who were 55 or older. The breakdown of attendance at the stadium was as follows: 23.81% went once, 42.33% went three to four times, and 33.86% went five or more times.

Confirmatory factor analysis (CFA) was performed to investigate the psychometric properties of the measuring devices. Table 2 shows the Composite Reliability (CR) and Average Variance Extracted (AVE) indices for the measurement model. The results demonstrated a good model fit ($\chi^2/df = 153.702/64 = 3.21$, CFI = 0.97, RMSEA = 0.03 and SRMR = 0.03). The composite reliability (CR) values, which ranged from 0.81 to 0.84, were far over the permissible limit of 0.7 (18) and provided evidence of the construct of components' internal consistency. All of the Average Variance Extracted (AVE) values were over the 0.50 cutoff and ranged from 0.61 (Self-Expression) to 0.67 (Satisfaction with Performance). Discriminant validity was established by comparing the AVE of each idea with squared inter-construct correlations. When the squared inter-construct correlations of each concept's AVE were examined, the findings showed acceptable levels of discriminant validity.

The first hypothesis (H₁), which was based on Table 3, claimed that Self-expression positively and significantly

impacts love for the brand, with a moderate effect size ($\beta = 0.56$). The t-value of 7.57 indicates strong statistical significance, confirming that self-expression is a significant predictor of brand love (H_1 supported). The second hypothesis postulated that Satisfaction with the performance has a strong positive and significant impact on love for the brand, with a high effect size ($\beta = 0.85$). The t-value of 8.89 shows decisive statistical significance, indicating that performance satisfaction is crucial in determining brand love. (H_2 supported).

The third hypothesis sought to determine if relationship satisfaction has a direct, positive impact on the brand, and the study found that satisfaction with the relationship has a significant positive impact on love for the brand, with a substantial effect size ($\beta = 0.75$). The t-value of 5.79 indicates significant statistical strength, showing that relationship satisfaction significantly influences brand love. All three hypothesized paths (H_1 , H_2 , H_3) show significant positive relationships with brand love. Satisfaction with performance (H_2) has the highest impact ($\beta = 0.85$), followed by satisfaction with the relationship (H_3) ($\beta = 0.75$) and self-expression (H_1) ($\beta = 0.56$). The high t-values and significance levels ($p < 0.01$) across all paths suggest that these factors strongly predict love for the brand.

DISCUSSION

Self-expression is key in forming emotional bonds between consumers and brands, including football teams. Fans who can express their identity through their team develop stronger emotional connections and loyalty. This study shows that self-expression significantly influences football team love, with a moderate effect size ($\beta = 0.56$). Football clubs can enhance fan loyalty by offering personalized merchandise, creating events for self-expression, and engaging fans on social media. Understanding fans' values and identities is crucial for developing products and activities that foster deeper connections and increase brand love (14).

Performance satisfaction is dominant in fostering brand love among football fans ($\beta = 0.85$). Fans who are satisfied with their team's performance develop stronger emotional bonds with the club. Football clubs should prioritize improving team performance by investing in players, coaching, and facilities (15). Transparent communication, fan involvement, and performance-based rewards enhance fan satisfaction and loyalty. Through digital platforms, clubs can strengthen emotional connections to keep fans engaged and informed about team progress.

Relationship satisfaction significantly impacts brand love, with a substantial effect size ($\beta = 0.75$). Fans who are satisfied with their interactions with the club develop deeper emotional bonds. Football clubs can improve relationship satisfaction by providing excellent fan experiences, building trust, and engaging with fans personally.

CONCLUSION

Satisfaction with performance, relationship satisfaction, and self-expression strongly predict brand love. These factors collectively contribute to fans' emotional bond towards Sabah football clubs, crucial for maintaining long-term loyalty and engagement. For Sabah football clubs, these findings highlight the need for a holistic approach to fan engagement that addresses multiple dimensions of the fan experience. Clubs can create a robust and loyal fan base by focusing on performance excellence, fostering positive relationships, and promoting self-expression. This, in turn, can lead to increased revenue, more substantial community support, and a more vibrant and engaged fan community.

APPLICABLE REMARKS

- Football clubs should enhance self-expression, performance, and relationship satisfaction to strengthen fan loyalty and emotional attachment.
- Offering personalized merchandise, creating fan engagement activities, and using social media to allow fans to express their identity can deepen emotional bonds. Improving team performance through investments in players and facilities and transparent communication is key to increasing satisfaction.
- Fostering positive relationships with fans through excellent service, trust-building, and personal engagement will further strengthen fan loyalty.
- A holistic fan engagement strategy that integrates these elements can help create a loyal, passionate fan base, benefiting the club's community and business growth.

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AUTHORS' CONTRIBUTIONS

Mohamad Nizam Nazarudin was responsible for the conceptualization, methodology, formal analysis, the preparation of the original draft, and the review and editing of the manuscript. Zakiah Noordin contributed to the study's conceptualization, investigation, data collection, and supervision. Jeki Haryanto handled the methodology, data curation, formal analysis, and visualization of the results. Wan Ahmad Munsif Wan Pa contributed to the research's methodology, data analysis, and supervision. Finally, Mohamad Rahizam Abdul Rahim was involved in the writing and reviewing of the manuscript, project administration, and funding acquisition. All authors have read and approved the final manuscript.

CONFLICT OF INTEREST

The authors mention no "Conflict of Interest" in this study.

ETHICAL CONSIDERATION

This research has met the standards of research ethics and has received approval to be a sample of all respondents.

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Table 1. Respondents' Demographic Information

Variable	Categories	N	%
Gender	Male	568	75.13
	Female	188	24.87
Marital Status	Single	380	50.26
	Married	376	49.74
Age	less than 25 years old	189	25
	25–34 years old	280	37.04
	35–44 years old	202	26.72
	45–54 years old	70	9.26
	55 years old and over	15	1.98
Attendance	1-2	180	23.81
	3-4	320	42.33
	5 and above	256	33.86

Table 2. Composite reliability (CR), average variance extracted (AVE), and Cronbach's α Coefficient

Variable	CR	AVE	Cronbach's α coefficient
Self-Expression	0.81	0.61	0.878
Satisfaction with the Performance	0.84	0.67	0.782
Satisfaction with the Relationship	0.83	0.65	0.726
Love Brand.	0.82	0.62	0.786

Table 3. Path Analysis

Path	β	t
Hypothesized direct paths		
H ₁ self-expression → love brand.	0.56 **	7.57
H ₂ satisfaction with the performance → love brand.	0.85 **	8.89
H ₃ satisfaction with the relationship → love brand.	0.75 **	5.79

Note. B = Standardized path coefficients; * $p < 0.05$, ** $p < 0.01$

Scoring Success: Ubiquitous Learning Strategies for Football Aptitude

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ABSTRACT

Background. This research aims to examine the effect of mobile learning (m-learning), which is an extension of distance education supported by mobile devices equipped with wireless technology. Learning models and processes require new teaching forms, learning, content, and dynamics between actors. Mobile learning is learning that can be accessed instantly and optionally, anywhere and at any time, which helps us create knowledge, satisfy curiosity, collaborate with others, and enrich experiences. **Objectives.** Program in a learning context to improve college students' soccer knowledge and skills by moderating the role of self-efficacy. **Methods.** The sample for this research consisted of 70 male and female students aged 14 to 15 years and coming from junior high school. These students were competent and had received mobile learning through learning anywhere. The data in this research was collected using a questionnaire instrument. The research instrument has gone through validity and reliability tests. After that, a normality test is carried out to test whether the independent and dependent variables in a regression model have a standard or abnormal distribution and continue with hypothesis testing. To test the relationship between the independent variable and the dependent variable, where there are factors that strengthen or weaken (moderating variables), researchers use moderated regression analysis (MRA). The data collected in the research is processed using a statistical data processing application, namely SPSS version 22 software. **Results.** The research results show that ubiquitous application can increase self-efficacy, knowledge, and football skills. **Conclusions.** The study concludes that a mobile training program in a ubiquitous learning context, moderated by self-efficacy, significantly enhances higher education students' football knowledge and skills.

KEYWORDS: *Football Knowledge and Skills, Mobile Training, Self-Efficacy, Ubiquitous Learning*

INTRODUCTION

Today's learning landscape has evolved significantly by integrating e-learning and m-learning, shifting away from traditional methods (1,2). E-learning leverages computer-based platforms and internet networks, while m-learning utilizes mobile devices (3–5). The emergence of ubiquitous learning, a technology-enabled approach allowing for any-time, anywhere learning, further enhances this shift (6).

Ubiquitous learning or U-Learning is a learning technology that can be done anywhere and anytime by combining mobile technologies as the primary supporting device (7). The difference between u-learning and conventional learning is that conventional learning follows the flow of lecturing, where the teacher or lecturer explains in front of the class, and the students or students listen to them (8). This method emphasizes understanding processes through exploration rather than step-by-step instruction, with teachers acting as

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facilitators. One of the teaching concepts applied in u-learning is that the teacher or lecturer provides global direction and creates an independent learning atmosphere in the broadest possible exploration space, but still in the same topic area (Sports, particularly football, are integral for maintaining physical fitness and well-being). Many people like to do sports, whether they are men and women, young or old. They do this to maintain good health and physical fitness, which are used as the basis for a happy and useful life (9–11).

This study explores the impact of mobile training in a ubiquitous learning context on enhancing football knowledge and skills moderated by self-efficacy. Most previous research only focuses on high school students, and ubiquitous learning implementation has many disadvantages. Therefore, the latest research should focus on another scope of research related to implementing mobile technologies in a ubiquitous learning context, especially for sports department students.

MATERIALS AND METHODS

The researcher used a quantitative research method with a verification approach in this study. This research uses an experimental type of research. The population in this study consisted of students majoring in physical education, health, and recreation. Meanwhile, the sample of this study is one class from the entire population selected by purposive sampling technique. The sampling technique was carried out using the purposive sampling method.

The data in this study were obtained through questionnaires distributed to 2 classes of 70 students. They were competent researchers who had received mobile training through ubiquitous learning. The study included normality, multicollinearity, and heteroscedasticity tests to ensure the validity of the regression model. The test used moderated regression analysis (MRA) to test the relationship between the independent and dependent variables in which some factors strengthen or weaken (moderating variables). The data collected in the study were then processed using statistical data processing applications, namely SPSS software version 22. Next, a normality test is carried out to see whether the data is usually distributed. Data analysis uses the paired t-test to determine if the data is typically distributed. However, if the data is not normally distributed, the data analysis used is the Wilcoxon t-test.

RESULTS

Validity and reliability tests are required before the questionnaire is used on a predetermined sample. Based on calculations, The data showed a normal distribution, with Test Statistic scores of 0.059 and Asymp. Sig. Values of 0.200 and 0.172. All questionnaire items scored above the r-table value of 0.23 with a significance of 0.000, indicating high validity.

Based on the test results, it was known that the instrument was declared to have high reliability with a Cronbach alpha score >0.71 . The Cronbach alpha scores for the variables were as follows: mobile training program (X) - 0.876, self-efficacy (Z) - 0.937, and students' football knowledge and skills (Y) - 0.957, demonstrating high reliability.

In order to determine the effect partially or individually between the mobile training program in ubiquitous learning (X) variable and self-efficacy on soccer skills and knowledge, a T-Test was conducted, and the results were presented in the following Table.

The mobile training program (X) significantly affected students' football knowledge and skills (t-score: 5.354, Sig: 0.000). Self-efficacy also moderated this effect significantly (t-score: 2.857, Sig: 0.007).

2. Determination Test

The R-Square score for the effect of the mobile training program on students' football knowledge and skills was 0.465, which increased to 0.574 when moderated by self-efficacy.

Based on the test results, it was known that the R-Square score on the relationship between mobile training programs in ubiquitous learning (X) and students' football knowledge and skills had a significant impact of 46.5%. This percentage increased when the self-efficacy variable was used as a moderating variable, with an R-Square acquisition of 0.574. This means that when a mobile training program in ubiquitous learning (X) was supported by self-efficacy, students could improve their football knowledge and skills by a percentage of 57.4%.

DISCUSSION

The findings support the hypothesis that mobile training in a ubiquitous learning context enhances football knowledge and skills, with self-efficacy playing a crucial moderating role. This aligns with previous research indicating the benefits of u-learning in fostering meaningful learning and increasing student participation and achievement (12,13), where ubiquitous learning context enabled meaningful learning. Applying U-learning could increase students' participation and achievement and help them learn. The U-learning method combined with the practice method could help students to develop soccer skills (14,15).

Self-efficacy plays a vital role in learning activities. A person will try to utilize his potential optimally if his self-efficacy is supported. Self-efficacy refers to the belief that the extent to which an individual can predict his or her ability to carry out a task or perform a task required to achieve a particular result. Self-efficacy has a significant influence on a person's behavior. High self-efficacy will motivate individuals cognitively to act appropriately and purposefully. The individual's view of self-efficacy will show how much effort is exerted and how long the individual will persist when encountering obstacles or unpleasant experiences. The results of this study are based on Bandura's findings, which state that individuals with self-efficacy could complete their work better.

CONCLUSION

The study concludes that a mobile training program in a ubiquitous learning context, moderated by self-efficacy, significantly enhances higher education students' football knowledge and skills. Educators are encouraged to integrate such programs to improve competencies across broader educational contexts. Educators are encouraged to integrate such programs to improve competencies across broader educational contexts.

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AUTHORS' CONTRIBUTIONS

Study concept and design and Acquisition of data: Mochamad Ridwan. Analysis and interpretation of data and drafting of the manuscript: Irma Febriyanti. Critical revision of the manuscript for important intellectual content and Statistical analysis: Sri Wicahyani. Administrative, technical, material support, and Study supervision: Yuni Fitriyah Ningsih.

CONFLICT OF INTEREST

The authors mention no "Conflict of Interest" in this study.

ETHICAL CONSIDERATION

This research has met the standards of research ethics and has received approval to be a sample of all respondents.

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Table 1. The Result of Validity Test

Variable	Indicators	R score	R table	Sig.	Explanation
Mobile training program in a ubiquitous learning (X)	X1	0.760	0.23	0.00	Valid
	X2	0.77	0.23	0.00	Valid
	X3	0.77	0.23	0.00	Valid
	X4	0.61	0.23	0.00	Valid
	X5	0.69	0.23	0.00	Valid
	X6	0.73	0.23	0.00	Valid
	X7	0.71	0.23	0.00	Valid
	X8	0.79	0.23	0.00	Valid
Self-efficacy (Z)	Z1	0.79	0.23	0.00	Valid
	Z2	0.86	0.23	0.00	Valid
	Z3	0.82	0.23	0.00	Valid
	Z4	0.80	0.23	0.00	Valid
	Z5	0.81	0.23	0.00	Valid
	Z6	0.77	0.23	0.00	Valid
	Z7	0.84	0.23	0.00	Valid
	Z8	0.84	0.23	0.00	Valid
	Z9	0.79	0.23	0.00	Valid
Students’ football knowledge and skills (Y)	Y1	0.79	0.23	0.00	Valid
	Y2	0.68	0.23	0.00	Valid
	Y3	0.73	0.23	0.00	Valid
	Y4	0.76	0.23	0.00	Valid
	Y5	0.72	0.23	0.00	Valid
	Y6	0.76	0.23	0.00	Valid
	Y7	0.87	0.23	0.00	Valid
	Y8	0.72	0.23	0.00	Valid
	Y9	0.71	0.23	0.00	Valid
	Y10	0.76	0.23	0.00	Valid
	Y11	0.78	0.23	0.00	Valid
	Y12	0.77	0.23	0.00	Valid
	Y13	0.82	0.23	0.00	Valid
	Y14	0.75	0.23	0.00	Valid
	Y15	0.74	0.23	0.00	Valid
	Y16	0.76	0.23	0.00	Valid
	Y17	0.76	0.23	0.00	Valid
	Y18	0.75	0.23	0.00	Valid

Table 2. The result of the Reliability Test

Variable	Cronbach Alpha Score	Explanation
Mobile training program in a ubiquitous learning (X)	0.876	High reliability
Self-efficacy (Z)	0.937	High reliability
Students' football knowledge and skills (Y)	0.957	High reliability

Table 3. The result of Paired T-Test

Hypothesis	T score	Sig.
The effect of the mobile training program in ubiquitous learning (X) on students' football knowledge and skills	5.354	.000
The effect of the mobile training program in ubiquitous learning (X) on students' football knowledge and skills moderated by self-efficacy	2.857	.007

Table 4. The result of the Coefficient Determination Test

Hypothesis	R	R Square
the effect of mobile training programs in a ubiquitous learning context on higher education students' football knowledge and skills	.682a	.465
the effect of mobile training programs in a ubiquitous learning context on higher education students' football knowledge and skills by moderating the roles of self-efficacy	.757a	.574

Short-Term Amrap and Emom Training Program Using Bosu, Kettlebell, and Dumbbell Complex to Improve Power, Strength Lower Extremity, and Core Stability in Competitive Athletes

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ABSTRACT

Background. Competitive athletes in sports like wushu sanda, karate, and fencing require strength, power, and core stability for complex movements that engage both aerobic and anaerobic energy systems. Functional training using tools such as the Bosu, dumbbells, and kettlebells is essential for improving power, lower extremity strength, and core stability, which enhances performance and reduces injury risk. **Objectives.** This study aims to analyze: (1) The effects of Bosu, kettlebell, and dumbbell complexes using AMRAP on power, lower extremity strength, and core stability; (2) The effects of Bosu, kettlebell, and dumbbell complexes using EMOM on these variables; (3) The differences between AMRAP and EMOM in improving power, strength, and core stability. **Methods.** The sample included 36 karate athletes aged 19-25, divided into three groups: AMRAP (n = 12), EMOM (n = 12), and control (n = 12). This quasi-experimental research used pre-and post-tests, including a leg strength dynamometer, balance beam, and Wattbike power test. **Results.** The EMOM group showed a significant improvement: 9% increase in power, 7% in strength, and 6% greater than the AMRAP group ($p < 0.05$). The AMRAP group demonstrated an 11% increase in core stability compared to the control group and 6% greater than the EMOM group ($p < 0.05$). The control group showed no significant changes. **Conclusion.** The study confirms that functional training with dumbbells, kettlebells, and Bosu effectively improves athletes' power, lower extremity strength, and core stability over 8 weeks.

KEYWORDS: *Amrap Emom, Strength Lower Extremity, Core Stability, Competitive Athletes*

INTRODUCTION

Improving the physical condition of competitive athletes aims to make physical abilities prime and valuable to support sports activities to achieve prime performance. An elite athlete has a peak physical condition, which means that the person can carry out activities with high intensity until they are finished without experiencing significant fatigue. Under this opinion, the researcher will create a training program that is under the goals or objectives of the

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training (1,2). The training aims to improve physical condition, strength, power, and balance. Training in physical activity is generally separated into two aspects of metabolism: aerobic and anaerobic (3,4). To see the increase in as many rounds as possible (AMRAP) program and every minute on the minute (EMOM) training program using functional media in the form of dumbbells, kettlebells, and bosu for 8 weeks with a training frequency of three times a week with medium to high intensity in competitive athletes in order to maximize the performance of strength, power and balance when competing where competitive athletes use aerobic and anaerobic energy systems at the same time so that this short-term training program can be helpful for competitive athletes such as wushu sanda, karate and fencing in optimizing the strength of their leg muscles where leg muscle strength can support all activities both during training and during competition (5,6).

Strength in the lower extremity is the ability of the leg muscles to perform running, standing, jumping, walking, pulling, and pushing movements maximally while minimizing injuries during competition (1,2,7–9). This study was conducted to increase leg muscle strength dynamically. In addition, optimizing strength capabilities will be transformed into dynamic power movements such as kicking and defending and body balance when defensive movements occur to maintain a stable position during competition. A comprehensive training approach with several training variations can increase athletes' motivation to train. However, the selection of training models, duration of training time, and complexity of the training program must still be adjusted to the specifications of the movements performed by athletes during competition and need to be considered to obtain optimal results in supporting athlete performance according to the training periodization stages (10,11). This study examines in detail the Amrap and Emom training programs by optimizing the use of media such as Bosu or what is commonly called both sides in the form of a semicircular ball with a soft surface (rubber), kettlebells and dumbbells made of iron with a specific weight (kg) adjusted to the training program. This study was conducted for eight weeks with a load of 80-100% of the maximum load determined by the 1 RM test and a training zone at a medium to high level, namely THR 85-100% with a very short rest period. Researchers saw increased physical condition from this training treatment by conducting initial and final tests. This training program aims to improve the components of physical condition, strength, power, and core stability in terms of balance in competitive athletes.

MATERIALS AND METHODS

The overall study was experimental research with a quantitative research type with a quasi-experimental approach (quasi-experiment). The sample in this study was 32 competitive national athletes of wushu sanda, karate, and fencing who would participate in national competitions in Indonesia. The sample was divided into three groups, namely Amrap ($n = 12$), Emom ($n = 12$), and control ($n = 12$) aged 19-25 years with a basal metabolic index of 21.43-23.65. The instruments used in this study were power (watt bike), leg strength (leg dynamometer test), and core stability use balance test (balance beam). Data analysis techniques used Manova, normality tests, linearity tests, and hypothesis tests. If the significance is below 0.05, the normality test means that the data to be tested has a significant difference from the standard normal data, meaning the data is not normal. If the significance is above 0.05, there is no significant difference between the data to be tested and the standard normal data, meaning the data is expected.

RESULTS

The data in this study consisted of (1) leg muscle power measured using a watt bike test, (2) leg strength test using a leg dynamometer (kg), and (3) core stability using a balance beam test (seconds). The results of the leg muscle strength variable data for the AMRAP group after being given treatment for eight weeks showed an increase of 14%, the EMOM group experienced an increase of 21%, and the control group did not experience a significant increase because the results ($p > 0.05$). It can be concluded that the leg muscle strength of the EMOM group experienced a significant increase and was better than the AMRAP group. The data on the abdominal muscle strength variables of the EMOM group after being given treatment for eight weeks showed an increase of 9%. It was more significant than the AMRAP group, which experienced an increase of 6%, and the control group did not experience a significant increase due to the intervention of the training program. So, it can be concluded that leg power with the EMOM training model is more efficient and optimal.

From the results of the core stability variable data of the EMOM group after being given treatment for eight weeks, it showed an increase of 6%, the same as the AMRAP group, which experienced an increase of 6%, and the control group did not experience a significant increase due to the intervention of the exercise program. So, it can be concluded that core stability with the EMOM and AMRAP exercise models is efficient and optimal in improving body balance for 8 weeks.

The results of Sig prove Hypothesis Testing in the table below. Leg muscle strength of $0 < 0.05$, it can be interpreted that H_0 is accepted, for the level of significance of leg muscle strength of $p < 0.05$ means H_0 is accepted, and in the power variable with a level of significance $p < 0.05$, then H_0 is accepted so it can be

concluded that there is no significant difference between the AMRAP, EMOM, and control groups.

Based on the three tables above, there are differences in each variable ST, PWR, and CS in the AMRAP, EMOM, and TIME Control groups. This shows that each variable's significance level is $p < 0.05$. So it can be concluded that there is a difference after being treated for eight weeks with a frequency of three times a week using functional training exercises at a THR intensity of 85-100% moderate to high and a load percentage of 80-100% of maximum repetitions using bosu, dumbbell, kettlebell.

DISCUSSION

The results of this study were similar. Three training models were used in the study: AMRAP, EMOM, and control. Each program has different characteristics for each variable used. The effectiveness of the program for each variable is also different. The AMRAP model turned out to be more effective for increasing core stability. At the same time, the EMOM program for eight weeks was very effective and optimal for increasing the physical condition components of leg strength, power, and core stability in competitive athletes, with the note that it was carried out for eight weeks at moderate to high-intensity THR 85-100%, three times a week with each session for 45 minutes.

CONCLUSION

This study concluded that the effect of AMRAP and EMOM training could significantly improve the physical condition of lower extremity strength, power, and core stability for eight weeks with increased strength and power using the EMOM model and increased core stability with the AMRAP model for competitive athletes such as fencing, wushu sanda, and karate.

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AUTHORS' CONTRIBUTIONS

Concept and design of the study: Lucy Widya Fathir, Rini Ismalasari, and Padli. Data acquisition: Sapto Wibowo and Parama Surya Kustrapsila. Data analysis and interpretation: Oce Wiriawan, Arifah Kaharina, and Gigih Siantoro. I compiled the script for Lucy Widya Fathir, Sapto Wibowo, and Muchamad Arif Al Ardha. Critical revision of the manuscript for important intellectual content: Dwi Cahyo Kartiko and Nasnoor Juzaily Bin Mohd Masiruddin. Statistical analysis: Proasca Widiawati. Administrative, technical, and material support: Lucy Widya Fathir and Yovhandra Octa. Study supervisor: Rini Ismalasari.

CONFLICT OF INTEREST

The authors mention no "Conflict of Interest" in this study.

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This research has met the standards of research ethics and has received approval to be a sample of all respondents.

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Table 1. Research Result of the Pre and Post-Leg Strength Test

Group	N	Pre Test	Post Test	Different
AMRAP	12	Mean = 166.8225	Mean = 180.9500	Mean = 14.1275
EMOM	12	Mean = 157.7867	Mean = 179.0000	Mean = 21.2133
CONTROL	12	Mean = 133.4555	Mean = 138.5800	Mean = 5.1245

Table 2. Research Result of the Pre and Post-Power Test

Group	N	Pre Test	Post Test	Different
AMRAP	12	Mean = 80.3543	Mean = 86.4530	Mean = 6.0987
EMOM	12	Mean = 77.7453	Mean = 87.2421	Mean = 9.4968
CONTROL	12	Mean = 73.4532	Mean = 73.5321	Mean = 0.0789

Table 3. Research Result of the Pre and Post-Core Stability Using Balance Beam Test

Group	N	Pre Test	Post Test	Different
AMRAP	12	Mean = 43.2311	Mean = 49.5283	Mean = 6.2972
EMOM	12	Mean = 41.2313	Mean = 47.4244	Mean = 6.1931
CONTROL	12	Mean = 40.8721	Mean = 41.3213	Mean = 0.4492

Table 4. Results of the analysis of the difference

Group	Variable	Pre-Test Mean	Post-Test Mean	t-value	p-value	Significance
AMRAP	Strength (ST)	14.13	-10.33	-10.33	0.000	Significant
	Power (PWR)	06.10	-5.31	-5.31	0.000	Significant
	Core Stability (CS)	06.30	-5.11	-5.11	0.001	Significant
EMOM	Strength (ST)	21.21	-5.10	-5.10	0.001	Significant
	Power (PWR)	09.50	-9.80	-9.80	0.000	Significant
	Core Stability (CS)	06.19	-5.35	-5.35	0.000	Significant
Control	Strength (ST)	05.12	-4.80	-4.80	0.001	Significant
	Power (PWR)	00.08	-6.00	-6.00	0.000	Significant
	Core Stability (CS)	00.45	-6.47	-6.47	0.000	Significant

Volleyball Learning Model for Students: A Research Development

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ABSTRACT

Background. The COVID-19 pandemic has impacted efficient learning, such as volleyball learning.

Objectives. This study aims to provide students with a valid, practical, and effective independent volleyball learning model. **Methods.** This research is research designed in two stages. The first stage is needs analysis, design projection, and developing an independent volleyball learning model for students based on the draft program. The validity to practicality test is carried out. In the second stage, the effectiveness test was carried out through field testing of the independent volleyball learning model. This research uses a research and development approach, namely the ADDIE development model. **Results.** The novelty emphasized in this development is creating a product as an independent volleyball learning model for students, which is packaged into a learning model book and a separate volleyball learning tutorial video. **Conclusion.** Based on this development, it will produce a guidebook containing an independent volleyball learning model for students during the COVID-19 pandemic.

KEYWORDS: Covid-19, Learning, Model, Pandemic, Volleyball

INTRODUCTION

Volleyball learning, a compulsory course measured, structured, and planned by following the applicable rules, aims to form a healthy body and spirit. Until now, sports have made a positive contribution to improving health. In addition to making the body fitter, sports are oriented toward achieving achievements as the times develop. In its development, many sports courses excelled, one of which was the sport of volleyball. Volleyball is one of the most popular sports worldwide, including in Indonesia. Similar to other sports, this sport is also expected to continue to be able to make the nation and state proud at national and international events (1,2). The COVID-19 pandemic has had many impacts on the sports sector, including on the physical condition of athletes. Without a good physical condition, a person will have difficulty adjusting to a game that requires excellent physical condition. The athlete's body structure supports this excellent physical condition.

Almost all sports have a limited face-to-face learning process; students learn 50 percent online and 50 percent offline. With Counting and publishing online and offline learning recommendations, learning is carried out indirectly through online learning platforms such as Google Form, Google Classroom, Zoom, e-learning, and communication media such as WhatsApp (3). This condition is exacerbated by the policies of various country's health authorities who take extraordinary measures to set rules to close multiple public facilities, including fitness centers and sports venues, to all sports universities, resulting in fewer opportunities for

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students to carry out face-to-face learning to maintain their physical condition (2,4).

The main principle and purpose of professional learning is to increase insight and knowledge as an initial capital to be applied to the community. The achievements achieved by an athlete are certainly not due to chance but must go through several stages of a long training program. Concerning the game of volleyball as an achievement sport, there are four elements in achieving achievement, namely physical condition, technique, tactics, and mentality (1,5). Of the four elements, the physical condition has the most essential and fundamental role in an achievement sport, which, if an athlete has an excellent physical condition, will support other abilities such as technique, tactics, and mentality (6). Proper physical condition training plays a vital role in improving the performance of a volleyball athlete. This aligns with previous research on the technical abilities of professional volleyball athletes, which found several indications of the importance of providing a physical training program for a volleyball athlete before developing a training program for the technical aspects of volleyball games.

The lack of safe guidelines for students regarding what they can or should do to maintain their learning program or physical activity routine has negative consequences for sports and learning practitioners (2,7,8). This certainly requires a quick response from various parties. In response to the above problems, the results of the researcher's previous research regarding the independent volleyball learning model for students are assumed to be able to answer current issues. Consistency in developing various volleyball learning models through various research activities from 2016 to 2021 is the basis for continuing the Development of an Independent Volleyball Learning Model for University Students during the COVID-19 pandemic.

MATERIALS AND METHODS

The development research model used in this research is the ADDIE development model. The use of the ADDIE model in developing this product consists of 5 main phases or stages, namely: ADDIE consists of five stages, namely: analysis, design, development, implementation, and evaluation (6,9). The implementation stage of this research has a target population covered in this research: independent volleyball learning for students. To make this research more manageable, researchers will take samples with a tiered cluster sampling technique. In this case, the province will be divided into three regional clusters. From each cluster, a representative student-athlete will be selected.

Finalizing the product development of an independent volleyball learning model for students during the COVID-19 pandemic is by asking for an assessment of 3 experts to validate. The input, suggestions, and data received are used as a basis for making revisions at this stage. The revised learning model has been submitted to the validator. To make it standardized, proceed with the test: 1) The validity test relates to the extent to which the instrument can measure what should be measured. 2) Reliability test, which is related to trust issues. 3) The instrument practicality test relates to the extent of the practicality of the instrument made. 4) Test the instrument's effectiveness, which relates to the extent of the efficiency of the usability made (10,11). All data were analyzed using IBM SPSS software. Significance was determined at the $p < 0.05$.

RESULTS

The tests carried out to make an independent volleyball learning model for students during the COVID-19 pandemic are validity and reliability tests. The score is obtained by calculating how many assessments the validator gives based on the available test items.

The validity and reliability test of the independent volleyball learning model for students during the co-19 pandemic in Table 1 has a value of (1) training material, which has a validity of 0.574, and Cronbach's Alpha reliability = 0.896 is in the excellent category.

(2) training methods have a validity of 0.586, and Cronbach's Alpha reliability = 0.963 is in the excellent category.

DISCUSSION

The background of this research is the unavailability of an independent volleyball learning model for students during the COVID-19 pandemic. The impact of the COVID-19 pandemic is very evident in education, where mixed (offline and online) lectures are held. The pandemic forces people, including students, to postpone various learning activities and stay home. In response to this problem, researchers need a relevant learning model for students following current conditions by developing an independent volleyball learning model for students during the COVID-19 pandemic. The objectives of this study were specifically to (1) assess the validity of developing an independent volleyball learning model for students during the COVID-19 pandemic, (2) determine the practicality of an independent volleyball learning model for students during the COVID-19 pandemic, and (3) test the effectiveness of developing an independent volleyball learning model

for students during the Covid-19 pandemic.

This research is planned to be carried out in 2 years with several stages of activity. The first stage is the needs analysis stage, design projection, and development of an independent volleyball learning model for students based on the draft program; validation testing is carried out until its practicality. The second stage, an effectiveness test, was conducted through field testing of an independent volleyball learning model for students during the COVID-19 pandemic, following the characteristics of the research and instruments developed.

CONCLUSION

Based on this development, it will produce a guidebook containing an independent volleyball learning model for students during the COVID-19 pandemic. It will be included in a guide for the volleyball learning model and video tutorials on separate volleyball learning models for students during the COVID-19 pandemic. The resulting product is an instruction for students in carrying out the learning process, where this product will describe the steps of techniques and forms of exercise that can be applied to students as instructions in independent volleyball learning for students during the COVID-19 pandemic.

APPLICABLE REMARKS

- Based on this development, a guidebook will be produced that outlines an independent volleyball learning model tailored for students during the COVID-19 pandemic.
- This guide will include a comprehensive framework for the volleyball learning model and video tutorials demonstrating distinct volleyball techniques suitable for independent practice.
- The resulting product will be a valuable resource for students, detailing the steps and exercises necessary for effective learning.
- By providing clear instructions and techniques, this guidebook aims to facilitate independent volleyball learning during the pandemic, ensuring that students can continue to develop their skills in a safe and accessible manner.

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AUTHORS' CONTRIBUTIONS

Study concept and design: Muhamad Sazeli Rifki and Endang Sepdanius. Data acquisition: Ariando Ariston and Raudhatul Hanifah. Analysis and interpretation of data: Hadi Pery Fajri. Drafting the manuscript: Sepriadi.

CONFLICT OF INTEREST

The authors mention no “Conflict of Interest” in this study.

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Table 1. Distribution of Validity and Reliability of Instruments

Goal	Validity	Reliability
Training Materials		
Training Objectives	0,574	0,896
Quality of Training		
Training Variations		
Training Method		
Systematization of Training	0,586	0,963
Training Effectiveness		
Training Appeal		

Development Model of a Physical Condition Exercise for Women's Soccer Athletes

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ABSTRACT

Background. Women's soccer has experienced tremendous growth globally, with increased participation and competitiveness. Tailored physical conditioning programs are essential to optimize performance and reduce injury risk. Physical conditioning is critical to soccer training, influencing athletic performance, injury prevention, and team success. Women's soccer athletes require specific conditioning programs addressing their physiological and biomechanical needs. **Objectives.** Develop a comprehensive physical conditioning model for women's soccer athletes. Investigate the effectiveness of the proposed model on athletic performance. Identify key factors influencing physical conditioning in women's soccer. This study's findings will contribute to developing evidence-based physical conditioning programs that benefit coaches, trainers, and women's soccer athletes worldwide. **Methods.** The method used in this research is model development, namely a training program module. The sample in this study is women's football athletes at Universitas Negeri Padang. **Results.** Results show significant improvements in cardiovascular endurance ($p < 0.01$), muscular strength ($p < 0.05$), power ($p < 0.01$), speed ($p < 0.05$), and agility ($p < 0.01$) among participants. The proposed model offers a structured and adaptable framework for optimizing physical conditioning, reducing injury risk, and enhancing overall performance in women's soccer. **Conclusions.** The development model of physical conditioning exercise for women's soccer athletes presented in this study provides a comprehensive and structured framework for optimizing athletic performance, reducing injury risk, and enhancing overall well-being. Key findings highlight significant improvements in cardiovascular endurance, muscular strength, power, speed, and agility among participants.

KEYWORDS: *Model development, football, Model Training*

INTRODUCTION

Football has undergone many changes and developments regarding rules and gameplay. The latest development in football in Indonesia was Indonesia's participation in the 2018 ASIAN Games in Jakarta. Indonesia also participated in the AFC Women's ASIAN Cup 2022 in India. Universitas Negeri Padang is one of the institutions that has contributed to the Best Women's Football Athletes in Indonesia since 2018. One of the best students at the Faculty of Sport Science UNP brought the name UNP to the Indonesian Football scene. Creating excellent and qualified players is undoubtedly supported by a quality training program, especially since the most essential thing an athlete needs to have is the ability to be in excellent physical condition. Physical condition is one of the supporting components that can help achieve that achievement. However,

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monotonous and unvaried physical condition training, separated from other components, will negatively impact athletes, so they lack motivation to exercise (1). Creating a new training program will give a new color to the training motivation of Universitas Negeri Padang women's soccer athletes so that it will produce maximum performance. Combining physical condition training with technical and tactical training is expected to support an athlete's performance when playing on the field (2). Because tactics, techniques, and physical conditions are not separate components during the game, what has been given during training will indirectly be applied in the match.

The model is a detailed program by the trainer/lecturer according to the needs. Football is a sport that is carried out in 2 x 45 minutes (standard), so it requires excellent physical condition (3). Excellent physical condition will maximally support each athlete's basic techniques and tactics.

These are some relevant research to this study. From various research results on the physical condition of soccer training models, researchers found several differences between training needs and scientific stages. The following research relevant to the research that will be carried out are: Research on the Development of Exercise models for The physical condition of football, (4). Development of an agility-based soccer training model and playing approach, (5). Football agility training model, (6). Development of circuit training models in futsal games, (3) The position of this research that the researcher will conduct is producing a training model with a separate method between components of physical conditions with techniques and tactics, but what researchers did combining physical conditions, techniques, and tactics at one time. - together to improve performance, (7). Furthermore, this research also explains the steps of the training process, and the subjects and variations of the exercises are more numerous compared to previous studies (8).

MATERIALS AND METHODS

The research method used was a research and development approach, which means that research produces a product by testing its effectiveness (6). The stages in this research were: (1) Designing a training model design and developing a training model for the physical condition of football in a holistic way. (2) The results of the exercise model design, (9). After conducting the analysis and design of the exercise variations of the developed model, 24 exercise variations were obtained. (3) expert in football and physical conditions carried out Expert Validation Validation. (4) several inputs and suggestions were obtained after expert validation in Revision I. Then, revisions were made based on input and suggestions from experts. (5) Small group trials, small group trials involving the Physical Condition Exercise Women's Soccer Athlete. (6) Revision II, after the small group trials, several inputs, suggestions, and propriety in implementing the exercise were obtained. (7) Large group trials. The results of the previous revision will be continued by conducting large group trials, which will be given to the Universitas Negeri Padang Women's Soccer Team. (8) Revision, large group trials have been carried out, from the results of the product trials, several inputs were obtained from the trainers and a team of experts so that another revision was carried out before the product was finalized

Finalization of Products: Product results from research in the form of a Holistic Physical Conditioning Training program module.

RESULTS

This research developed a Holistic Physical Condition Training program module that can be utilized by football coaches, especially women's football coaches in Indonesia.

Following the requirements analysis test, it was discovered that all of the research variable data met the requirements for further statistical testing, namely hypothesis testing. The t-test was used based on the statistical test results to see the effect of the average count in the same group with a significant level of 0.05. The initial test results for condition exercise women's soccer athletes with the application of special physical conditions obtained an average count of 50.00 and a standard deviation of 4.60 with a sample of 24 people. Meanwhile, the final test's mean score was 56,79, with a standard deviation of 3,42.

The increase in physical condition exercise Women's Soccer Athletes was 16.79, with an average initial test score of 50.00 and a final test score of 56,79. Physical condition exercise was the most important essential preparation for achieving optimal physical condition exercise outcomes.

DISCUSSION

This physical condition is critical because it can also affect the match. According to (10), "Physical condition is an important element and the basis for developing techniques, tactics, and strategies." Physical condition in the game is one of the prerequisites necessary in every effort to improve performance, according to (11) (12). Based

on the quote above, physical condition is an important requirement every soccer player must possess to achieve. Based on the study's results, the overall physical condition of female soccer athletes at Padang State University was still low, or most were classified as moderate. For this reason, it needs to be improved more by doing programmed and continuous training.

CONCLUSION

This development product contains holistic physical condition training models, combining specific technical and physical conditions training simultaneously. So, this product can be used as an alternative training in soccer games for female athletes to improve their physical condition and abilities optimally according to their needs during a soccer game that requires a minimum of 2x45 minutes.

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AUTHORS' CONTRIBUTIONS

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CONFLICT OF INTEREST

The authors state that this study has no "Conflict of Interest."

ETHICAL CONSIDERATION

This research adheres to ethical standards and has obtained approval to include all respondents as samples.

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Table 1. Frequency Distribution of Preliminary Test Data Results and Final Tests of Physical Condition Exercise Women's Soccer Athlete

Interval Class	Category	Preliminary Test		Final Test	
		Absolute Frequency	Relative Frequency	Absolute Frequency	Relative Frequency
00.30 – 00.40	Excellent	0	0,00	3	12,50
00.41 – 00.50	Good	8	33,33	12	50
00.51 – 01.00	Fair	10	41,67	4	16,67
01.00 – 01.10	Poor	4	16,67	5	20,83
01.11 – 01.20	Bad	2	8,33	0	0,00
Total		24	100	24	100

Table 2. Data Normality

Data	Observation	Ltable	Exp
Preliminary Test of Physical Condition Exercise Women's Soccer Athlete	0,170	0,185	Normal
Preliminary Test of Physical Condition Exercise Women's Soccer Athlete	0,169	0,185	Normal

Table 3. Summarizes The Results of Hypothesis Testing

Implementation Of Physical Conditions	Mean	SD	tcount	ttable	Test Result	Exp
Preliminary Test	50	4,60	10,46	2,06	Significant	Ho was rejected, and Ha was accepted
Final Test	56,79	3,42				

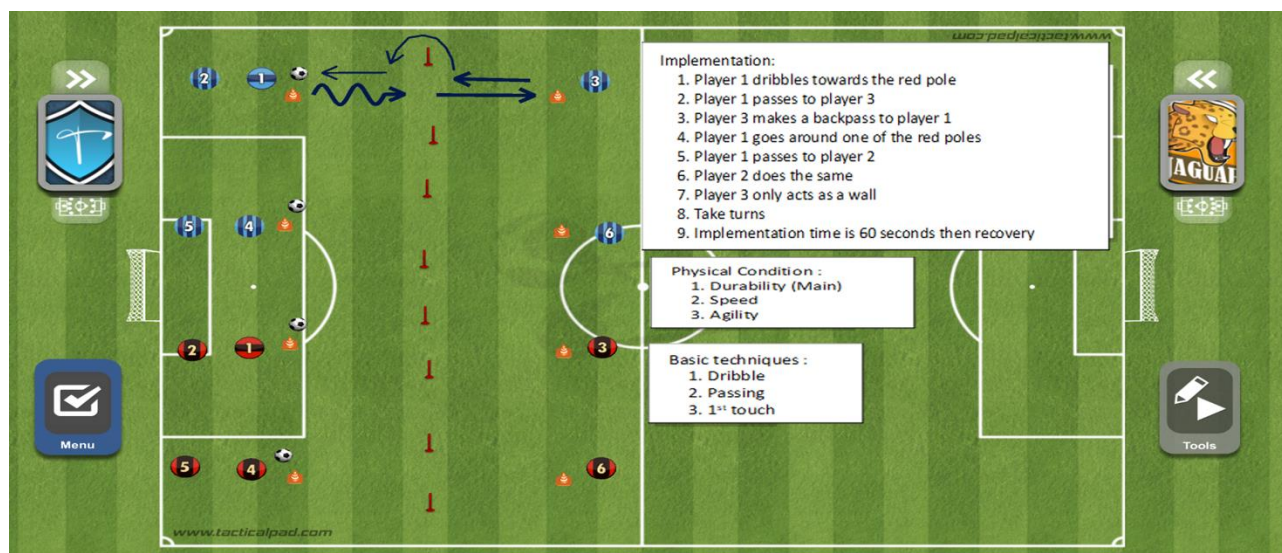


Figure 1. Agility and Rebon Passing Exercises

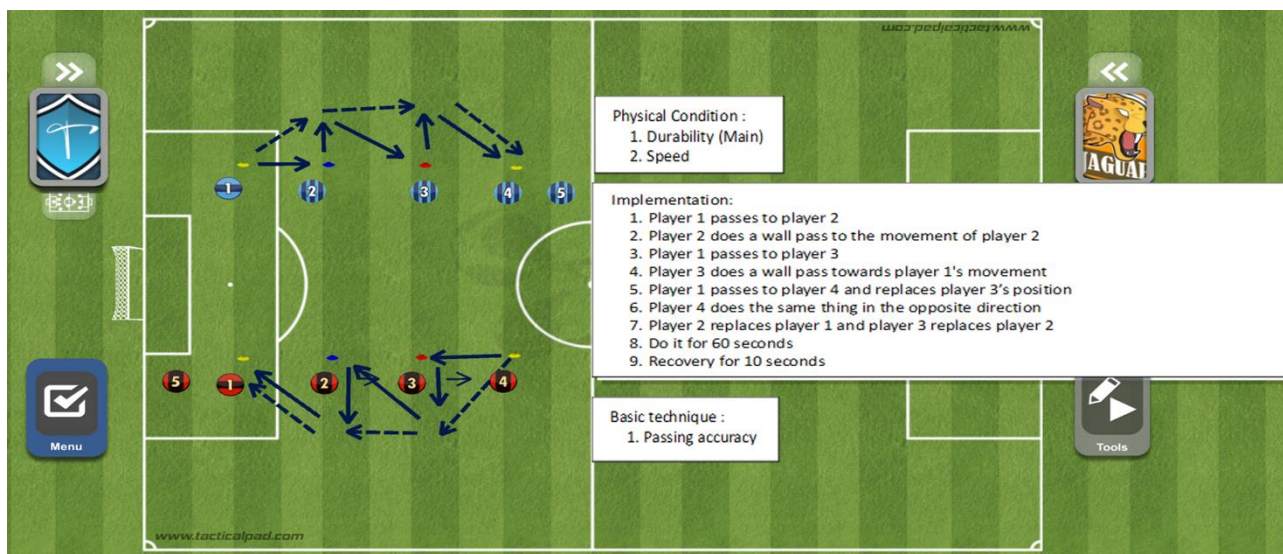


Figure 2. Speed and Accuracy Exercises

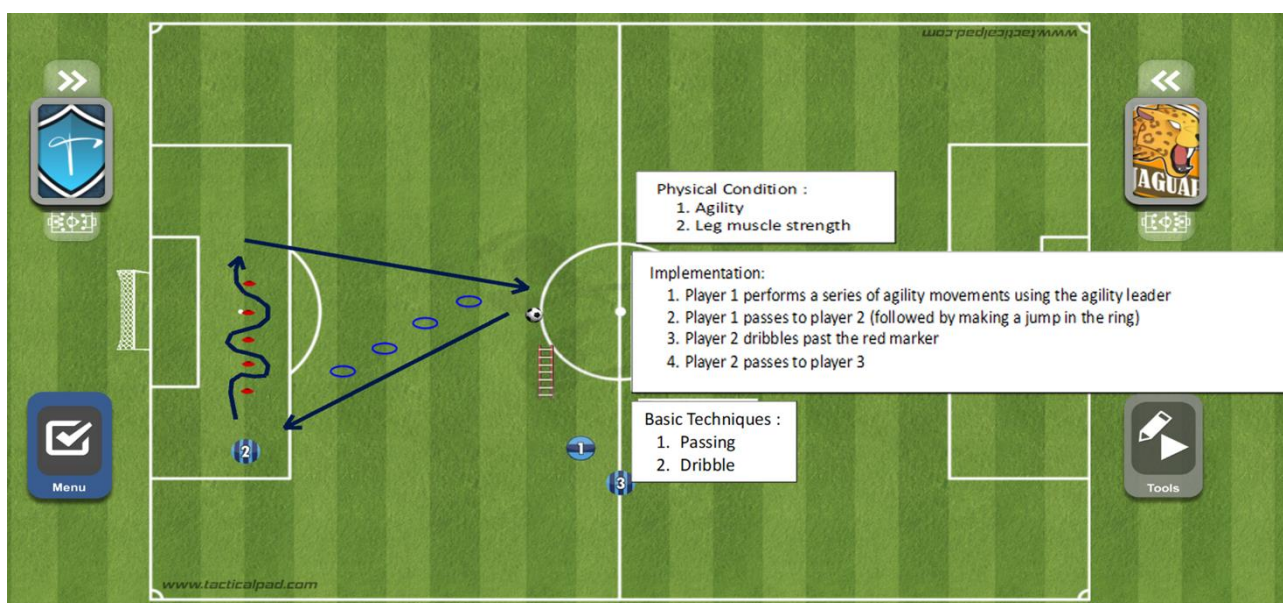


Figure 3. Speed Agility and Rebon Exercises

Application of Online Learning: Sport Modification and Little Small Games

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ABSTRACT

Background. The lack of learning media facilities for students in online classes, which makes it difficult for them to understand the offered learning materials, is the leading cause of students' low learning outcomes in sports and small game modification. **Objectives.** This project aims to create an electronic module about how sports and small games can be modified. **Methods.** This research and development (R&D) is utilizing the ADDIE development approach. The study technique requires several tasks, including investigating prospective and real-world issues, gathering data through creating, validating, and revising game models, and testing the models' efficacy and efficiency. **Results.** A) the material experts gave the high valid category with a percentage of 90.5%; b) the media experts gave the high valid category with 92.55%. In the meantime, students who tested the product gave it a score of 3.85, which is in the high attractive category with a 94.85% percentage. **Conclusions.** The application in sports modification and Little Small Games has revolutionized how students learn, train, and compete. This study demonstrates the effectiveness of enhancing student performance, promoting player development, and fostering engagement. Key findings highlight improved technical skills, tactical awareness, and physical fitness among students.

KEYWORDS: *Modification, Games, Online*

INTRODUCTION

The 21st-century world's trends are reflected in the growing use of communication and information technology in all facets of life, including education (1). As a result, learning activities are making the most of the Internet as a technological advantage. Generation Z's extensive usage of communication and information technologies throughout the industrial revolution can be used as a teaching-learning strategy called "Cybergogy." According to the study, a lack of resources for teaching and learning is one of the things that keeps lecturers using outdated methods (2). Three credits are required for the course modification of sports and small games, which teaches students how to practice on a big or small scale and change a sport or more in the form of games. The teacher must take into account four factors when it comes to sports modification: (a) changing the field's dimensions, (b) altering the equipment, (c) changing the game's duration, and (d) changing the game's rules.

E-modules are digitally packaged instructional resources that help teachers and students learn. They are organized methodically so students can study independently and solve issues (2–4). According to studies, e-modules can also enhance student learning outcomes by facilitating learning (5). Additionally, interactive

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electronic modules have the potential to significantly enhance student learning outcomes, according to (6). According to (7), e-modules play a key role in online teaching and learning processes and offer the following advantages: a) students can use them interactively on digital platforms; b) learning materials can be supported by video-audio, animation, graphics, texts, and exams that provide immediate feedback. One of the most incredible options for raising students' comprehension and learning results is the e-module (5). In conclusion, students may find that the Cybergogy-based sports and small game modification e-module is the finest substitute approach, particularly for online courses.

According to (8), Cybergogy is a learning approach in which students learn online or are digitally connected to a network that allows teachers and students to keep the situation more engaging and relevant without being constrained by schedules, curricula, or classrooms. By adjusting students' demands concerning their internet connection, the Cybergogy strategy is implemented regardless of time or place, allowing them to access comprehensive and diverse content (9). According to [12], Cybergogy also makes learning more manageable by creating communities where students actively share their thoughts and work out answers. According to (10), the Cybergogy learning strategy model can advance cognitive, emotive, and social factors, including task vision, assessment, learning model, learning context, grouping, teacher role, and student role as indicators of engaged learning. Creating unique, encouraging learning environments can be utilized, for instance, to investigate students' emotional cues, cultivate positive emotions, boost students' self-confidence, and stimulate their curiosity (11).

MATERIALS AND METHODS

The research technique known as research and development (R&D) begins with an activity that will ultimately be monitored and developed to bring innovation to life. This development research's flow chart looks like this: 1) Understanding the research topic through preliminary research using questionnaires and interviews to determine issues, learning resources, and student motivation. 2) Creating a model through student engagement and observation of the learning process (planning, execution, and evaluation). Professional specialists will now debate the produced model to offer immediate feedback. 3) Assessing the model's efficacy and assessing the learning process and outcomes through questionnaires and testing tools. Based on the trial and error phases, adjustments, additions, and subtractions are made, along with any extra things that may be required.

RESULT AND DISCUSSION

Students will test the material and practicality, and media professionals will construct the module's feasibility assessment based on practical material emphasizing validity and practicality. The stages of analysis, design, and development comprise the ADDIE development model, which is simple to use in this study because of its planned procedures and evaluation sessions.

- a. **Need Analysis Stage.** The first step in observing the design of an e-module based on the needs in teaching-learning was to discuss the content for sports modification courses and Cybergogy-based little games with the teaching team and students during the needs analysis stage. Therefore, it was determined that the following changes would be made: (1) large ball games like basketball, football, and volleyball; (2) small ball games like badminton, softball, rounders, and table tennis; (3) athletic sports; (4) rhythmic gymnastics; (5) floor exercises; (6) games for physical fitness; (7) games for self-defense; and (8) activities in the water.
- b. **Designing Stage.** Before creating the product, the researchers used the Kvisoft Flipbook Maker application as the framework to facilitate all of the needs analysis observation results and offer answers to the issues by the Cybergogy-based e-module. In order to ultimately meet the learning objectives, this stage seeks to provide the best instructional resources that address the needs of teachers and students. The book cover, the preface, the table of contents, the module's usage instructions, the introduction, the learning materials (game models and theories), the formative assessments for each of the materials created, and the video of the game models are the components of the e-module. The storyboard for the modified sport and minigame based on Cybergogy learning is shown below.
 - 1) The module title, author identification, photo, and institutional identity are all included in the e-module book cover, intended to draw readers. The preface is a leading introduction sentence to the table of contents.
 - 2) The module's Table of Contents serves as a guide for readers.
 - 3) Cyberpsychology-based educational resources for sports and tiny game modification classes that include the material's title and description.

- 4) The video of altered sports and small-game game kinds depending on the information provided during the needs analysis phases.
 - 5) The references that the researchers used to gather data for creating the e-modules
- c. Development Stage. Using the KVISoft Flipbook Maker tool, the researcher began designing the Cybergogy-based e-module during this stage of development. The evaluation and measurement of the developed product's viability and usefulness would then be permitted. Two subject-matter lecturers and material specialists conducted validation, and the results showed that the field testing category had a legitimate average score of 3.60. Lastly, the validation by media specialists and two technology specialists yielded an average score of 3.70, a highly valid field testing category.
 - d. Implementation. The e-module is now prepared for testing with students enrolled in courses. A questionnaire in the form of statements will be used to gather responses. This comes after the product validity. Consequently, the e-module's average score was 3.60, using "very interesting" as the criterion or interpretation. It makes sense that this modified e-module on sports and little games would be highly engaging for online courses.
 - e. Evaluation. The last steps in this review stage are assessment and evaluation, which describe the usefulness of the modules' availability and verify the testing results of modified sports and small game e-modules.

The percentage of learning material validation results by the expert can be seen in table 1 below:

CONCLUSION

Using the Kvisoft Flipbook Maker program and the ADDIE paradigm, the Cybergogy-based sports and little game modification e-module has advanced to the development stage. A) the material experts gave the e-module a score of 3.60, falling into the high valid category with a percentage of 90.5%; b) the media experts gave it a score of 3.65, also falling into the high valid category with 92.55%. In the meantime, students who tested the product gave it a score of 3.85, which is in the high attractive category with a 94.85% percentage. With this Cybergogy-based e-module, it can be inferred that students are highly motivated to participate in online lectures and study independently.

APPLICABLE REMARKS

- Enhances physical education accessibility and Promotes inclusive learning environments.
- Develop critical thinking and problem-solving skills. Furthermore, it fosters teamwork and communication.

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AUTHORS' CONTRIBUTIONS

Concept and design of the study: Rosmawati, Data acquisition: Oyatra Utama Warda. Data analysis and interpretation: Bayu Haryanto, Compiled the script: Rizki Almauli. Critical revision of the manuscript for important intellectual content: Rosmawati. Statistical analysis: Bayu Haryanto, Administrative, technical, and material support: Oyatra Utama Warda. Study supervisor: Rosmawati.

CONFLICTS OF INTEREST

The author states no conflict of interest concerning this article's research, authorship, and publication.

ETHICAL CONSIDERATION

This research has met the standards of research ethics and has received approval to be a sample of all respondents.

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The authors have no financial interests related to the material in the manuscript.

ARTIFICIAL INTELLIGENCE (AI) USE

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Table 1. Criteria The Product

No.	Indicator	Score	Percentage	Criteria
1	Material Expert	3,60	90,5%	High Valid
2	Media Expert	3,65	92,55%	High Valid
3	Student Tested The Product	3,85	94,85%	High Attractive

The Role of Concentration, Coordination, and Arm Strength in Improving Woodball Athletes' Shot Accuracy

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ABSTRACT

Background. Inaccurate hitting direction and fear when hitting are challenges for woodball athletes.

Objectives. The research aimed to determine the relationship between concentration, hand-eye coordination, and arm muscle strength in woodball athletes' shots. **Methods.** Type of quantitative research with a causal social correlation approach. The population of woodball players is 25 people. Grid Concentration Test measured the concentration instrument. The hand-eye coordination is measured by throwing a tennis ball against a wall. Arm muscle strength was measured using push-ups, and punch results were measured using the punch test. The technique uses path analysis. **Results.** Research results: 1) the path coefficient $p_{y1} = 0.312$ is significant. 2) path coefficient $p_{y2} = 0.503$ significant path analysis coefficient. 3) path coefficient $p_{y3} = 0.365$ significant path analysis coefficient. 4) path coefficient $p_{31} = 0.028$ analysis coefficient is not significant. 5) path coefficient $p_{32} = 0.331$ path analysis coefficient is insignificant. 6) Further tests on variables X1, X2, significant path analysis. **Conclusions.** These three factors contribute significantly to hitting accuracy in woodball. Improving these factors is important in an athlete's training program.

KEYWORDS: Concentration, Eye-Hand Coordination, Arm Muscle Strength, Woodball

INTRODUCTION

Sport is a series of regular and planned physical movements that a person does consciously to improve their functional abilities (1,2). All age groups, including the elderly, can do this activity. Activities that can improve physical fitness through sports are one way to maintain physical and mental health, which is important for keeping the body in prime condition (3).

The development of the world of sports covers various aspects, including the emergence of new sports in Indonesia. One of the sports that has just entered Indonesia is Woodball. In Indonesia, Woodball was first developed in 2006 and began to develop in several regions (4). In 2012, the Indonesia Woodball Association (IWbA) had Regional Management in 14 Provinces, and on May 16, 2013, IWbA officially became a member of KONI. Woodball has various positive values, such as precision, patience, and never giving up. This sport also reflects a person's character and way of working in everyday life, including emotions, risk-taking, strategy, and planning in decision-making (5). Under Law No. 11 of 2022 concerning Sports, Article 18 states that

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educational sports are held to instill character values and acquire the knowledge, skills, and attitudes needed to build a healthy and active lifestyle throughout life.

In education, Woodball can be used to improve students' knowledge and motor skills through movement exercises in small ball games (6). These exercises include holding the mallet and hitting the ball in Woodball (7). The winner in the game of Woodball is the player who makes the fewest strokes compared to the other players (8).

Woodball is a sport that combines strategy and skill, namely hitting the ball with a stick to get it into the goal. Success in this game is greatly influenced by three important factors: concentration, eye-hand coordination, and arm muscle strength. Physical strength, playing technique, and mentality determine a player's success.

MATERIALS AND METHODS

The population of woodball athletes is 25, consisting of 13 male and 12 female athletes. A quantitative method with a path analysis approach is used. Testing the causal relationship between the dimensions of concentration level (X1), eye-hand coordination (X2), arm muscle strength (X3), and the results of hitting a wooden ball (Y). This research was conducted to determine whether an independent variable directly influences the dependent variable using the path analysis method in Figure 1.

RESULTS

The study on 25 Woodball athletes provided information on concentration, eye-hand coordination, arm muscle strength, and woodball hitting results. Descriptive data showed that the average concentration value of men was 12.00 and women 11.67, eye-hand coordination of men 24.31 and women 25.00, arm muscle strength of 19.77 and women 19.67, and the hitting results of men 9.67 and women 10.67 (Table 1).

Based on the results of the path analysis test, it is known that 1) concentration is directly related to the athlete's hitting results $py1 = 0.312$, 2) hand-eye coordination is directly and significantly related to the hitting results $py2 = 0.503$, 3) arm muscle strength is directly and significantly related to the results punch $py3 = 0.365$, 4) concentration is not directly related to the result of the punch through arm muscle strength $p31 = 0.028$, 5) Hand-eye coordination is not directly related to the result of the punch through arm muscle strength $p32 = 0.331$, 6) Concentration, hand-eye coordination and arm muscle strength are simultaneously and significantly related to punch results (Figure 2).

DISCUSSION

This research shows that the three factors have a significant relationship with hitting results, as indicated by the calculated F value, which is greater than the F table and has a significant p-value. Concentration has been proven important for improving woodball hitting skills, as proven by previous studies. (7,9) shows a significant relationship between concentration and long-range shooting results.

Eye-hand coordination has also been shown to be directly related to shooting accuracy (10), where good coordination skills increase serve accuracy (11). Concentration, eye-hand coordination, and arm muscle strength contribute to optimal hitting results (10). Arm muscle strength is important to improve the performance of movements that require speed and strength (12). Combining these three factors can increase the overall effectiveness of the woodball game (13).

Further research proves that hand-eye coordination is directly related to the results of the shot, and by having good hand-eye coordination skills, the accuracy of long-distance service will increase. The shot prioritizes rhythm in controlling the entire swing, and hand-eye coordination is moved rhythmically when the ball hits the mallet. Good hand-eye coordination can increase accuracy in woodball shots, which will provide sound and optimal results later.

CONCLUSION

This study confirms the significant impact of concentration, hand-eye coordination, and arm muscle strength on woodball throwing results. These findings improve the understanding of key factors that support success in this sport, emphasizing the importance of skill development in woodball. Players with optimal concentration can better understand the game's dynamics and respond quickly to changes.

Coordination between the eyes and hands is essential for achieving accuracy in hitting; the better this coordination, the more accurate the hit. Consistent arm muscle training reduces fatigue during physical movements, increases arm strength, and allows players to use maximum force in hitting. Thus, concentration, eye-hand coordination, and arm muscle strength have clear, practical implications for improving the

performance of woodball athletes.

APPLICABLE REMARKS

- Players with optimal concentration can better understand the game's dynamics and respond quickly to changes.
- Coordination between the eyes and hands is essential to achieve accuracy in hitting; The better this coordination, the more accurate the punch will be.

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AUTHORS' CONTRIBUTIONS

Concept and design of the study: Nuridin Widya Pranoto. Data acquisition: Hadi Pery Fajri. Data analysis and interpretation: Rani Nurhasanah. Compiled the script: Varhatun Fauziah. Critical revision of the manuscript for important intellectual content: Alexandre Sibomana. Statistical analysis: Japhet Ndayisenga. Administrative, technical, and material support: Joan Siswoyo. Study supervisor: Vlad Adrian Geantă.

CONFLICT OF INTEREST

The authors mention no "Conflict of Interest" in this study.

ETHICAL CONSIDERATION

This research has met the standards of research ethics and has received approval to be a sample of all respondents.

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FINANCIAL DISCLOSURE

The authors have no financial interests related to the material in the manuscript.

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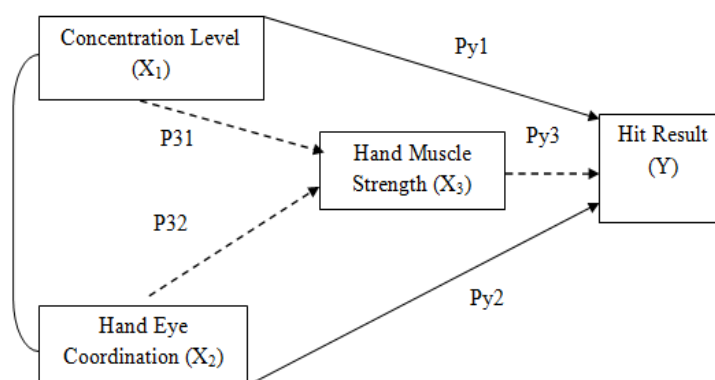


Figure 1. Path Diagram of Factors Affecting Woodball Shot Accuracy

Table 1. Descriptive Results of Concentration, Eye-Hand Coordination, and Arm Muscle Strength

	Concentration (X1)	Eye Hand Coordination (X2)	Arm Muscle Strength (X3)	Punch Result
N	13	13	13	13
Average Son	12.00	24.31	19.77	9.69
N	12	12	12	12
Average Daughter	11.67	25	19.67	10.67

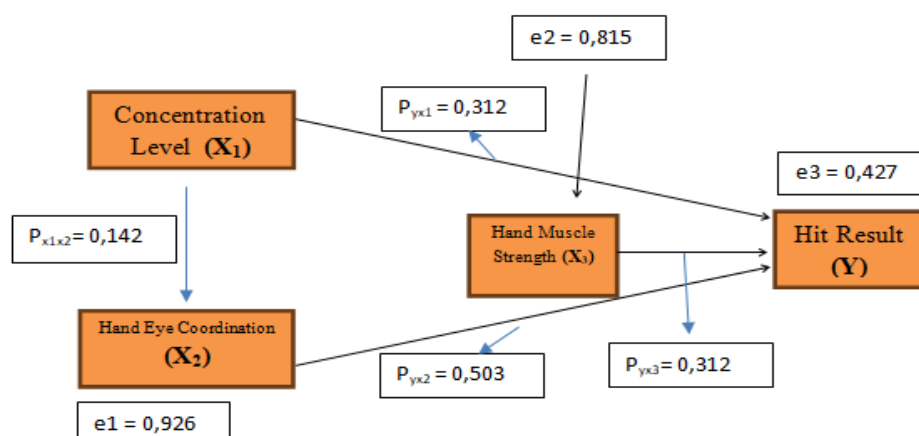


Figure 2. Statistical Path Analysis of Concentration, Coordination, and Arm Strength on Woodball Hitting Results

Development of a Fundamental Movement in Early Childhood Model for Training Swimming Skills

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ABSTRACT

Background. With an emphasis on fundamental motor swimming skills like coordination, balance, strength, and breathing, this study attempts to create a suitable fundamental swimming skill training model for young children. Teaching young children the fundamentals of swimming is crucial for their motor, cognitive, and social-emotional development and aquatic safety. **Objectives.** This training paradigm was created to help kids learn in an enjoyable and developmentally appropriate manner using a play-based approach. **Methods.** The model development process uses the ADDIE model, which consists of five stages: analysis, design, development, implementation, and evaluation. The five processes were carried out using training program analysis, material analysis, and kid characteristics analysis. After seven validators (an expert team) completed the validation test, ten kindergarten teachers conducted a practicality test. **Results.** Following the model's validation and usefulness, the Fundamental Movement in Early Childhood Model for Training Swimming Skills conducts the efficacy test. The validation results show that this model has a high degree of validity, with a firm or high score of 0.82 on the Aiken scale. The evaluation results show how helpful this approach is, with an average score of 86.7% on the Guilford scale. **Conclusions.** The Fundamental Movement in Training Swimming Skills of 15 preschool-aged children significantly improved after using this learning approach, as seen by the T value of 7.30 being more than T Table 1.75. As a result, it is reasonable to presume that the influence is substantial.

KEYWORDS: *Movement Skills, Swimming, Early Childhood*

INTRODUCTION

Early children are in a critical period of motor development when they start to learn the fundamental movement abilities that will serve as the basis for later, more complex physical activities. Swimming is a crucial life skill for safety and recreational value. It is an essential basic motor ability(1). Early swimming instruction can improve children's physical, social-emotional, and cognitive development and confidence in the water (2). However, due to their distinct age characteristics and the requirement for enjoyable and developmentally appropriate ways, teaching swimming abilities to young children necessitates a strategy different from teaching it to older children.

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In practice, many traditional swimming programs continue to use a technique-focused approach, which is frequently less successful for young children (3). Technique-based methods are frequently overly somber and inappropriate for kids who require play activities to inspire them to learn (4). In order to teach the fundamentals of swimming skills in an enjoyable and developmentally appropriate manner, a game-based fundamental swimming skill training paradigm is therefore required (5).

This project intends to create a water movement-based training model for basic swimming skills, especially for young children. In addition to enhancing fundamental swimming abilities like breathing, balance, and coordination, this approach is anticipated to make learning enjoyable and motivate kids to participate actively (6). This model is intended to give educators, trainers, and educational institutions a more helpful tool for teaching young children to swim (7).

MATERIALS AND METHODS

In order to create a fundamental swimming training model for young children, this research and development (R&D) project used the ADDIE approach, which stands for Analysis, Design, Development, Implementation, and Evaluation(8).

Analysis: This stage highlights the necessity for game-based swimming instruction emphasizing breathing, balance, and coordination while suitable for early children's motor development.

Design: A water play-based training model is created based on the analysis's findings to teach fundamental swimming abilities pleasantly and gradually while guaranteeing safety and simplicity.

Development: Seven experts assessed the model using the Aiken V Scale to test content validity to ensure that it was appropriate for children's learning needs and characteristics.

Implementation: The Guilford Scale, which measures how easy it is to implement in learning, was used to evaluate the model's practicality after being verified in a brief experiment with a group of young children.

Evaluation: A comparison of the children's basic motor skills pre-test and post-test was conducted to observe how their skills improved following the model's deployment.

This method guarantees that the created model is reliable, helpful, and efficient in enhancing young children's foundational swimming abilities(9).

Research Participants: Young children participated in a program designed to teach them the fundamentals of swimming. Data collection methods included surveys for teachers and instructors, motor skill pre-tests and post-tests, and direct observation. **Analysis of the Results:** The pretest-posttest difference test was used to examine the results and quantitatively evaluate the model's efficacy.

RESULTS

This study aims to create and evaluate an early childhood water game-based model for acquiring basic movement swimming skills. The findings of this study include testing of the model's validity, applicability, and efficacy. These tests use various techniques to guarantee the model's appropriateness, simplicity of use, and influence on kids' fundamental swimming motor abilities(10).

Test of Model Validity. Seven experts, including early childhood education specialists and swimming coaches, assessed the model's validity using the Aiken V Scale. With a score of 0.82, the validity test results indicate this model has a high validity value, particularly regarding the content's alignment with the learning objectives for early childhood swimming. According to experts, this model's foundational movement skills—such as breathing, balance, and coordination—are suitable for teaching youngsters the fundamentals of swimming and meeting their developmental needs. According to the Aiken V scale, every program element in this model received above-average validity, suggesting that it is very relevant for teaching young children to swim.

First item: catch the fish. Items 2 and 3 are the Colorful Crab and Water Hop Spin. Item 4: Duck Walk Item 5: Frog Jump Item 6: Bubble Ball Items 7 and 8 are the Treasure Run, River Glide, Catch and Throw, and Swim to the Island, respectively. According to the validation findings, the learning model has a high level of validity (0.82), with most of its components receiving strong or high scores.

Test of Model Practicality. Teachers and swimming instructors participated in a modest trial to gauge the model's viability. After receiving instructions on how to apply this model, they were requested to use it during swimming lessons. The Guilford Scale was used to evaluate practicality, utilizing metrics such as time needed for each task, children's engagement in the activity, and ease of use. The findings demonstrated that instructors thought the concept was efficient. Teachers and trainers reported that the rules and instructions were simple to comprehend and follow and that the games in this model were very appealing to kids, which increased their enthusiasm and encouraged them to participate fully in the activities.

This model had a high practicality score of 86.7% on the Guilford scale, with an average value higher than

the suitable practicality threshold. This implies that swimming instructors can employ the concept in early childhood learning settings.

Test of Model Effectiveness. The model's efficacy was evaluated by comparing the pre-test and post-test results of the program's participants' basic swimming motor skills. Balance, hand-foot coordination, breathing ability, and kids' comfort level in the water were among the abilities assessed. In every area assessed, the post-test findings showed notable improvement over the pre-test values. With a t-statistic of 7.30, higher than the t-table of 1.75, the post-test findings demonstrated a significant improvement over the pre-test results in every category examined.

The most noticeable improvement was in balance and coordination abilities. Coordination activities like "Swim To the Island" and "Water Hop Spin," as well as balance-training games like "Duck Walk," were successful in enhancing these abilities. Additionally, breathing becomes more manageable, particularly for kids initially uneasy in the water. They overcame their concerns and developed their fundamental breathing abilities by playing games like blowing bubbles and breathing underwater.

A statistical analysis of the pre-test and post-test data revealed notable changes between the periods before and after the workout program was implemented. This increase in fundamental motor skills demonstrates that this game-based approach is entertaining and successfully enhances young children's foundational swimming abilities.

The table of exercise program effectiveness shows significant differences in paired t-tests ($p < 0.05$). Table 3 provides a description.

The pre-test and post-test results show that this training approach improves early childhood swimmers' basic movement skills.

DISCUSSION

Early children's swimming skills have been successfully improved using the fundamental movement swimming skills model centered on entertaining water activities (11). In addition to keeping kids entertained, the activities help them develop vital motor skills like balance, coordination, and self-assurance in the water (12). According to instructor feedback, the model was straightforward to use and practical, and it fits in well with the developmental needs of the kids (13).

CONCLUSION

The created model promotes basic swimming abilities through entertaining and developmentally appropriate games (14). This method is helpful for teachers and coaches since it helps young children become more proficient swimmers and fosters a good attitude toward aquatic activities (15).

APPLICABLE REMARKS

- This methodology uses entertaining, developmentally appropriate games to help kids get better at swimming.
- It promotes a favorable attitude toward water activities while assisting coaches and teachers in properly teaching swimming.
- Children grow their cognitive, emotive, brave, self-assured, and cooperative abilities in addition to their physical abilities.

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The author helped with the model's design, research, data analysis, and creation of kid-friendly swimming-based games.

CONFLICT OF INTEREST

According to the authors, there is no "Conflict of Interest" in this work.

AUTHORS' CONTRIBUTIONS

Study design and concept: Pringgo Mardesia, Andri Gemaini. Data collection: Syaiful Haq. Data interpretation and analysis: Hadi Pery Fajri Armaita. Arfa Adha, Rivalwan, and Wedi are drafting the manuscript. Andri Gemaini critically reviewed the work for significant intellectual content. Husnul Khatimah and Aulia Rahmad conducted the statistical analysis.

CONFLICT OF INTEREST

According to the authors, there is no "Conflict of Interest" in this work.

ETHICAL CONSIDERATION

This study has been authorized as a representative sample of all respondents and conforms with research ethics regulations.

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The authors have no financial interest in the work's substance.

ARTIFICIAL INTELLIGENCE (AI) USE

USE This manuscript was not prepared, written, or edited using ARTIFICIAL INTELLIGENCE (AI) USE.

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Table 1. Results of Validation of FMSS Training Model. The Development of a Fundamental Movement in Early Childhood Model for Training Swimming Skills

	Item 1		Item 2		Item 3		Item 4		Item 5		Item 6		Item 7		Item 8		Item 9		Item 10	
Evaluator	Score	s	Score	s	Score	s	Score	s	Score	s	Score	s	Score	s	Score	s	Score	s	Score	s
A	4	3	4	3	3	2	3,7	2,7	4	3	4	3	4	3	4	3	3	2	3,7	2,7
B	2	1	3	2	3	2	3,8	2,8	4	3	4	3	4	3	3	2	3	2	3,8	2,8
C	4	3	4	3	4	3	3,8	2,8	4	3	4	3	3	2	4	3	4	3	3,8	2,8
D	3	2	3	2	3	2	3,8	2,8	3	2	3	2	3	2	3	2	3	2	3,5	2,5
E	3	2	4	3	3	2	3,7	2,7	3	2	3	2	3	2	4	3	3	2	3,5	2,5
F	3	2	3	2	3	2	3,6	2,6	3	2	2	1	3	2	3	2	3	2	3	2
G	4	3	4	3	4	3	4	3	4	3	3	2	4	3	4	3	4	3	3,9	2,9
Σs	16		18		16		19,4		18		16		17		18		16		18,2	
V	0,76		0,85		0,76		0,92		0,85		0,76		0,81		0,85		0,76		0,87	

Table 2. Practicality Test Results of FMSS Training

No	Observer	Score	Presentation (%)
1	Observer 1	330	82,5
2	Observer 2	340	85
3	Observer 3	340	85
4	Observer 4	328	82
5	Observer 5	315	78,5
6	Observer 6	379	94,75
7	Observer 7	340	85
8	Observer 8	363	90,75
9	Observer 9	370	92,5
10	Observer 10	363	90,75
Score		3468	Good/Practice
Average		86,7	

Table 3. Result of FMSS Program effectiveness

Different Test Method	Group	p-value
Paired T-test	G1 (Pre-Test and Post-Test)	0.769
	G2 (Pre-Test and Post-Test)	0.000*

The Effectiveness of 8-Week Small-Side Games (SSGS) and Daily-Physical Activity in Increasing Endurance Cardiovascular and Motoric Skills

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ABSTRACT

Background. Physical education, sports, and recreation require varied learning models such as small side games where research has shown that by dividing students into several groups in carrying out teacher movement tasks, learning can run effectively, efficiently, and optimally, and it can improve children's motor skills and cardiovascular endurance (VO₂MaxO). **Objectives.** This study aims to analyze (1) the effects of Small-Sided Games (SSGs) and daily physical activity on improving cardiovascular endurance and motor skills and (2) the differences between SSGs with and without daily physical activity in improving these outcomes. **Methods.** The sample comprised 69 junior high school students (ages 13.08 ± 0.70 years) who received 8 weeks of treatment. Students were randomly assigned to three groups: Group SSGs-A (23 students, SSGs with daily physical activity), Group SSGs-B (23 students, SSGs without daily physical activity), and the Control Group (CG) (23 students). Pre- and post-test data were collected using the VO₂Max and Barrow Motor Ability Test (including standing board jump, medicine ball put, and zig-zag run). The study was analyzed using Multivariate Analysis (One-Way MANOVA) with normality and homogeneity tests. **Results.** The SSGs-A group showed a significant improvement in VO₂Max (+10%) and motor skills (+18%) compared to the CG ($p < 0.05$). SSGs-A also showed a more significant improvement in VO₂Max (11%) and motor skills than SSGs-B, which did not include daily physical activity ($p < 0.05$). **Conclusion.** The study demonstrates that combining SSGs with daily physical activity significantly improves students' cardiovascular endurance and motor skills. Physical education, sports, and health teachers should incorporate SSGs into their programs to enhance students' physical fitness and motor abilities.

KEYWORDS: *Small-Side Games, Sport Daily Activity, Endurance Cardiovascular, Motoric Skills*

INTRODUCTION

Sports are physical activities that children can do to improve fitness and motor skills (1)—the main thing in achieving fitness and health at school. Through physical education, sports, and health lessons, children are

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expected to be able to move and play happily at school and in their daily lives. Physical education, sports, and health education are needed at all levels of education. It can optimize physical growth and movement in children and is important in forming quality, fit, healthy, active, and productive individuals (2,3). However, there must be creativity and innovation in the teaching and learning process where physical education teachers can create fun teaching and learning strategies such as Small-sided games.

Small-sided games are a learning strategy where students are divided into several study groups in the field by carrying out instructions from the teacher so that students move actively and their physical fitness will increase along with their motoric and health qualities (4,5). Previous research that has been conducted on small-side games in physical education, sports, and health learning in schools is the key to the success of basic motor movements from a series of physical activities in supporting better motoric abilities, including running, walking, sports, and also affective, social and cognitive (6,7). Fundamental motor skills can be divided into basic locomotor movements, stabilization, and manipulation. The support of teachers, friends at school/peers, and parents at home is a benchmark for student independence in carrying out daily sports activities at home so that the stages of student movement tasks can be carried out optimally; in addition, children's motor skills will also increase (8,9). This study aims to provide information on developing a Physical Education program with a small-side games model and sports activities. In contrast, at home (daily sports activities, according to the World Health Organization that are carried out for 150 minutes per week) in the form of locomotor, non-locomotor, stabilization, manipulative, automation, rotational, and translatory movement tasks in achieving cardiovascular endurance quality (VO2Max) and increasing basic motoric movements for eight weeks.

MATERIALS AND METHODS

The research is a quantitative quasi-experimental model (quasi-experiment). The sample was divided into three groups, namely Small-side games with sport-daily activity SSGs-A ($n = 23$), Small-side games without sport-daily activity SSGs-B ($n = 23$) and control group CG ($n = 12$) aged 13-14 years old with a height of 155.3-168.7 cm and weight of 53.5-67.5 kg with a basal metabolic index of 19.23-22.45. The instruments used in this study were cardiovascular endurance (VO2Max) and barrow motor ability test (3 items battery test; motor ability involved standing board jump, medicine ball put, zig-zag run). Data analysis techniques used Manova, normality tests, linearity tests, and hypothesis tests with SPSS 25.

RESULTS

The results of this study indicate that there is a significant effect on increasing cardiovascular endurance (VO2Max) and motoric skills from SSGs and daily physical activity in eight weeks ($p < 0.05$) as well as the control group, which was not given a physical education program intervention and daily sports activities had no significant impact on increasing cardiovascular endurance and motor skills.

The results of the data in Table 1 above can be observed that the results of the SSGs-A group treatment showed a significant increase in cardiovascular endurance where VO2Max increased by 6% compared to the SSGs-B group and 8% in the CG group, where the average difference in results was 2% better SSGs-A after being given treatment for eight weeks, while the SSGs-B group was 5% better than CG, so this learning method is very optimal in achieving the objectives of junior high school students physical education lessons, more efficient and effective for teachers to apply to students at school, students are healthy, fit and active, so that the results of the third group there is no difference between the SSGs-A, SSGs-B and control groups which is Sig. ($p < 0.05$).

The data above in Table 2 show a significant increase in the Small Side Games learning model in the SSGs-A group, where the increase reached 4% more compared to the SSGs-B group and 6% from the CG group. The group with small-side games intervention and daily sports activities significantly improved motor skills, as seen from the results of the medicine ball test on the arm and shoulder strength components Sig. ($p < 0.05$).

The data results in Table 3 above show that there is a significant increase in the results of treatment with the small side games model and daily sports activities in increasing agility motor movements as seen from the results of the zig-zag test with a percentage of 5% from the SSGs-A group to the SSGs-B group and 7% in the CG group where the results of the SSGs-B group also increased by 5% like the SSGs-A group towards the CG group. Testing in the table below is proven by the Sig results. Leg zig-zug run of ($p < 0.05$), it can be interpreted that H_0 is accepted, for the level of significance of leg muscle strength of ($p < 0.05$) means H_0 is accepted and in the agility variable with a level of significant ($p < 0.05$) then H_0 is accepted so it can be concluded that there is no significant difference between the SSGs-A, SSGs-B and control groups (CG).

The data results in Table 4 above show that there is a significant increase in the results of treatment with the small side games model and daily sports activities in increasing motor power movements as seen from the

results of the standing broad jump test with a percentage of 6% from the SSGs-A group to the SSGs-B group and 9% in the group CG where the results of the SSGs-B group also increased 6% like the SSGs-A group to a level of significance ($p < 0.05$) then H_0 is accepted so it can be concluded that there is no significant difference between the SSGs -A, SSGs-B and control groups (CG).

Table 5 shows that each variable's significance level is significant ($p < 0.05$). So it can be concluded that there is a difference after being treated for eight weeks with a one-time physical education program on small side games at school with 90 minutes duration and daily physical activity at home with the frequency of two to five times a week using WHO standard 150 minutes per week with low to moderate intensity THR 65-80% like walking, jogging, cycling, jumping rope and sports.

DISCUSSION

Physical Education learning has a positive impact on student's physical fitness by reviewing daily physical activity while at home by following the World Health Organization standards where students can move actively with a minimum of 15-60 minutes of exercise per day, a maximum of 150 minutes per week (10,11). Small-side games have a very positive impact on students' motoric movements, especially for students who like team sports such as volleyball; students can expand their movement learning experiences with stimulus or programs from teachers such as innovation and teaching and learning strategies, such as in this study using the small-side games model where students can move actively and learn basic locomotor movements, stabilization, manipulative /automation with a period of ninety minutes at school.

In addition, there is an additional physical activity intervention at home, such as light exercise for 15-60 minutes per day, a maximum of 150 minutes per week (12). This study shows a significant effect ($p < 0.05$) on physical fitness, namely cardiovascular endurance (VO_{2Max}) and motor skills in the small side games and daily physical activity group for eight weeks, as well as the small side games group without additional activity intervention at home, there was also an increase in VO_{2Max} and motor skills.

CONCLUSION

This study concluded that small-sided games and daily physical activity improve physical fitness in endurance, cardiovascular (VO_{2Max}), and motoric skills (barrow motor ability test; power, strength, and agility). So, the small-sided games model and the habit of routine physical activity at home will help students effectively and efficiently achieve physical fitness, good motor skills, and a good quality of life in the long term. This program is highly recommended for physical education teachers who are choosing a learning model.

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AUTHORS' CONTRIBUTIONS

Concept and design of the study: Lucy Widya Fathir and Padli. Data acquisition: Sapto Wibowo, Taufiq Hidayat and Kolektus Oky Ristanto. Data analysis and interpretation: Nanik Indahwati and Heryanto Nur Muhammad. I compiled the script for Lucy Widya Fathir, Sapto Wibowo, Parama Surya Kustrapsila, and Muchamad Arif Al Ardha. Critical revision of the manuscript for important intellectual content: Dwi Cahyo Kartiko and Nasnoor Juzaily Bin Mohd Masiruddin. Statistical analysis: Prisca Widiawati and Parama Surya Kustrapsila. Administrative, technical, and material support: Lucy Widya Fathir, Mochamad Ridwan, and Yovhandra Octa. Study supervisor: Nurhasan and Padli.

CONFLICT OF INTEREST

The authors mention no "Conflict of Interest" in this study.

ETHICAL CONSIDERATION

This research has met the standards of research ethics and has received approval to be a sample of all respondents.

FUNDING/SUPPORT

No institution, organization, or person supported this study. **ROLE OF THE SPONSOR** The funding organizations are public institutions and have no role in the design and conduct of the study, collection, management, and analysis of the data or preparation, review, and approval of the manuscript.

FINANCIAL DISCLOSURE

The authors have no financial interests related to the material in the manuscript.

ARTIFICIAL INTELLIGENCE (AI) USE

There was NO use of AI for preparing, writing, or editing this manuscript.

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Table 1. Research Result of the Descriptive Statistic of Endurance Cardiovascular (VO2Max)

Data	Mean	Std. Deviation	N
Endurance Cardiovascular (VO2Max)			
SSGs-A	51,7129	3,8439	23
SSGs-B	49,0000	3,1363	23
CG	45,5800	2,4241	23
Total	81,9343	3,13477	39

Table 2. Research Result of the Descriptive Statistic of Medicine Ball Put (Barrow Motor Ability Test)

Data		Mean	Std. Deviation	N
Medicine Ball put	SSGs-A	2,72500	1,9784	23
	SSGs-B	2,11360	1,1059	23
	CG	1,90192	1,0128	23
	Total	2,24684	1,3657	39

Table 3. Research Result of the Descriptive Statistic of Zig-zag Run (Barrow Motor Ability Test)

Data		Mean	Std. Deviation	N
Zig Zag Run	SSGs-A	21,7930	3,59784	23
	SSGs-B	22,1820	3,56059	23
	CG	23,6729	3,45768	23
	Total	22,5493	3,43411	39

Table 4. Research Result of the Descriptive Statistic of Standing Broad Jump (Barrow Motor Ability Test)

Data		Mean	Std. Deviation	N
Standing broad Jump	SSGs-A	2,7392	1,8839	23
	SSGs-B	2,1212	1,5059	23
	CG	1,9510	1,0468	23
	Total	2,2704	1,4788	39

Table 5. Paired Sample Test (SSGs-A group 1, SSGs-B group 2, and CG group 3)

Pair	Mean Difference	Std. Deviation	Std. Error Mean	Confidence Interval (Lower)	Confidence Interval (Upper)	t	df	Sig. (2-tailed)
1	-1.275.000	390.335	123.435	-1.594.220	-887.771	-10.329	9	0.000
2	-240.000	142.894	0.45218	-342.223	-137.777	-5.309	9	0.000
3	-180.000	106.699	0.33770	-244.884	-115.116	-5.107	9	0.001
4	-1.369.000	0.86855	0.27473	-1.431.540	-1.306.460	-49.847	9	0.000
5	-1.309.000	503.162	259.214	-1.870.240	-747.760	-5.053	9	0.001
6	-180.000	0.55470	0.18530	-210.841	-149.159	-9.717	9	0.000
7	-100.000	0.89443	0.28284	-162.265	-0.37735	-3.536	9	0.006
8	-330.000	417.001	131.741	-631.035	-0.28965	-2.505	9	0.034
9	-143.000	0.89989	0.28452	-207.533	-0.78467	-5.103	9	0.001
10	-134.000	0.31305	0.09899	-156.721	-111.279	-13.538	9	0.000
11	-142.254	0.57748	0.18271	-181.305	-122.221	-7.784	9	0.000

Development of West Sumatra Volleyball Athlete Agility Training Model

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ABSTRACT

Background. Agility is crucial in volleyball, but athletes in West Sumatra exhibit suboptimal agility, limiting their competitive performance. **Objectives.** This study aimed to develop and validate an agility training model to enhance athletes' physical and mental performance. **Methods.** The study involved 25 volleyball athletes (ages 16–25) from West Sumatra clubs, using a Research and Development (R&D) approach with 10 stages, including expert validation and field trials. Content validity was assessed using Aiken's V, and reliability was measured with Cronbach's Alpha in SPSS 20. **Results.** The training model significantly improved athletes' agility and mental readiness by incorporating multidirectional, plyometric, and rapid reaction exercises. The content validity score was 0.83, and reliability reached 1.0, confirming the model's validity and reliability. **Conclusion.** The model effectively enhanced the agility and performance of West Sumatra volleyball athletes and has the potential to improve national-level competitiveness.

KEYWORDS: *Plyometric Training, Multidirectional Training, Rapid Reaction Training*

INTRODUCTION

Agility is one of the key aspects in various sports, including volleyball, which requires the ability to respond quickly and effectively to changes in the situation on the court(1,2). In this fast-paced game, athletes are expected to be able to move nimbly to anticipate and respond to a ball moving at high speed. Observations of the performance of volleyball athletes in West Sumatra show that the players' agility is not entirely optimal, which often leads to their difficulty in facing competition at a higher level. This agility limitation not only affects individual performance but also impacts the overall team performance. While basic techniques such as passing, blocking, and spiking are often the main focus of training, the agility aspects that support fast movement on the court are often overlooked. As the standard of competition increases nationally, a lack of agility can be a major obstacle to achieving maximum results individually and as a team. Less significant developments in this area suggest an urgent need to design a more comprehensive approach to practice (3,4).

This study aims to develop an agility training model for West Sumatra volleyball athletes to provide a practical, evidence-based solution for coaches to enhance athlete performance. The model addresses existing limitations in training, particularly in agility, and seeks to improve the competitiveness of West Sumatra athletes at the national level. The findings are expected to improve athlete performance locally and nationally while offering coaches a reference for creating more effective and measurable training programs.

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MATERIALS AND METHODS

Study design. This Research and Development (R&D) study followed ten stages: data collection, model development, expert validation, trials, revisions, and implementation. It aimed to create an effective agility training model to improve the performance of West Sumatra volleyball athletes.

Participant. This study involved 25 volleyball athletes from several sports clubs in West Sumatra who met the inclusion criteria, namely at least two years of experience, age 16-25 years, beginner to intermediate skill level, and excellent physical condition without injury. The initial evaluation was carried out to measure agility and technical skills to assess performance improvement after the intervention. In addition, athletes provide feedback on the effectiveness and ease of training programs for model refinement.

Procedure. This research follows a systematic procedure to develop and test the effectiveness of an agility training model for volleyball athletes. The first stage involves data collection through observation and interviews to identify athletes' needs, focusing on agility in basic techniques like passing, serving, smashing, and blocking. The second stage is developing a multidirectional agility training model, validated by nine experts using Aiken's V, achieving high validity (0.83). Revisions are made based on expert feedback, including adjustments to movements and competitive elements. The third stage is a field trial with 25 athletes, followed by periodic evaluations to assess agility and technical skills improvements. The final stage includes evaluating and refining the model based on trial results and feedback, ensuring its readiness for broader implementation.

RESULTS

The product of this research is an agility training model for volleyball athletes presented in a comprehensive program. This model includes practice modules focusing on basic techniques such as serves, passes, smashes, and blocks while integrating agility elements like speed, balance, endurance, and strength. Multidirectional exercises are central to each module, aimed at improving reaction time, direction-changing abilities, and physical exercises to strengthen muscles and body stability. The coaching stages include understanding the purpose of the training, preparing equipment, explaining techniques, conducting exercises, and performing routine evaluations. The program also includes assessment tools and evaluation scales to monitor technical skills and physical condition improvements, provide feedback, and identify areas for further development.

The agility exercise model's validity and reliability were obtained from the assessment results of nine experts, who were analyzed using Aiken's V formula. Intensive discussions were conducted with the validators, and the product underwent two revisions until the conclusion that the developed training model could be implemented correctly was reached. Validity analysis using Aiken's V technique showed a score of $V=0.83$, which was categorized as high validity. Details of the analysis can be seen in Table 1.

The study assessed athletes' responses to the agility training program regarding technical skills, physical condition, psychological aspects, and measurability—a questionnaire captured satisfaction and effectiveness, enabling athletes to provide direct feedback. Table 4 presents a detailed assessment.

The assessment showed that most athletes responded positively to the training program, with 88% approval for technical skills and measurability and 92% for psychological aspects. This indicates that the program is effective and well-received. The program's reliability, analyzed using SPSS 20, showed a Cronbach's Alpha score of 1.000, confirming that the training program is consistent and reliable for improving athletes' agility.

DISCUSSION

This study highlights the importance of developing an agility training model for volleyball athletes in West Sumatra. The results showed significant improvement in athletes' agility, with exercises incorporating multidirectional, plyometric, and rapid reaction elements enhancing both physical abilities and mental readiness for matches. These findings align with previous studies emphasizing the importance of specific exercises for quick response and direction change in volleyball (5). An evidence-based approach tailored to athletes' needs proved more effective than conventional training. In addition to physical improvements, athletes reported increased confidence and mental readiness, indicating that agility training also positively affects psychological performance. The positive athlete feedback suggests that this model can be widely implemented in volleyball training programs at all levels.

Several studies have considered the possibility that volleyball sprint agility and performance can be improved through plyometric training (1,6,7). However, theoretically, plyometrics can help volleyball players develop both capacities. Sprint performance requires explosiveness for the production of concentric force and SSC in the lower limb muscles and can be utilized primarily by the player's ability to use and optimize SSC's elastic and nerve properties in plyometric training (8). In addition, agility, which is multifactorial and highly complex, can be improved through plyometric training involving a variety of neuromuscular adaptations (e.g.,

increased intermuscular coordination and trigger frequency), leading to an increase in the rate of power development and power output (9,10)(11,12)(4,13).

CONCLUSIONS

The results of this study show that the agility training model specially designed for volleyball athletes in West Sumatra effectively improves athletes' agility and overall performance. An exercise program that includes multidirectional, plyometric, and rapid reaction exercises significantly impacts athletes' physical and psychological aspects. This improvement manifests in the ability to respond quickly to match situations and in athletes' confidence and mental readiness to face competition. The program's effectiveness highlights the importance of integrating an element of agility often overlooked in conventional exercises. This evidence-based, locally tailored model can be applied to other sports clubs to enhance national competitiveness. The study highlights the need for continuous monitoring and program adjustments to ensure long-term effectiveness and sustainability.

APPLICABLE REMARKS

- This multidirectional, plyometric, and rapid reaction-based agility training model can be applied by sports coaches, especially volleyball, to significantly improve athletes' physical and mental performance and prepare them for national-level competitions.
- This model's validity (Aiken's $V = 0.83$) and reliability (Cronbach's $\alpha = 1.0$) confirm that the program is based on strong scientific evidence, making it feasible to implement it widely in various sports clubs in Indonesia.

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AUTHORS' CONTRIBUTIONS

Study concept and design: Hermanzoni, Nuridin Widya Pranoto. Acquisition of data: Septri, Ariando Ariston. Analysis and interpretation of data: Nuridin Widya Pranoto, Muhamad Sazeli Rifki. Drafting the manuscript: Varhatun Fauziah, Vlad Adrian Geantă. Critical manuscript revision for important intellectual content: Varhatun Fauziah, Vlad Adrian Geantă. Statistical analysis: Hermanzoni, Septri.

CONFLICT OF INTEREST

The authors state that this study has no "Conflict of Interest."

ETHICAL CONSIDERATION

This research adheres to ethical standards and has obtained approval to include all respondents as samples.

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FINANCIAL DISCLOSURE

The authors have no financial interests related to the material in the manuscript.

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In completing this manuscript, the authors did not use artificial intelligence (AI) to prepare, write, or edit.

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Figure 1. Volleyball Athlete Agility Training Program Book's Cover

Table 1. Aiken's V Analysis on Large-Scale Tests

Expert (N)	Grain	Σ Rating	$\bar{x}$ Rating	Σs	$\bar{x} s$	V	Categories
9	1-20	630	70	450	50	0.83	Tall

Table 2. Assessment of Athletes' Response to the Agility Training Program

No	Question	Assessment Criteria	N	Number of Answers		Percentage (%)	
				Yes	No	Yes	No
1	1-5	Technical Skills	25	22	3	88%	12%
2	6-10	Physical Condition	25	21	4	84%	16%
3	11-15	Physiological	25	23	2	92%	8%
4	16-20	Measurability	25	22	3	88%	12%
$\bar{x}$			25	22	3	88%	12%

Effects of Physical Activity on Motor Skills and Cognitive Development in Early Childhood: A Systematic Review

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ABSTRACT

Background. Physical activity forms a basis for motor and cognitive development during early childhood, impacting overall development and later physical literacy. These skills do not come naturally; instead, they demand specific interventions. **Objectives.** This review aims to evaluate the efficacy of a physical activity intervention program on motor skills and cognitive development in early childhood through articles published from 2019 to 2024. **Methods.** Searches were conducted across four major databases. Out of 1,699 records found, eight articles met the final inclusion criteria. Reviews included both motor skill programs and game-based play. **Results.** This review pointed out that PA improved early childhood motor and cognitive skills, yet the methodological quality of the selected studies varied. **Conclusions.** Physical activity is effective for motor and cognitive development, but further intense methodological studies are required.

KEYWORDS: *Physical Intervention, Cognitive Development, Child Health*

INTRODUCTION

Participation in physical activity (PA) is an important factor for children to grow in a balanced physical, emotional, social, and cognitive way (1). Therefore, PA in early years establishes a sustainable healthy lifestyle, with global data showing that 41 million children under age 5 were obese in 2019 (2,3). Fundamental motor skills (FMC), which include locomotion(4), object manipulation(5), and stability(4), should be mastered before 6 years of age for optimal exploration of the environment and an active lifestyle. PA positively impacts brain development through BDNF, neuroelectrical activity, and brain circulation based on findings that align with neuroscience developments. Research also shows that PA can improve students' academic performance, executive function, and behavior. Although the relationship between PA and cognition has been widely studied, comprehensive studies on its impact on early childhood are still limited. This study fills the gap by exploring the long-term effects of PA interventions on early childhood cognitive development through a novel methodological approach.

MATERIALS AND METHODS

Search Strategy and Study Selection. The systematic review adhered to the PRISMA-P guidelines and searched for articles published between January 2019 and June 2024 across four primary databases. After eliminating duplicate records, 299 articles were identified, of which 38 were chosen for a full-text review. Ultimately, eight articles were included in the final analysis. Exclusions were made based on unsuitable study designs, insufficient data, or the absence of clinical outcomes. A summary table outlines key study details, including the publication year, methodology, sample, intervention, and outcomes, while the PRISMA

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flowchart visualizes the selection process.

Study quality. Methodological quality was assessed based on the following factors: selection bias, study design, confounders, blinding, data collection methods, and withdrawals and dropouts. Only two of the 35 studies (6%) showed strong methodological quality, while nine studies (26%) were of moderate quality, and 24 studies (69%) were considered methodologically weak. The ratings for each section and the overall study quality are presented in Table 1.

Note: The EPHPP tool was adjusted for consistent assessment. Quasi-experimental studies were classified as Controlled Clinical Trials (CCT). Confounding factors included age, gender, health status, and baseline scores. Participants were assumed to be unaware of the study's purpose unless stated otherwise. Measurement validity was determined by mentions in the article or references to established tools like Wechsler or Bayley Scales. Reliability was acknowledged only if explicitly reported. Participant withdrawal information was noted if numbers and reasons were provided, while dropouts were excluded from the analysis.

RESULTS

The present study suggests a positive relationship between PA with the development of HMF and improved cognitive development in early childhood. Well-structured PA interventions can effectively develop HMF in pre-schoolers and may contribute to better cognitive and behavioral functioning in young children. Research in preschool and elementary school-aged children has shown that physical activity interventions positively affect the development of motor skills and moderate to vigorous physical activity (MVPA). This was drawn from multiple studies conducted in diverse settings and for varying durations.

This meta-analysis combines studies exploring the relationship between physical interventions and preschool children's motor development. The evidence in the included studies shows that structured PA, including exergaming and motor skills programs, significantly results in higher rates of children's MVPA and increases in their total motor functioning. Gao et al. (2019) noted the benefits of exergaming in an educational setting, and Bezerra et al. (2021) stated the necessity of regular physical exercise to enhance executive function. Programs aimed at motor skill interventions have also been established as being just as essential in enhancing general motor abilities in young children. Variations in the research designs and methodological strategies show that interventions' frequency and duration are crucial factors influencing the results.

DISCUSSION

Evidence suggests that many physical activity interventions produce significant gains in motor skills and cognitive functioning among preschool and primary school children; for example, one study found that an 8-week video game intervention increased the amount of time children spent in moderate to vigorous physical activity (MVPA). For instance, a study done in 2019 indicated that an 8-week video game intervention improved MVPA, PC, and MSC in pre-schoolers. Again, Jones et al. (2020) observed that the participants in the experimental condition had higher improvements in motor skills following their involvement in a 20-week motor skills program. It has been shown that play-based therapies enhance object-control abilities. Additionally, Bezerra et al. (2021) discovered that preschool-aged children who engaged in more physical activities regularly showed higher improvements in their executive skills, while Pham et al. (2021) indicated significant differences in IQ within that age group—reported significant differences in cognitive skills between the experimental and control groups after 20 weeks of "brain" play. This evidence supports the importance of incorporating physical activity into early childhood education programs to support optimal motor and cognitive development.

CONCLUSION

Studies show that organized physical therapies, like exergaming and movement skills programs, can significantly increase MVPA and motor skills among pre-schoolers. This finding suggests powerful support for including multi-physical activities in classroom settings to foster preschool children's mental and physical health development. The study shows that while the motor skills program may significantly improve toddlers' fundamental and fine motor skills, exergaming effectively increases classroom MVPA levels. There was also a positive association between pre-schoolers executive function and daily physical activity, indicating the far-reaching benefits of these physical interventions.

APPLICABLE REMARKS

- Integrating structured physical activity such as exergaming and motor skills programs in early childhood education programs is essential to improve their motor and cognitive development.

- Physical activity interventions support global efforts to prevent childhood obesity and build healthy living habits early on.

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AUTHORS' CONTRIBUTIONS

Study concept and design: Rezki, Fahmil Haris, Data Acquisition: Gusril, Alnedral. Analysis and interpretation of data: Bafirman, Anton Komaini. Drafting the manuscript: Fahmil Haris, Gusril. Critical manuscript revision for important intellectual content: Rezki, Fahmil Haris. Statistical analysis: Alnedral, Bafirman.

CONFLICTS OF INTEREST

The authors state that this study has no "Conflict of Interest."

ETHICAL CONSIDERATION

This research adheres to ethical standards and has obtained approval to include all respondents as samples.

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FINANCIAL DISCLOSURE

The authors have no financial interests related to the material in the manuscript.

ARTIFICIAL INTELLIGENCE (AI) USE

In completing this manuscript, the authors did not use artificial intelligence (AI) to prepare, write, or edit.

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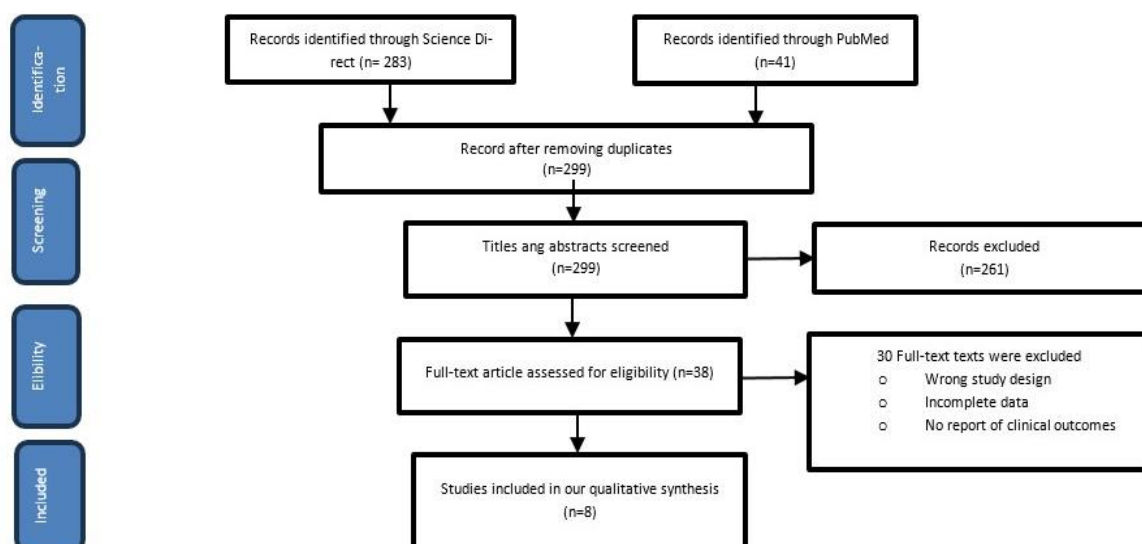


Figure 1. PRISMA research flowchart through the review process

Table 1. Methodological quality of included studies

Reference	Selection bias	Study design	Confounders	Blinding	Data collection methods	Withdrawal and dropouts	Overall quality scores
(5)	weak	strong	strong	currently	currently	strong	currently
(6)	Currently	strong	Strong	currently	strong	strong	strong
(7)	weak	strong	weak	strong	currently	strong	currently
(8)	Currently	strong	Strong	strong	currently	strong	currently
(9)	weak	strong	Strong	currently	strong	strong	currently
(10)	Currently	strong	Strong	currently	strong	currently	strong
(11)	Currently	strong	Weak	currently	strong	currently	strong
(12)	Currently	strong	Strong	currently		weak	strong
(13)	Currently	strong	Strong	strong	currently	Weak	weak
(14)	Weak	strong	Strong	strong	currently	Weak	strong
(15)	Currently	strong	Strong	strong	currently	Weak	strong

Table 2. Results of Article Review of Randomized Trials

Author	Sample	Testing/ settings	Outcomes/instruments	Dose	Exposure	Findings
(6)	65 preschool children from 2 schools	Pre-post	PC, MSC, and MVPA	100 minutes/week exergaming (5 days × 20 minutes)	8 weeks	Exergaming positively affected preschool children's MVPA, PC, and MSC.
(7)	123 preschool children (3-5 years)	Pre-post	Accelerometer, EF measured with Early Tool Box	compositional data analysis	7 days	The relationship between 24-hour MB and EF in preschool children provides new insights.
(8)	SS:97 Age:4.64 ± 0.5yr; EG:52 CG:45	Pre-post	TGMD-2 (Raw score)	3x/week, 20 minutes per session	20 weeks	Significant improvement in EG compared to CG (d = 0.75)—significant differences in jumping and sum of five motor skills.
(10)	SS: 153, EG: 85, CG: 68, age 4.5 ± 0.5 years Age: 8.55	pre-post	TGMD-2	3x/week, 30 minutes per session	6 months	PA in EG showed large effects across time and between groups (P < 0.001).
(11)	years, SS: 55, EG: 28, CG: 27	pre-post	FMS (LC, OC)	2x/week, 35 minutes per session	20 weeks	There is a significant difference in LC and OC between EG and CG, and EG performs better.
(12)	SS: 66, EG: 49, CG: 17, age 4.2 ± 0.7 years	Pre-post	TGMD-2 (GMQ percentiles)	1-5x/week, 40 minutes	24 weeks	GMQ, LM, and OC increased in EG and CG.
(13)	SS: 66, EG: 46, CG: 20, age 4.1 ± 0.6 years	pre-post	physical activity (PA).	1x/week, 45 minutes per session	10 weeks	LC and OK increased in EG, with no change in CG.
(14)	SS: 100, EG: 51, CG: 49, age 8.6 ± 0.7 years	pre-post	FMS	2x/week, 30 minutes per session	4 weeks	There was a significant difference in FMS between EG and CG, and the time of gender group showed significant changes. CG has no change in LC and OC.

Development of Nutrition Status Measurement In Students Using Digital Technology

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ABSTRACT

Background. The development and evaluation of a digital application designed to assess students' nutritional adequacy have demonstrated its validity, practicality, and effectiveness as a tool for measuring nutritional status, providing valuable insights for students and the community to manage healthy diets. **Objectives.** This study aims to determine the nutritional adequacy of students using digital technology. **Methods.** The research and development method used is the Borg and Gall model. Research data was obtained through observation, tests, and questionnaires. The data collection instruments were validation sheets of experts (media experts, nutritionists, and linguists), rubrics for measuring student nutritional status, and questionnaires for assessing student responses. The data obtained were analyzed to prove the resulting product's validity, practicality, and effectiveness. **Results.** The results of the study stated that the validation assessment of the experts that the product developed was valid/feasible to use. Products are also categorized as very practical. The results of trials on a small and large scale show that the application is very efficient because it can prove the nutritional status of students. **Conclusions.** It is stated that this application product can be used by students and the community as a measuring tool for nutritional status to further regulate diet or consumption of foods with high nutrition.

KEYWORDS: *Development, Nutritional Status, Digital Technology*

INTRODUCTION

Food is a critical need for everyone to survive. In addition, food is one of the main things supporting the body in various activities. Wishful thinking is a basic need that must be available at all times, both in terms of quantity and quality, safe, nutritious, and affordable by people's purchasing power (1). Therefore, the balance of food consumption can determine a person's health. Overeating one type of food without balancing it with other foods can lead to health problems (2). Lack of public knowledge in regulating diet is one factor affecting a person's nutrition.

Factors that affect the growth and nutritional status of students in developing countries include infectious diseases and consumption of food that does not meet nutritional needs. In the short term, impaired growth and development of students will affect learning concentration and achievement. The long-term result is a decrease in human resources (HR) quality. Good nutritional or nutritional status will lead to optimal health degrees and will assist school students in improving their thinking ability and learning performance (3).

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High activity starting from school, courses, doing homework (PR), and preparing for work for the next day makes students' stamina decline quickly, but if it is not supported by adequate and balanced nutritious food intake. Therefore, to keep students' stamina in shape while participating in school activities, they must have breakfast that meets nutritional adequacy. Energy from breakfast for students is recommended to be around 1/3 of the energy needed daily.

This research was carried out on students of SMA Negeri 2 Sembawa, Banyuasin Regency, because, according to the observations made by the authors on the activities and habits of students during the COVID-19 pandemic (4,5), there were changes. These changes include the limitations of students doing physical activities, such as the absence of PJO learning in schools, large-scale social restrictions, and learning online or studying at home. The decrease in students' physical activity certainly impacts increasing body weight because food intake that enters the body does not become energy but becomes fat content. In addition, in measuring the nutritional adequacy of students in schools, they still use a manual system, so it requires a longer processing process. The analysis results are less accurate and less practical than digital technology measurements.

The intervention group using the application improved more than the manual intervention group (6). Another finding is that electronic-based recording and reporting models can produce more information output and are helpful in nutrition program planning, monitoring, and evaluation. Electronic-based systems are better quality, and data analysis output is greater for planning, monitoring, and evaluating nutrition programs and supporting decision-making (7).

Following up on the existing nutritional status measurement application, it seems that the language used is English, so it is difficult for users to operate it, and the food consumption measured is the hotel menu. Therefore, the authors developed it using Indonesian, adding measurements of energy consumption, nutrients, and food consumed by students.

Based on the background of the problems above and previous research, the authors are interested in further research to develop measurements of nutritional status in students through innovative use of Indonesian-language digital technology by consuming 100 grams of food servings or doses, resulting in a novelty in the field of health and nutrition.

MATERIALS AND METHODS

The research development method that the author uses is the Borg and Gall model with the reason (8) that this model can address real and urgent needs by developing solutions to a problem while generating knowledge that can be used in the future, being able to produce a product/model that has a high validation value because through a series of field trials and validated by experts, encouraging a continuous process of product/model innovation so that it is hoped that models/products that are always up to date with current demands will be found, and become a liaison between theoretical and field research. Methods of data collection are observation, tests, and questionnaires. The data collection instruments were validation sheets of experts (media experts, nutritionists, and linguists), rubrics for measuring student nutritional status, and questionnaires for assessing student responses. Media experts play a role in assessing the application's ease, attractiveness, usefulness, security, and clarity. Furthermore, the nutritionist assesses the suitability of the application with the materials, indicators, objectives, instruments, and instrument items with the criteria. Meanwhile, linguists assess the manual, which covers the cover aspect with indicators: the writing on the cover follows the EYD, the description on the cover and back pages is easy to understand, and the suitability of the writing on the cover page with the mother of the book. Then, the paraphrase and content aspects of the book include indicators: the language used follows the EYD, is formal, does not cause multiple interpretations, the sentence structure is clear, and the accuracy of the choice of command sentences is high.

The data obtained were analyzed to prove the resulting product's validity, practicality, and effectiveness. Validity analysis is used to measure the feasibility of measuring nutritional status using digital technology; according to experts, practicality analysis measures student responses to nutritional status measurement applications, and effectiveness is used to measure the performance of digital applications and whether they can produce student nutritional status output.

RESULTS

The initial product of the development of measuring nutritional status in students of SMA Negeri 2 Sembawa, Banyuasin Regency, using digital technology, before being tested, needs to be validated by experts according to the field of expertise. In design validation, the validator validates one item of product

development, namely the measurement of nutritional status using digital technology. In this case, the validator assesses the application program installed on the laptop (notebook).

The validation of the nutritional status measurement developed was assessed by Dr. Sardianto M.S, M.Sc., M.Pd., who is a program expert from Sriwijaya State University. Dr. Windi Dwi Andika, M.Pd., a nutritionist from Sriwijaya State University, assessed material validation. The validation of writing manuals was assessed by Ernalida, S.Pd., M.Hum., Ph.D., an Indonesian language expert from Sriwijaya State University.

Validation is done by providing the initial product concept of the nutritional status measurement application program installed on laptops (notebooks). The validator assesses the application program through a validation sheet according to their expertise. The validation sheet is a checklist sheet (✓) on the aspects measured, whether or not the model's design is appropriate, and expert input on the design developed by the researcher.

The Media expert's assessment of the digital application is designed to measure nutritional status through a validation sheet regarding the quality of the developed application model. The results of the initial product assessment of the development of nutritional status measurements using digital technology from media experts were not good, with a total score of 25 out of a maximum score of 35 and 71.43% as a percentage. Notes that become criticisms of media experts are: (1) improve the self-data processing application, especially on application responses. For example, if the data on height do not match, then the appropriate data should appear for age, height, and weight; (2) run time error still occurs if the morning, afternoon, and evening consumption does not match the available options. If possible, add data on the type of consumption. The author's follow-up to the criticism was to revise the application so that the second evaluator obtained a total score of 28, representing 80%. The notes given by the expert at this meeting were: the database in Microsoft Access needs adjustments and additions according to Rubik's data given to students, especially regarding morning, afternoon, and evening consumption. In response, the author revised the application and got an assessment of 35 with a percentage of 100%. The final comment given by the expert is that this nutritional status measurement application is already good; the database can be added as needed. Please test the application.

Nutritionists assessed the material in the application design to measure nutritional status twice. In the first meeting, nutritionists gave a total score of 16 out of a maximum score of 25, and the percentage was 64%. The notes given are: (1) complete the material again by adding the consumption of morning, afternoon, and evening according to the actual situation; (2) include the level of consumption in the measurement of nutritional status; and (3) the application is not following the items of the instrument because there are still run-time errors when the database is entered. Following up on these corrections, the authors made revisions so that they could be resubmitted. The assessment results at the second meeting obtained a score of 96% of the total score of 24 and a maximum score of 25. Based on his assessment, the nutritionist stated that the material was good enough and could be tested in the field.

The assessment of the initial product manual for developing nutritional status measurements using digital technology from linguists was not good; the score given was 30 out of a maximum score of 40, with a 75% percentage. According to the linguist of the initial product manual, the development of measuring nutritional status using digital technology needs to be revised with the following notes: (1) use PUEBI for spelling, diction, and sentence writing guidelines; (2) writing words, sentences in English italicized; (3) re-check the writing of the title and numbering of the image; and (4) learn to write and use standard words in Indonesian (KBBI). Based on this, the author again revised. The next meeting obtained a total score of 33 with a percentage of 82.5%. According to linguists, the development manual for measuring nutritional status using digital technology is appropriate for use with revisions.

The subsequent analysis is the practicality of measuring the level of student response in using measurement applications through a questionnaire sheet totaling 10 statements, including the application's suitability and ease of application. Analysis of the practicality of measuring nutritional status using digital technology based on scores obtained from student questionnaires, where the maximum score is multiplied by the number of students ($4 \times 50 = 200$) and then categorized. The results of the practicality analysis are shown in the following diagram.

Figure 1 above shows 42 students (84%) with an interval value of 86 – 100 in the efficient category, eight students (16%) between the interval values of 76 – 100 are classified as practical, and in other interval values it is not found (0.0%). Thus, efficiency is the dominant practicality category in developing nutritional status measurements using digital technology.

The analysis of validity and practicality has been described above, followed by the effectiveness analysis. This analysis is an assessment of filling in the rubric for assessing nutritional adequacy numbers on a small scale and a large scale using the developed application. The results of the analysis of nutritional adequacy figures on a small and large scale based on the assessment rubric can be seen in the following diagram:

Figure 2 above shows that five students (50%) out of 10 in the small-scale trial have excess nutritional status, and the rest are malnourished. Meanwhile, in a large-scale trial, it was stated that 21 students (42%) of 50 students had excess nutritional status, and 29 students (58%) had malnutrition status. This shows that the performance of digital applications in measuring nutritional status in small and large groups is 100%.

DISCUSSION

Nutrition is needed for students for growth and development, energy, thinking power, and endurance. Nutrition is a condition in which organisms usually consume food through digestion, absorption, transportation, storage, metabolism, and excretion of substances not used to maintain life, growth, and normal body function organs and produce energy. Sufficient energy is needed for daily activities and the body's metabolic processes. Likewise, increased protein requirements due to the rapid growth and development process. If energy intake is limited / less, protein will be used as energy. In Addition, quality nutrition will optimize brain growth and development.

Nutrition is a food source that works in the body (3). Nutrition includes everything that happens to food, from when it is eaten until it is used for various bodily functions. Nutrients are food components the body needs in sufficient quantities to grow, reproduce, and lead an everyday and healthy life. These nutrients include water, protein, fat, carbohydrates, minerals, and vitamins. Each group has several nutrients: proteins, fats, carbohydrates, minerals, and vitamins; hence, the plural form of these words has been used. So, more than 40 essential nutrients are provided by food, which are used to produce thousands of substances necessary for life and physical fitness.

A person's nutritional status depends on nutritional intake and needs; if the nutritional intake and body needs are balanced, they will have a good nutritional status (9). Nutritional status is "a measure of success in fulfilling nutrition for a person indicated by weight and height. Nutritional status assessment is the interpretation of information obtained from the assessment of food intake, biochemistry, anthropometry, and clinical studies (10).

The development of measuring nutritional status using digital technology developed and made by the author is a product that aims to make it easier for students and the general public to measure nutritional adequacy rates so that the nutritional status of the food consumed in the morning, afternoon, and evening is known.

The digital technology developed is an application for developing a student nutritional status measurement tool through Microsoft Visual Basic from Windows 10. Three experts have validated this product: media, material, and language. The results of product validation obtained several criticisms, suggestions, and comments, followed up or revised to produce products suitable for use, and then tested on a small scale with 10 students of SMA Negeri 2 Banyuasin. The test results on a small scale show that the product's performance can function adequately, and there is no system error. The product was then tested on a large scale with 50 students.

Products declared feasible and tested on both small and large scales need to be analyzed for practicality through student responses to a questionnaire comprising 10 statements regarding the use of nutritional status measurement applications. The average percentage of student responses was 91% in the very high category, with 42 students (84%) at the interval value of 86-100 in the efficient category and eight students (16%) between the interval scores of 76-100 classified as practical. Thus, the practicality of developing nutritional status measurements using digital technology is in an efficient category. Practical products show that the developed digital technology can help teachers and students measure nutritional status and use it properly.

Another analysis is the effectiveness of using digital technology in measuring nutritional status. The application is declared effective if there is no system error, namely an error or failure in the computer program, so it does not run as it should. Based on the performance of digital applications in measuring nutritional status on a small and large scale, the effectiveness is stated to be 100%. After reviewing the performance of this application, it shows several weaknesses that need improvement, such as food consumption only at a dose of 100 grams, age in the range of 14-17 years, and can be used only on Windows 10. In addition, this product has advantages such as being easy to operate, being done offline using a computer or laptop and being more practical and effective in determining nutritional status, as a new idea in nutrition science.

The study results concluded that the average nutritional status was good, the consumption of energy and nutrients was lacking, the food consumed by students was classified as moderate, and the lifestyle was moderate (11). Research (12) states that the more nutritional status (z-score) and percent body fat, the earlier the age of menarche. Normalize nutritional status and body fat percentage by maintaining consumption patterns and increasing physical activity, such as cycling, swimming, etc. Furthermore, research (13) shows that overweight students' nutrition and physical fitness have the lowest physical fitness while students with

poor/limited nutrition have the highest physical fitness. Understanding adolescents' physical activity and sedentary behavior can help teachers, parents, and governments determine effective adolescent policies and interventions.

CONCLUSION

Based on the explanation above, it can be stated that the development of measuring nutritional status using digital technology for students of SMA Negeri 2 Banyuasin has very high implications for students; this application product can be used by students and the community as a measuring tool for nutritional status so that further it can regulate patterns eat or consume various types of foods that have high nutrition. Students can also measure the nutritional adequacy rate at any time by entering the type of food they have consumed.

APPLICABLE REMARKS

- The digital application for assessing students' nutritional adequacy has been validated as feasible and practical, proving its effectiveness in providing accurate insights into students' nutritional status.
- This application is an efficient tool for promoting healthy nutrition and informed food consumption choices by enabling students and the community to measure and manage their dietary intake.

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AUTHORS' CONTRIBUTIONS

Study concept and design: Hartati. Acquisition of data: Bayu Hardyono. Analysis and interpretation of data: Agus Hariyanto. Drafting the manuscript: Alvendo Prataman. Critical revision of the manuscript for important intellectual content: Hartati. Statistical analysis: Agus Hariyanto.

CONFLICTS OF INTEREST

The authors state that this study has no "Conflict of Interest."

ETHICAL CONSIDERATION

This research adheres to ethical standards and has obtained approval to include all respondents as samples.

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The authors have no financial interests related to the material in the manuscript.

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In completing this manuscript, the authors did not use artificial intelligence (AI) to prepare, write, or edit.

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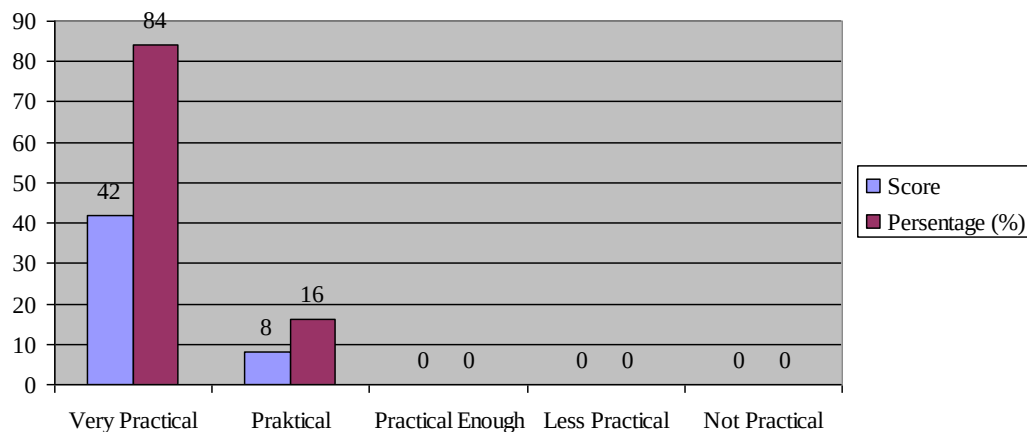


Figure 1. Student Response Diagram

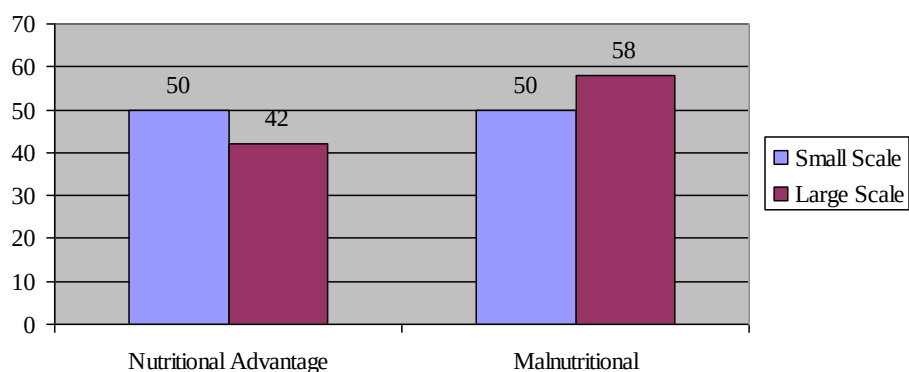


Figure 2. Diagram of Student Nutritional Status

Validity of Android-Based Model for Butterfly Style Swimming Training

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ABSTRACT

Background. Developing effective training models for butterfly stroke swimming remains challenging for many trainers. **Objectives.** This study aims to create a high-quality butterfly-stroke swimming training model tailored for Android devices, adhering to systematic development stages and providing a practical and beneficial training tool. **Methods.** This research employs a research and development (R&D) methodology. The steps include an initial needs analysis, model design development, product creation, evaluation, and revision. The developed training model underwent validation by material and media experts. Test subjects included athletes from Build Swimming Club and GSC Padang who participated in the butterfly-stroke swimming training program. Data collection involved questionnaires assessing product quality, suggestions for improvement, and other qualitative feedback. **Results.** The validation by material experts yielded a "good" rating, with an average score of 4.04 in aspects of swimming material quality and content. Similarly, media experts rated the training model as "good," with an average score of 4.04 in display and programming aspects. **Conclusions.** The results demonstrate that the Android-based butterfly-stroke swimming training model is a suitable and effective tool for training processes. It addresses gaps in existing methods, offering a reliable and user-friendly solution for trainers and athletes alike.

KEYWORDS: *Training Model, Butterfly Stroke Swimming, Swimming, Android-Based Application*

INTRODUCTION

Swimming is a sport performed in water that significantly improves health and fitness by engaging all the body's muscles (1,2). Additionally, it substantially benefits cardiovascular and pulmonary health (3,4).

The butterfly stroke is the most elegant among the various swimming styles. Its movement resembles a dolphin's, requiring synchronized activity of all muscles during hand pulls, leg kicks, and breathing. The butterfly stroke is a symmetrical movement where both arms and legs are moved simultaneously (5–7). Swimming speed is influenced by stroke frequency and length, making these critical elements in performance (6,8). Proper breathing techniques are also essential in swimming, as it is impossible to cover long distances without effective breath control (9,10).

The butterfly stroke is considered an advanced style. Before mastering this, swimmers need proficiency in other styles, such as freestyle or breaststroke. Due to its complex movements and coordination requirements, the butterfly stroke is often deemed the most challenging style (11).

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In this style, the arms move simultaneously during the underwater (sweep) and recovery phases above water. This coordination makes it difficult for athletes to lift their heads and necks to breathe efficiently. Waist flexibility is a critical factor contributing to the difficulty of teaching the butterfly stroke compared to other styles (12). Additionally, the simultaneous leg kicks required in the butterfly stroke further complicate the technique for beginners.

Adequate equipment is necessary to enhance the mastery of butterfly stroke techniques. Tools such as fins, kickboards, pull buoys, and hand paddles are instrumental in training (13).

Achieving optimal swimming performance also requires access to proper facilities, appropriate technology, and well-targeted training models implemented effectively. However, observations in various swimming clubs reveal that many coaches rely on personal experience rather than developing practical and systematic butterfly stroke training models. Coaches often train swimmers based on their experience as athletes or by observing techniques on platforms like Google or YouTube. Resistance to innovation and the lack of new training models further hinder progress.

Effective butterfly stroke training models should address athletes' challenges, enabling them to master the technique more efficiently. Coaches must innovate and create training methods that facilitate rapid skill acquisition, particularly for novice athletes, ensuring they develop proper movement and technique.

Incorporating technology into butterfly stroke training models can make the process more accessible and practical. For instance, the Adobe Flash Professional CS6 application can create interactive training programs compatible with Android devices.

Adobe Flash Professional CS6 is a popular 2D vector animation program among animators (14). Leveraging such technology aligns with modern coaches' reliance on gadgets, which have become indispensable tools in daily life. This application offers an innovative approach to packaging butterfly-stroke training models in a user-friendly format.

Combining butterfly stroke training with technology forms the foundation for developing a practical model accessible to coaches and athletes via mobile devices. Motivated by the challenges and opportunities described above, this study aims to create an Android-based butterfly stroke training model using the Adobe Flash Professional CS6 application.

MATERIALS AND METHODS

Type of research. This study employs a research and development (R&D) methodology. The primary aim is to evaluate the feasibility of developing a butterfly stroke training model using Adobe Flash CS6, designed for Android devices. The model is intended to be used as a training tool at the SeaRIA Aquatic Swimming Club. The following framework outlines the development process for the training model.

Research Subjects. The subjects of this study are swimmers from the SeaRIA Aquatic swimming club, specifically those in the Age Group (KU) IV and V categories, ranging from 8 to 11 years old.

Research Instruments. The research utilizes a Likert scale-based instrument, divided into two components: a) a material expert feasibility test instrument and b) a media expert feasibility test instrument.

The data collected through the scale are presented as averages classified according to feasibility levels. Assessments are provided by material experts and media experts, focusing on aspects such as quality, material content, display, and programming.

Data Collection Technique. A validation sheet is employed to evaluate whether the designed media is valid. Two validators are involved in this process: Media Validator and material validator.

Each validation aspect is divided into several statements. The rating scale for the validation sheet uses a Likert scale, as outlined in Table 1. Validators directly validate the sheet, providing ratings based on predefined criteria.

Data analysis technique. The validation results provided by the validators for all assessed aspects are presented in tabular format. The maximum score on the validation sheet is calculated using the following formula to evaluate the validity of the model:

$$\text{Maximum score} = \text{Number of Validatos} \times \text{Number of Indicators} \times \text{Maximum Score per item (1)}$$

The validity value is then determined using a formula adapted from Purwanto (Saputri, 2015: 8), designed to quantify the model's feasibility and effectiveness (Table 1).

RESULTS

Stage 1 and Stage 2 Product Revisions. The initial version of the product's overall design had a dark color scheme that obscured the swimmers' image. After revisions, the color scheme was updated to blue, providing a more precise and visually appealing representation of swimmers performing the butterfly stroke.

During the second stage of revisions, expert validation offered valuable feedback to enhance the learning media. One notable change was on the Exercise Model page, where an image icon initially depicted freestyle swimming. Following expert input, this was corrected to display the butterfly stroke accurately. Similarly, the Exercise Schedule page underwent improvements; its original black-and-white schedule table was redesigned with a red-and-white color scheme to enhance visibility and aesthetic appeal.

The alignment of photos and text was also refined. Displayed initially side by side in a less structured manner, the layout was adjusted to present the images and text more cohesively.

Additionally, the profile menu was expanded to include information about the promoters, a feature absent in the initial version. These revisions significantly improved the usability and overall quality of the product.

Material Expert Validation Data. The validation process was conducted following the initial revision of the training model based on the feedback provided by the material expert. The suggestions from the material expert were incorporated to enhance the quality of the training model. Both the questionnaire and the Adobe Flash application were evaluated during this process.

The data collected reflect the material expert's evaluation of the revised media. In the second validation stage, the material expert assigned an average score of 4.29, categorizing the training model as "very good." These results demonstrate a notable improvement in the quality of the media developed. For a detailed breakdown of the results, refer to Table 2.

Meanwhile, from the material expert's assessment of the exercise material's content aspect, assessing with a score of 4.29 is included in the "very good" category. More details can be seen in Table 3 as follows:

The material expert evaluated the training media and categorized its quality as "good." This media is deemed highly effective for butterfly stroke swimming training, specifically for swimmers in the KU IV and V categories. Implementing this training model is anticipated to enhance both technique and speed in the butterfly stroke.

Media Expert Validation Data. The validation data from media experts were collected through questionnaires addressing display and programming aspects. The questionnaires were provided alongside the application developed using Adobe Flash. Media experts evaluated the application by testing its functionality and providing feedback and suggestions for improvement based on its content and usability. The assessment by media experts yielded an average score of 4.08 for the display aspect, placing it in the "good" category. A detailed summary of the data is presented in Table 4.

While in the aspect of programming media experts assess with an average score of 4 included in the "Good" category, more details can be seen in Table 5 as follows:

The media expert evaluated the training model based on its appearance and programming in this validation. The training model was deemed "good" and suitable for progression to the next stage without requiring further revisions. The overall conclusion is that the training model is appropriate for trial implementation.

The material expert validation assessed the butterfly-stroke swimming training model based on its product quality. Specifically, the evaluation focused on the quality of swimming material and the content/material aspect.

The assessment included 14 questionnaire items, rated as "very good" with an average score of 4.29. A detailed breakdown of the frequency distribution for the quality of swimming material is shown in Table 6 and Figure 3:

The data indicate that 28.57% of the material quality items were rated as "very good," while 71.43% were rated as "good." The overall average score of 4.29 places the material quality aspect in the "very good" category. The content/material aspect was also assessed using 14 questionnaire items, yielding an average score of 3.78, categorized as "good." The frequency distribution for this aspect is detailed in Table 7 and Figure 4.

The data reveal that 28.57% of the content/material items were rated as "very good," 28.57% as "good," and 42.86% as "good enough." The average score of 3.78 indicates that the content/material aspect meets the "good" criteria.

Based on the assessment above, it shows that in the evaluation of material experts, there is progress, seen from the content/material aspects obtained data: 28.57% are included in the "very good" category, 28.57% in the "good" category and 42.86% in the "good enough" category. The overall content/material aspect average is 3.78, included in the "good" criteria. Also, the results of the comprehensive evaluation of the exercise model being developed at the second stage by the material expert can be seen in Table 8 and Figure 5 as follows:

The assessment data demonstrate that the model achieved an overall average score of 4.04, categorizing it as "good." This includes scores for the quality of swimming material (4.29) and the content/material aspect (3.78).

In addition to quantitative assessments, material experts provided comments and suggestions to enhance the training model. These suggestions were implemented, resulting in an improved product ready for subsequent validation.

Media experts evaluated the display aspect of the training media, which consisted of 24 items. The results are summarized in Table 9 and Figure 5:

The data from Figure 6 indicate that 37.5% of the items were rated "very good," 33.33% were rated "good," and 29.17% were rated "good enough." The overall average score for the display aspect is 4.08, categorized as "good."

The programming aspect, consisting of 10 items, was also evaluated. Results are detailed in Table 10 and Figure 2.

The programming aspect received 30% of ratings in the "very good" category, 40% in the "good" category, and 30% in the "good enough" category. The overall average score for this aspect is 4.00, classified as "good."

The combined results for the display and programming aspects are summarized in Table 11:

The results confirm that the butterfly-style swimming training media is categorized as "good," with an overall average score of 4.04. Based on these findings, media experts concluded that the product is ready for field testing.

DISCUSSION

The findings of this study underscore the effectiveness of an Android-based butterfly-stroke swimming training model developed using Adobe Flash CS6. This innovative approach has demonstrated its feasibility and practicality for athletes and coaches. Below, the key insights and implications are discussed in detail.

Material experts evaluated the content and quality of the training model, with an average score of 4.29, categorizing it as "very good." The aspects that stood out included the clarity of instructions, the exercise model's suitability, and the training materials' appropriateness. These findings validate the model's robustness in delivering high-quality, systematic instruction for butterfly stroke swimming.

Media experts comprehensively evaluated the display and programming aspects, yielding an average score of 4.08, also categorized as "good." Specific strengths included the accuracy of color selection, button placement, and video clarity. This reflects the model's effectiveness in delivering an intuitive and engaging user interface, which is crucial for fostering user interaction and understanding (14).

The training model offers a structured, visually appealing, user-friendly tool for teaching butterfly stroke techniques. Traditional coaching methods often rely heavily on verbal instructions or personal demonstrations. This model supplements such methods by providing interactive and repeatable training materials, allowing coaches to focus on addressing individual athlete needs. Moreover, its integration with modern technology encourages a broader adoption of innovative training practices (15).

Athletes benefit from the model's accessibility and detailed instructional design. The ability to practice techniques independently, supported by high-quality visual aids, enhances their capacity for self-guided improvement. The model also facilitates the development of critical aspects of the butterfly stroke, such as arm-leg coordination and effective breathing techniques (8).

Despite its promising results, the study has limitations. The scope of the research was confined to a specific age group (8-11 years) and participants from a single swimming club. Future studies should include a more diverse population and broader age range to generalize these findings.

Additionally, while Adobe Flash CS6 proved effective in this study, advancements in technology necessitate exploring alternative platforms for future development. Transitioning to more modern, widely supported tools could enhance compatibility and ensure long-term usability (6).

Future research should also consider longitudinal studies to evaluate the sustained impact of this training model on performance metrics such as stroke efficiency, speed, and endurance. Incorporating feedback from athletes and coaches during extended trials could further refine the model and maximize its efficacy.

Expanding user trials across different skill levels and competitive categories will help evaluate the model's adaptability and effectiveness in varied contexts. Integrating advanced technologies like modern programming tools like Unity or other app development platforms can enhance the training model's graphical and functional features.

Additionally, developing supplementary modules to address other aspects of swimming, such as mental conditioning, nutrition, and injury prevention, would provide a more holistic training approach.

CONCLUSIONS

The development of the butterfly-style swimming training model followed a rigorous and systematic

process consisting of ten stages: identifying potential and problems, data collection, product design, design validation, design revision, product trial, product revision, usage trial, product refinement, and mass production.

During these stages, the training model was carefully designed to determine the training objectives, principles, models, materials, and equipment and develop training schedules and evaluation mechanisms for movement errors. This comprehensive process culminated in a final product—a butterfly-style swimming training model developed using Adobe Flash CS6 for Android, tailored for practical use by athletes and coaches.

Experts evaluated the training model for validity. Material experts assessed the model's quality as "Good," emphasizing its value in teaching butterfly stroke techniques. Similarly, media experts validated the model's usability, concluding that the development of the training media using Adobe Flash CS6 was also of "Good" quality. These assessments affirm that the training model is practical and effective for enhancing butterfly-stroke swimming skills.

It is recommended that coaches integrate this butterfly-style swimming training model into their training programs. The model's interactive and visual nature facilitates better understanding and imitation of proper techniques by athletes. As traditional training often relies solely on verbal instructions, this model introduces an innovative and engaging approach to coaching. Coaches are encouraged to develop such training tools further to inspire athletes and enhance their training outcomes, as the success of an athlete's performance is deeply influenced by the quality of coaching provided.

This training model provides athletes an excellent opportunity to refine their butterfly stroke techniques. By leveraging its Android-based accessibility, athletes can use the model independently, whether under the guidance of a coach or during self-training sessions. This independent practice allows athletes to master correct swimming techniques and improve their overall performance.

Future researchers are encouraged to expand upon this study to maximize its potential contributions to swimming training and sports research. Conducting product trials with a broader scope of participants can provide more comprehensive insights into the model's effectiveness.

Additionally, extending the duration of future research will allow for a more thorough evaluation of training outcomes and further refinement of the model.

By addressing these areas, future studies can significantly enhance the quality of training tools and research in swimming.

APPLICABLE REMARKS

- The Android-based butterfly-stroke swimming training model provides a user-friendly and effective solution, validated by experts with a "good" rating of 4.04 in both content and media, making it highly suitable for trainers and athletes.
- This systematically developed training model addresses gaps in traditional methods and enhances the practicality and reliability of butterfly stroke training, benefiting athletes and advancing coaching techniques.

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AUTHORS' CONTRIBUTIONS

Study concept and design: Meiriani Armen. Acquisition of data: Syahrastani. Analysis and interpretation of data: Hendri Neldi. Drafting the manuscript: Vlad Adrian Geantă. Critical manuscript revision for important intellectual content: Meiriani Armen, Vlad Adrian Geantă. Statistical analysis: Meiriani Armen.

CONFLICT OF INTEREST

The authors state that this study has no "Conflict of Interest."

ETHICAL CONSIDERATION

This research adheres to ethical standards and has obtained approval to include all respondents as samples.

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The authors have no financial interests related to the material in the manuscript.

ARTIFICIAL INTELLIGENCE (AI) USE

In completing this manuscript, the authors did not use artificial intelligence (AI) to prepare, write, or edit.

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Table 1. Validity Assessment Criteria

Percentage	Criteria
90% - 100%	Very Valid
80% - 89%	Valid
65% - 79%	Fairly Valid
55% - 64%	Less Valid
0% - 54%	Invalid

Source: Saputri (2015:8)

Table 2. Score of Swimming Material Quality Aspects from Material Experts.

No.	Assessed Aspect	Rating Scale					Criteria
		1	2	3	4	5	
1	Clarity of instructions				V		Good
2	Clarity of training model				V		Good
3	Suitability of Exercise model and Butterfly-style swimming technique				V		Good
4	Suitability of the material with the exercise objectives					V	Good
5	Appropriateness of choosing the material provided					V	Very good
6	Accuracy of language selection in describing the material					V	Good
7	Video clarity and accuracy					V	Very good
8	Ease of selecting the exercise model menu					V	Very good
9	Provision of an exercise program				V		Good
10	Clarity of evaluation Giving					V	Very good
11	Suitability of evaluation with material					V	Good
12	Strengthening that positive reinforcement for the training model				V		Good
13	Strengthening Positive for exercise programs				V		Good
14	Availability of evaluation movement				V		Good
	Total				40	20	
	Total Score			60			
	Average			4,29			Very good

Table 3. Score of Content/Material Aspects from Experts

No.	Assessed Aspect	Rating Scale					Criteria
		1	2	3	4	5	
1	Correctness of content/concept					V	Good
2	Depth of material					V	Very good
3	Coverage material for exercise achievement			V			Simply
4	Clarity of material/concept				V		Good
5	Material actualization			V			Simply
6	Logical systematization of presentation			V			Simply
7	Accuracy of language selection to explain the material					V	Good
8	Accuracy video in explaining the material					V	Very good
9	Accuracy selection of images associated with the material				V		Good
10	Appropriateness of the evaluation to the training model			V			Simply
11	Clarity of training model			V			Simply
12	Motivating athletes to look at training models					V	Very good
13	Level of difficulty of the exercise program			V			Simply
14	Evaluation difficulty level					V	Very good
	Total			18	20	15	
	Total Score			53			
	Average			3,78			Good

Table 4. Display Aspect Score from Media Expert

No.	Assessed Aspect	Rating Scale					Comment
		1	2	3	4	5	
1	Accuracy of color selection (Background)					√	Very good
2	Appropriateness of text and background color					√	Very good
3	Model Title Writing				√		Good
4	Accuracy in choosing music				√		Simply
5	Video attractiveness					√	Very good
6	Design attractiveness				√		Good
7	Video clarity					√	Good
8	Clarity of video sound			√			Simply
9	Clarity of narrative				√		Simply
10	Video size				√		Good
11	Video Form				√		Good
12	Relevance video with the material					√	Very good
13	Button placement					√	Very good
14	Use of appropriate layout and layout				√		Good
15	Button consistency					√	Very good
16	Button size					√	Very good
17	Accuracy of button color selection						√Very good
18	Accuracy of text color selection				√		Good
19	Accuracy of font selection			√			Simply
20	Accuracy of font size			√			Simply
21	Video color clarity				√		Simply
22	Clarity of video size			√			Simply
23	Slide design view					√	Very good
24	Composition of each slide				√		Good
	Total			21	32	45	
	Total Score			98			
	Average			4,08			Good

Table 5. Programming Aspect Scores from Media Experts

No.	Assessed Aspect	Rating Scale					Comments
		1	2	3	4	5	
1	Athlete interactive level				√		Simply
2	Ease of interacting with the media					√	Good
3	Clarity instructions for use						√Very good
4	Clarity of navigation structure					√	Good
5	Ease of button usage						√Very good
6	Video accuracy					√	√Very good
7	Video settings					√	Good
8	Providing feedback on athlete responses				√		Simply
9	Text Efficiency				√		Simply
10	Slide usage efficiency				√		Good
	Total			9	16	15	
	Total Score			40			
	Average			4			Good

Table 6. Frequency of assessment of material quality aspects

Criteria	Frequency	%
Very good	4	28,57
Good	10	71,43
Good enough	0	0
Less Good	0	0
Very Less	0	0
Total	14	100 %

Table 7. Frequency distribution of content/material quality aspects

Criteria	Frequency	%
Very good	4	28,57
Good	4	28,57
Good enough	6	42,86
Less Good	0	0
Very Less	0	0
Total	14	100 %

Table 8. Product quality of the butterfly-style swimming training model results of validation by experts

Aspects	Average Score	Criteria
Aspect Quality of swimming material	4,29	Very good
Content/material aspect	3,78	Good
Average	4,04	Good

Table 9. Frequency of Display Aspect Assessment by Media Experts

Criteria	Frequency	%
Very good	9	37,5
Good	8	33,33
Good enough	7	29,17
Less Good	0	0
Very Less	0	0
Total	24	100 %

Table 10. Frequency Distribution of Programming Aspect Assessment by Media Experts

Criteria	Frequency	%
Very good	3	30
Good	4	40
Good enough	3	30
Less Good	0	0
Very Less	0	0
Total	10	100 %

Table 11. Overall Quality of Butterfly Style Swimming Training Media by Media Experts

Aspects	Average Score	Criteria
Display Aspect	4,08	Good
Programming Aspects	4,00	Good
Average	4,04	Good

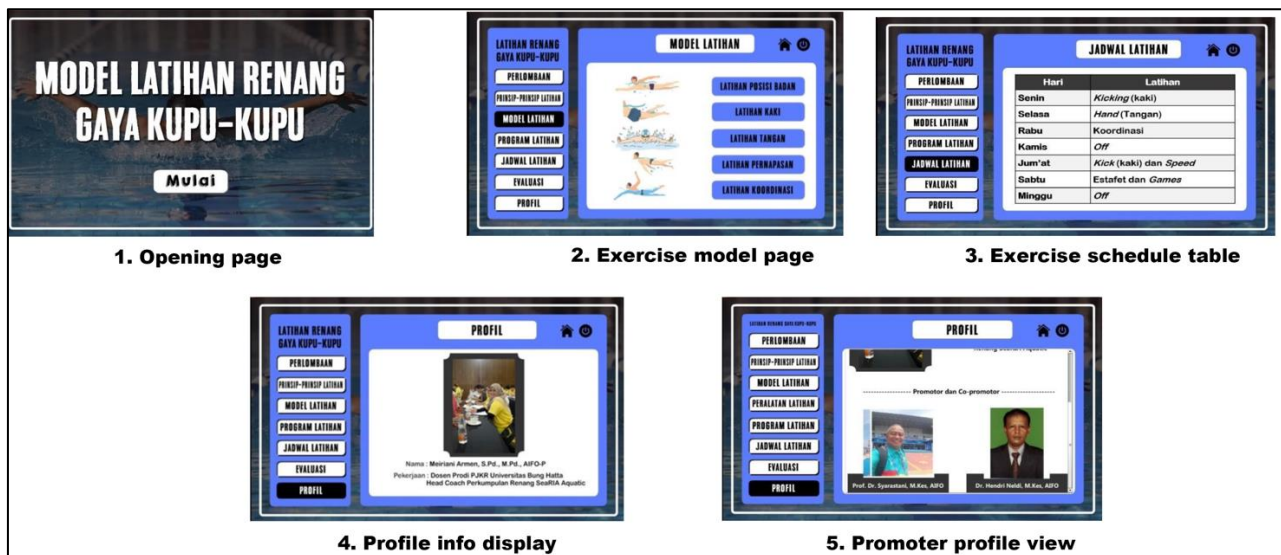


Figure 1. Initial product

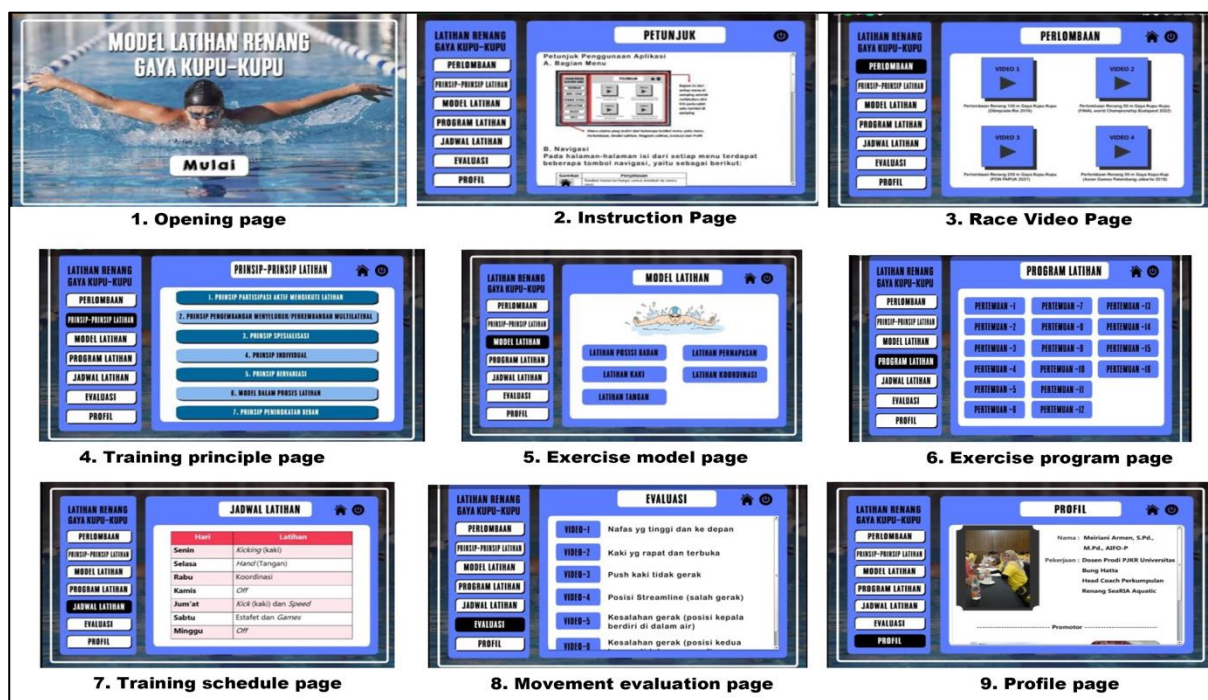


Figure 2. Final product

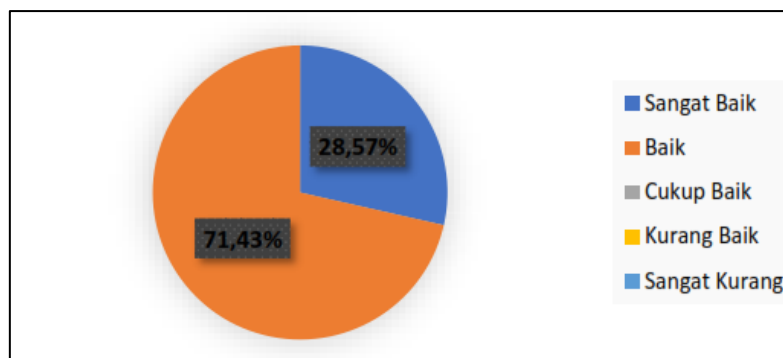


Figure 3. Assessment of swimming material quality aspects

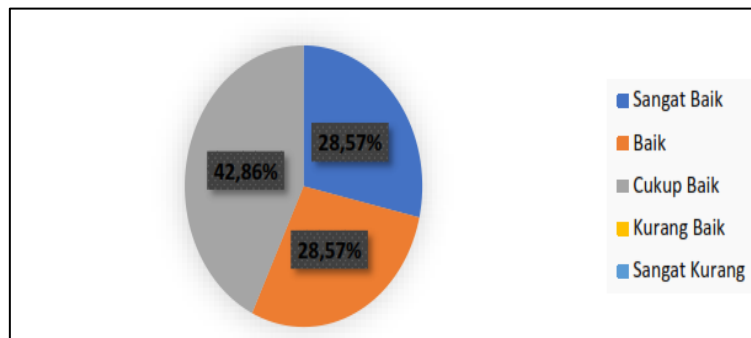


Figure 4. Swimming content/material aspect assessment

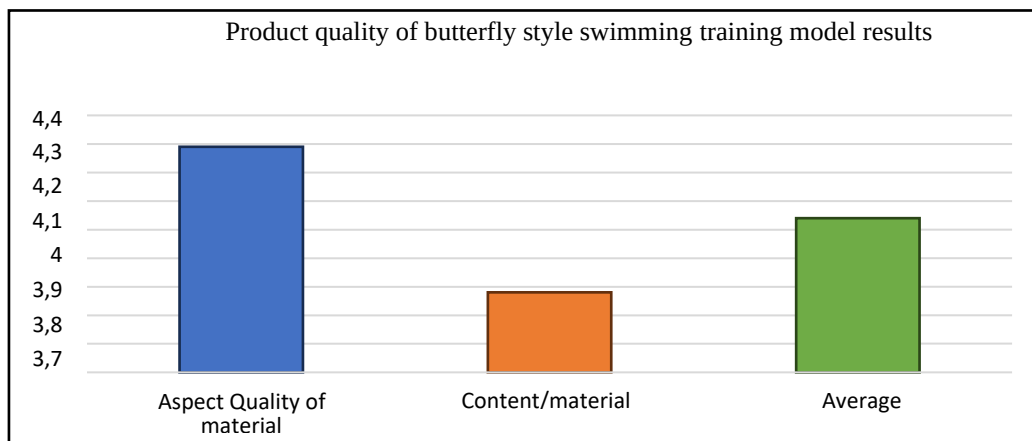


Figure 5. Quality of butterfly-style swimming training model results validated by material experts

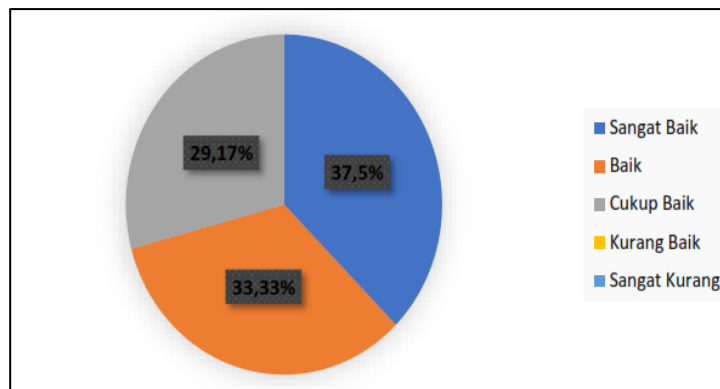


Figure 6. Media expert display aspect assessment

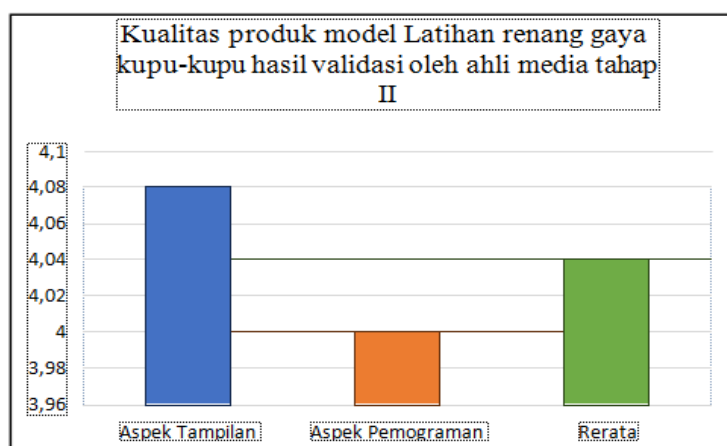


Figure 8. Product Quality Bar Diagram of Butterfly Style Swimming Training Media Validation by Experts

Enhancing Pencak Silat Skills with Developed Mixed Reality Hologram Learning Media

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ABSTRACT

Background. Pencak Silat is a traditional martial art from Southeast Asia that incorporates self-defense, striking, and grappling techniques. Due to the complexity of its movements, mastering Pencak Silat requires high levels of concentration, precision, and memory, which can pose challenges for Sports Science students. A suitable learning aid is essential to help students effectively learn and retain these techniques. Visual tools that support technique recall and practice are crucial in overcoming these challenges. **Objectives.** This study uses mixed reality and hologram technology to create a Pencak Silat learning medium. The objective is to evaluate whether this tool can enhance students' ability to perform Pencak Silat techniques and improve their overall proficiency in the martial art. **Methods.** The research utilized a development research (R&D) approach based on the Plomp model, with a pre-experimental one-group pretest-posttest design. A total of 44 Sports Science students participated, alongside nine experts who evaluated the product's feasibility before implementation. The research was conducted in three stages: preliminary, prototyping, and evaluation. Over four weeks, students attended two weekly practice sessions using the hologram-based learning tool. Descriptive statistics summarized the results, while paired-sample t-tests assessed the significance of improvements in student performance with a 95% confidence level. **Results.** The mixed reality learning medium was validated with an average score of 0.89, indicating high validity, and a reliability score of 0.85, demonstrating strong consistency. The tool's effectiveness was confirmed through significant improvements in the students' skills, with the average post-test score increasing to 80.93 from a pre-test score of 62.45. Statistical analysis using t-tests showed the improvements to be significant ($p < 0.05$). **Conclusion.** The Pencak Silat learning medium developed through mixed reality and hologram technology proved to be an effective tool for enhancing the martial arts skills of Sports Science students. This innovative learning aid facilitates skill acquisition and provides an engaging and immersive learning experience. As a result, it holds significant potential for broader application in both motor learning and martial arts education, making it a valuable resource for educational programs involving Pencak Silat training.

KEYWORDS: *Pencak Silat, Sports Technology, Mixed Reality Technology, Hologram Technology, Learning Media Development*

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INTRODUCTION

Pencak Silat, a traditional martial art and a form of local wisdom, is integral to Indonesia's cultural heritage (1–3). The practice of Pencak Silat, like other martial arts, requires mastery of several essential aspects: mental and spiritual development, physical abilities, artistic movement, and self-defense skills (4–8).

However, despite its cultural significance, the teaching of Pencak Silat faces several challenges.

Traditional teaching methods often rely heavily on memorization and direct demonstration while lacking adequate visual aids and digital resources that could enhance the learning experience.

Recent research has highlighted the need for innovative training resources in response to these challenges. For instance, a study developed a web-based training media for the doubles category of Pencak Silat, validated by both coaches and athletes, which demonstrated significant improvements in training effectiveness and accessibility (9).

As Lubis et al. (2022) state, conventional approaches can hinder students' understanding and retention of techniques, emphasizing the need for innovative educational strategies. Furthermore, the study conducted by (10) demonstrates that integrating problem-based learning and flipped classroom models with an Android application based on biomechanical analysis can significantly enhance learning outcomes in Pencak Silat. This integration effectively addresses the challenges posed by traditional teaching methods and supports students in mastering the techniques of this martial art.

Additionally, the findings indicate a significant effect of these innovative strategies, presenting viable solutions to the limitations of traditional teaching methods.

Another promising approach is highlighted in the study by (10), which emphasizes the effectiveness of a tactical game-based training program specifically designed for novice practitioners of Pencak Silat. This study demonstrates that incorporating principles of tactical games can significantly enhance technical and tactical skills in single-stance techniques, aligning with the need for innovative educational strategies.

Moreover, research has shown that teaching Pencak Silat from an early age, particularly to elementary school students, can significantly enhance motor skills and character development. A quasi-experimental study demonstrated marked improvements in both areas after 12 weeks of training, revealing significant differences in motor skill performance and character values (11). Additionally, structured home-based training programs, such as Tabata and circuit weight training, effectively improved physical fitness in Pencak Silat athletes, showcasing the potential of integrating innovative training methodologies into traditional teaching approaches (12,13). Also, research on the Complex Training (CT) method, conducted remotely using accessible technological tools, has demonstrated significant improvements in the physical conditioning of Pencak Silat athletes. This study highlights the effectiveness of modern training approaches in enhancing athletes' power and fatigue index over 12 weeks (14).

Furthermore, Pencak Silat is a core subject for Sports Science students. A preliminary study conducted at the Faculty of Sports Science at Universitas Negeri Padang, focusing on Sports Science students, identified several issues related to the teaching methods and learning resources used in Pencak Silat courses. The researcher observed the following problems: 1) The course a team delivers material of lecturers using traditional, conventional methods. In this approach, the lecturers demonstrate, practice, and evaluate the entire sequence of Pencak Silat movements. Students must memorize each movement in detail, which cannot be effectively accomplished by repeating the movements once or twice.

Students often struggle to practice independently without the guidance of a coach or lecturer, as the only available resource is a textbook, which lacks visual aids for movements. Furthermore, there is a shortage of learning materials tailored to students' needs. Although digital learning tools are increasingly available, many are not aligned with the course syllabus or students' learning styles. Additionally, modern technology, which could support current learning preferences, is not fully utilized in teaching Pencak Silat. These challenges have led the researcher to explore how technological resources can be integrated. With advancements in digital technology, the researcher aims to implement three-dimensional (3D) technology-based learning media in Pencak Silat courses.

Technological progress in the Fourth Industrial Revolution (Industry 4.0) and Society 5.0, particularly in information and communication technologies, has introduced many innovations that facilitate learning (15,16). One growing trend in educational media is the use of three-dimensional technology, incorporating Augmented Reality (AR), Virtual Reality (VR), and Mixed Reality (MR) (17–20). Reality technology merges the real and virtual worlds, creating new environments where physical and digital objects coexist and interact in real-time (21,22). Unlike AR or VR alone, Mixed Reality blends real and virtual elements (23).

Mixed reality has begun to be applied in educational contexts, providing practical and easily understood information while effectively illustrating complex concepts (21,24).

Consequently, incorporating 3D technology based on Mixed Reality in the development of Pencak Silat learning media is expected to improve both the effectiveness and efficiency of the teaching and learning process. Additionally, from a psychological standpoint, using Mixed Reality can increase students' interest and motivation.

Therefore, this study aims to develop an innovative learning media using three-dimensional technology by integrating Augmented Reality and Virtual Reality to enhance students' mastery of Pencak Silat techniques. This is achieved by recording and creating detailed, highly accurate replicas of Pencak Silat movements. The Mixed Reality-based learning media, featuring holographic technology, particularly appeals to the millennial generation, including teachers, trainers, lecturers, and other stakeholders. Furthermore, this product can be accessed by anyone, anywhere.

Consequently, integrating advanced technologies, such as Mixed Reality, into Pencak Silat training programs could significantly improve the effectiveness of instruction, fostering better engagement and mastery of this martial art among students.

MATERIALS AND METHODS

Research Design. This study employs a dual research framework, combining Research and Development (R&D) with a pre-experimental design. The R&D methodology, following the Plomp Model (25), allows for the systematic development of educational tools tailored to enhance the learning of Pencak Silat techniques. This model emphasizes iterative cycles of design, implementation, and evaluation, ensuring that the final product effectively meets the learning needs of students.

In tandem, the pre-experimental design utilizes a one-group pretest-posttest approach (26). This design enables the assessment of changes in student performance resulting from the intervention of the mixed reality-based learning medium. By measuring students' skills before and after the implementation of the educational tool, the study can accurately quantify the effectiveness of the intervention. This comprehensive approach facilitates the development of a robust learning medium and rigorously evaluates its impact on student outcomes.

Participants. In addition to the student participants, the research engaged nine experts to evaluate the validity and feasibility of the developed learning medium. This expert panel included 4 Pencak Silat specialists, who provided insights into the technical and pedagogical aspects of martial arts, ensuring that the learning tool accurately represented the techniques and principles of Pencak Silat. Furthermore, three media technology experts assessed the learning medium's technological implementation and user interface, while two language experts evaluated the clarity and accessibility of instructional materials. Their collective expertise was instrumental in refining the learning product, enhancing its overall quality and effectiveness in supporting students' learning experiences (Table 1).

Procedures. The procedures in this research include the preliminary research, prototyping phase, and assessment phase, as outlined by Plomp and Nieveen (25). preliminary research consists of a needs analysis and conceptualization, including student analysis, Pencak Silat study, and technology analysis.

During the prototyping phase, a digital Mixed Reality learning medium utilizing hologram technology was explicitly designed for Pencak Silat instruction. This medium encompasses a user instruction menu, various Pencak Silat techniques, lesson plans, learning materials, practice videos, and evaluation tools.

The developed product was reviewed by independent experts who assessed its content relevance and overall effectiveness. The assessment phase represents the implementation stage, focused on evaluating the effectiveness of the developed product. The implementation process consists of the following steps:

1. Pre-test Data: This step involves measuring Pencak Silat's skill levels before the intervention using the developed product.
2. Treatment: The program uses the digital Mixed Reality-based Pencak Silat learning medium. This treatment is provided to Sports Science students enrolled in a Pencak Silat course over approximately one month, comprising eight sessions.
3. Post-Test Data: Pencak Silat's skills are reassessed using the digital Mixed Reality-based learning medium after the treatment.

The classification for pencak silat skills with single techniques is presented in Table 2.

Statistical analysis. Aiken's V coefficient was used to calculate the inter-rater validity (27), while reliability was assessed using the Intraclass Correlation Coefficient (ICC) (28) (Table 3). The effectiveness of the product was evaluated using a paired t-test. All data were analyzed using the IBM SPSS v.23 statistical program.

RESULTS

Product Description. The outcome of this research is a product designed to enhance Pencak Silat's technical

skills. This product includes a user menu, usage instructions, lesson plans, learning resources, and practice videos (see Figures 1 and 2).

The instructions for utilizing the media, both online and offline, are accessible through the help menu. A comprehensive overview of the material students can study is available under the syllabus. Each session is accompanied by materials in PDF format, accessible via the materials menu. The instructional videos within the application demonstrate the learning process for each pencak silat technique, covering the initial, execution, and final phases. Additionally, the application features animated videos depicting individuals performing various pencak silat techniques, along with a dedicated training menu. The product also includes animations illustrating the execution of techniques, segmented into the preparatory, core, and concluding phases.

Validity and reliability. A panel of nine experts conducted assessments to evaluate the validity and reliability of the product through written reports and discussions. The experts concluded that the digital mixed reality system, utilizing hologram technology, is feasible for implementation. Post-revision assessment results are presented in Table 4. The findings indicate an average validity score of 0.88 (high) and a reliability score of 0.85 (very high). Based on these results, field testing of the digital mixed reality system with hologram technology can further enhance pencak silat skills (Table 4).

Product Effectiveness. The implementation of the product involved 44 sports science students to demonstrate its effectiveness in improving pencak silat skills. The results of the descriptive analysis are presented in Table 5.

Table 5 presents the comparative analysis of average pencak silat skill levels between the pre-test and post-test, measured across the initial, primary, and final phases. The pre-test scores showed an overall mean of 61.45 ± 4.22 , indicating a low skill level, whereas the post-test scores demonstrated a significant improvement, with an overall mean of 70.63 ± 7.63 . The average differences in pencak silat skills across the pre-test and post-test for each phase are depicted in the accompanying figure, highlighting the progression in skill acquisition.

The test results indicate that the data are typically distributed and homogeneous ($p > 0.05$), as shown in Table 6.

The results of the paired sample t-test, as presented in **Table 7**, demonstrate a statistically significant difference between the pre-test and post-test scores ($p < 0.05$), indicating that the digital mixed reality-based learning media utilizing hologram technology effectively improves pencak silat skills. This is further supported by the data in **Table 2**, which shows a mean pre-test score of 61.35 ± 4.22 (low) and a post-test score of 70.63 ± 7.63 (adequate), reflecting an improvement of 9.28 points. Moreover, **Table 5** reports a significant correlation ($p < 0.05$) between the increase in pencak silat skills from the pre-test to the post-test, as indicated by the correlation coefficient r . The corresponding regression model is $Y = 5.875 + 0.891X$, where X represents the skill improvement.

DISCUSSIONS

The development and implementation of the digital mixed reality-based learning media for pencak silat, utilizing hologram technology, yielded promising results. The product achieved a high validity score ($M = 0.88$) and a very high-reliability score ($M = 0.85$), indicating the robustness of the content and consistency of expert evaluations. Furthermore, the implementation of this learning tool demonstrated statistically significant improvements in the pencak silat skills of sports science students ($p < .05$), underscoring the effectiveness of the media. Importantly, this digital platform is accessible offline, allowing students to engage with learning materials, instructions, and applications related to pencak silat education without an internet connection.

These findings align with previous research that highlights the effectiveness of virtual learning environments in enhancing sports performance, particularly in pencak silat (29). Other studies have also emphasized the significant role that mixed reality and hologram technologies play in supporting instructors and coaches to improve learning outcomes (22,30,31). These technologies address some inherent limitations of traditional learning environments, creating more dynamic and interactive learning experiences (32).

The integration of advanced technology in education, particularly in sports training, has facilitated both the development and delivery of instructional content. Thus, innovative approaches can enhance students' motivation and engagement by creating more immersive learning environments. (33). One can also use technology to enhance learning performance in sports techniques (34).

Before implementation, the learning media underwent thorough testing for validity and reliability. Multiple independent evaluators assessed the content's relevance, ensuring a rigorous evaluation process. The Intraclass Correlation Coefficient (ICC) was employed to measure the consistency of the expert assessments, and the product was refined based on their feedback until a consensus was reached. This iterative process ensured the

tool's effectiveness during the implementation phase.

Despite the positive outcomes, several limitations should be considered. The study sample consisted of 44 sports science students (25 males and 19 females) enrolled in a pencak silat course, limiting the generalizability of the findings. Future research should aim to include a more extensive and more diverse participant pool and compare results between male and female students. Additionally, the experimental design employed a one-group pretest-posttest approach, which limits the ability to make causal inferences. Including a comparison group in future studies would provide more substantial evidence of the product's effectiveness.

CONCLUSIONS

This study concludes that developing a digital mixed reality-based learning media product utilizing hologram technology effectively enhances pencak silat skills among sports science students. The product's effectiveness is supported by high validity ($M = 0.89$) and high reliability ($M = 0.85$) scores, as assessed by expert evaluators. Furthermore, the effectiveness testing results revealed statistically significant improvements in pencak silat skills ($p < .05$), with an average post-test score of 70.63 ± 7.63 compared to a pre-test score of 61.35 ± 4.22 , demonstrating an increase of 9.28 points. Therefore, this digital mixed reality-based learning media has proven valuable for enhancing pencak silat skills.

These findings highlight the potential of integrating advanced technologies in sports education, particularly martial arts training. The engaging nature of mixed reality learning not only aids in skill acquisition but also fosters a deeper understanding of techniques and movements. This innovative approach can serve as a model for future research and development in other areas of sports science education.

Additionally, the successful implementation of this learning media underscores the importance of continuous adaptation and enhancement of teaching methods to meet the evolving needs of students in a digital age. Therefore, this digital mixed reality-based learning media has proven to be a valuable tool for enhancing Pencak Silat skills and offers significant implications for broader applications in sports education.

APPLICABLE REMARKS

- The mixed reality and hologram-based learning medium significantly enhanced students' proficiency in Pencak Silat techniques, as evidenced by the increase in average scores from 62.45 to 80.93 and statistically significant improvements ($p < 0.05$).
- Validated with high validity (0.89) and reliability (0.85) scores, this innovative tool offers a practical and consistent method for teaching Pencak Silat, addressing challenges in technique recall and practice for Sports Science students.

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AUTHORS' CONTRIBUTIONS

Study concept and design: Sonya Nelson, Resmi Darni. Acquisition of data: Hady Peri Fajri, Septri. Analysis and interpretation of data: Juanda Putra, Ilham. Drafting the manuscript: Ilham, Vlad Adrian Geantă. Critical revision of the manuscript for important intellectual content: Bekir Erhan Orhan. Statistical analysis: Dessi Novita Sari, Weni Sasmita,.

CONFLICT OF INTEREST

The authors mention no "Conflict of Interest" in this study.

ETHICAL CONSIDERATION

This research adheres to ethical standards and has obtained approval to include all respondents as samples.

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FINANCIAL DISCLOSURE

The authors have no financial interests related to the material in the manuscript.

ARTIFICIAL INTELLIGENCE (AI) USE

In completing this manuscript, the authors did not use artificial intelligence (AI) to prepare, write, or edit.

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Table 1. Anthropometrics characteristics of the research participants

Variable	Gender	
	Male (n=25)	Female (n=19)
Age	19.46 ± 0.50	19.43 ± 0.37
Weight	71.13 ± 1.20	60.41 ± 1.36
Height	150.12 ± 2.89	147.24 ± 2.82
BMI	21.13 ± 1.43	24.13 ± 1.14

Table 2. Classification of Pencak Silat Skill Scores

Score	Classification
90 ≤ N ≤ 100	Very good
80 ≤ N ≤ 89	Good
65 ≤ N ≤ 79	Enough
30 ≤ N ≤ 64	Less
0 ≤ N ≤ 29	Very less

Table 3. Classification of validity and reliability scores

Validity		Reliability	
Index V	Classification	ICC	Classification
V < 0.4	Low	> 0.80	Very high
0.4 ≤ V ≤ 0.8	Enough	0.61-0.80	High
V > 0.8	High	0.41-0.60	Enough
		< 0.41	Low

Table 4. Validity and reliability of the product.

Experts (N=9)	Validity	$\bar{x}$	Reliability	Information	
				Validity	Reliability
Gymnastics experts (n=3)	0.88	0.88	0.85	High	Very high
	0.89				
	0.87				
Technology experts (n=3)	0.89	0.89	0.86	High	Very high
	0.88				
	0.89				
Language experts (n=3)	0.90	0.89	0.85	High	Very high
	0.89				
	0.8				
$\bar{x}$		0.89	0.85	High	Very high

Note: $\bar{x}$: Mean

Table 5. Results of the descriptive analysis for Pencak Silat skills

Data	N	Phase	Min	Max	$M \pm SD$		Classification	$\bar{X}_2 - \bar{X}_1$
					Every phase	All phases		
Pre-test	44	Initial	47.00	77.10	63.31 $\pm$ 5.99	61.35 $\pm$ 4.22	Less	9.28
		Main	46.00	72.00	59.22 $\pm$ 5.69			
		Final	56.00	76.00	67.83 $\pm$ 5.04			
Post-test	44	Initial	57.12	80.00	69.71 $\pm$ 7.43	70.63 $\pm$ 7.63	Enough	
		Main	52.00	85.00	68.11 $\pm$ 7.28			
		Final	61.00	83.00	74.98 $\pm$ 6.18			

Note: $\bar{X}_2 - \bar{X}_1$: The difference between Post-test and Pre-test data.

Table 5. Normality and homogeneity of data

Normality test		Homogeneity test	
Data	P	Data	P
Pretest	0.821	Pretest-post-test	0.324
Post-test	0.712		

Note: The data are normally distributed and homogeneous ($p > 0.05$); the Shapiro-Wilk test was used to assess normality, while Levene's test was used to evaluate homogeneity.

Table 6. Paired t-test

Data	df	R (n=18)	p*	$M \pm SD$	SEM	t	p (2-tailed)*
Pretest-post-test	44	0.890	.000	9.28 $\pm$ 2.16	0.423	17.13	.000

Note: A significant difference is indicated by ($p < 0.05$).

**Figure 1. Initial Display of the Application Content**



Figure 2. Display of application content for Pencak Silat technique selection.

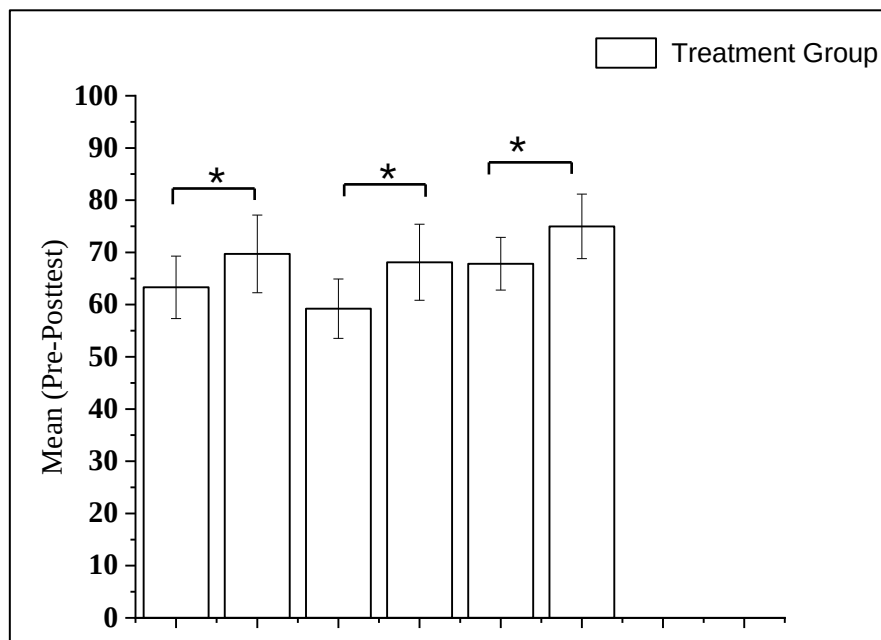


Figure 3. The average Pencak Silat skills between pre-test and post-test by an implementation phase.