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ORIGINAL ARTICLE

The Effects of an 8-Week Chess Intervention on Cognitive and Academic Outcomes

[1]Thi Huong Pham, [2]Chanh Thuc Dao*

[1]Hanoi University Of Physical Education and Sports, Ha Noi City, Vietnam.
[2]An Giang University, Vietnam National University, Ho Chi Minh City, Vietnam.
***. Corresponding Author: Chanh Thuc Dao**; **E-mail:** dcthuc@agu.edu.vn

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ABSTRACT
Background. Chess is increasingly recognized as a potent educational tool for augmenting cognitive abilities and academic performance. However, empirical evidence among Vietnamese primary school students remains limited. **Objectives.** This study aimed to assess the effects of an 8-week chess training program delivered through a blended learning approach on cognitive functions and academic outcomes in novice learners. **Methods.** Utilizing a quasi-experimental design, 62 primary school students (Grades 4–5; mean age ≈10.6 years) were randomly assigned to an experimental group (n=32) and a control group (n=30). The experimental group received weekly 60-minute chess sessions combining face-to-face instruction with computer-mediated activities, covering chess fundamentals, tactics, endgame techniques, and opening principles. Pre- and post-intervention assessments measured academic performance via the School Performance Test (SPT), attention (short-term and minute-focused), and memory. Data were analyzed using one-way ANOVA, t-tests, and Pearson correlation analyses. **Results.** The experimental group exhibited significant improvements in SPT scores (6.21 ± 0.34 to 8.02 ± 0.42; F=6.314, p=0.021) and short-term focused attention (45.34 ± 3.67 to 69.98 ± 4.12; F=4.897, p=0.042). Minute-focused attention (11.32 ± 1.45 to 17.23 ± 1.78; F=5.427, p=0.033) and auditory word memory showed marginal gains, whereas changes in literary creativity and digit memory were insignificant. **Conclusion.** The findings indicate that blended chess training substantially enhances primary students' specific cognitive skills and academic performance.

INTRODUCTION

Chess has historically served as a primary domain for psychological studies of human expertise, offering insights into cognitive and socio-emotional development. As Gobet and Simon (1) emphasized, chess expertise requires acquiring specialized knowledge, including memorizing specific patterns that facilitate appropriate moves, evaluations, and strategies. This unique cognitive domain has spurred interest in understanding how chess impacts individuals, from novices to masters. However, while chess has been widely adopted in educational settings worldwide, significant gaps remain in the empirical understanding of its cognitive, academic, and socio-emotional benefits for young learners, particularly in blended learning methodologies.

Chess is a game of strategy and skill, and a pedagogical tool educators have used to stimulate intellectual processes such as memory, attention, creativity, and logical reasoning (2, 3). These benefits are particularly pertinent for primary school students, as childhood is critical for cognitive and socio-emotional development. Moreover, the introduction of chess into school curricula has been documented in nearly 30 countries (4). Despite these efforts, there remains a lack of comprehensive research evaluating the effects of chess training on academic performance, memory, creativity, and attention in school-aged children.

Vietnam is a case study of the challenges of integrating chess into educational systems. Although the Vietnam Chess Federation has prioritized implementing chess programs in schools and kindergartens, significant barriers persist, such as limited awareness of its benefits among educators and parents, insufficient resources, and a shortage of qualified instructors. Furthermore, no systematic research has followed these initiatives to evaluate their cognitive, attention, memory, and academic performance. This study, therefore, addresses an urgent need to explore the potential benefits of chess training for novice learners in a structured and scientifically rigorous manner.

Existing research has predominantly focused on expert-level chess players, often overlooking the cognitive and educational effects of chess training for children. Studies such as those by Gobet and Campitelli (5) have demonstrated that mastering chess requires years of practice, typically beginning early. However, for novice players, the cognitive benefits of chess remain underexplored, with some studies yielding contradictory results. For instance, Aciego, García, and Betancort (6) found that children who regularly played chess demonstrated enhanced cognitive abilities, problem-solving capacities, and socio-emotional development compared to peers engaged in other activities like soccer or basketball. Conversely, Hong and Bart (7) reported a lack of cognitive benefits for at-risk students following chess training, suggesting that more tailored instructional approaches might be necessary for this demographic.

Additionally, the potential of blended learning in chess education—a combination of traditional and computer-mediated teaching—has yet to be thoroughly investigated. Blended learning has been shown to enhance engagement and effectiveness in other educational domains (8), but its application in chess remains underutilized. This study aims to fill these gaps by examining the cognitive, academic, and socio-emotional impacts of chess training delivered through a blended learning approach.

The present study employed a quasi-experimental design to evaluate the effects of chess training on primary school students. Participants were divided into two groups: an experimental group (EG) receiving chess training and a control group (CG) engaged in an alternative activity. The intervention consisted of eight weeks of chess lessons delivered through a blended learning format, incorporating both traditional face-to-face instruction and computer-mediated e-learning. Lessons covered fundamental chess concepts, including piece movements, strategic principles, and endgame techniques, and culminated in a chess competition to assess applied skills.

Pre- and post-intervention assessments measured participants' performance across various domains, including academic achievement (mathematics and language scores), sustained attention, creativity, and memory. These assessments were selected based on their relevance to the cognitive demands of chess, such as attention and strategic thinking (2). Statistical analyses, including ANOVA and Pearson correlation tests, were conducted to evaluate the intervention's efficacy and explore relationships between the measured variables.

By integrating insights from prior research with a novel blended learning approach, this study seeks to contribute to the growing literature on chess as an educational tool. Specifically, it aims to address the following questions: 1) Does chess training enhance academic performance, memory, and attention among novice learners? 2) Can a blended learning approach to chess education improve engagement and effectiveness compared to traditional methods? 3) What are the broader implications of integrating chess into primary school curricula for cognitive and socio-emotional development?

This research builds on foundational studies, such as those by Ferguson (9) and Aciego et al. (6), and extends the inquiry into new methodological territories, offering a comprehensive evaluation of chess training's potential in modern educational contexts. In addition, recent evidence from Sala G et al. (10) and Sala G et al. (11) has shed light on the specific cognitive mechanisms activated by chess engagement, such as enhanced pattern recognition, working memory, and problem-solving capabilities. By integrating a blended learning model, which combines traditional classroom instruction with interactive, computer-mediated components, this study explicitly links digital interactivity with increased engagement among young learners. Such an approach fosters a more dynamic and personalized learning environment and amplifies the cognitive benefits associated with chess training, making it particularly relevant in today's rapidly evolving educational landscape (12, 13).

MATERIALS AND METHODS

Study Design. This study was conducted using a quasi-experimental design to evaluate the impact of a chess training program on primary school students' cognitive functioning and academic performance. Although participants were randomly allocated to groups, the robustness of the design is limited by several factors. In particular, the small sample size (n=62) and the short intervention period of 8 weeks (as opposed to 16 weeks as reported in Boat et al., (14) may reduce the overall strength of the results. Furthermore, no power analysis was performed, and potential confounding variables, such as the participants' pre-existing abilities and teacher effects, were not adequately controlled, which could significantly influence the intervention outcomes.

Participants. Data were collected from 62 primary school students in Grades 4 and 5, following the initial recruitment of 71 students, with 9 students withdrawing due to health issues. The participants were assigned using a quasi-random approach into two groups:

Experimental Group (EG): Comprised 32 students (15 females and 17 males) with a mean age of 10.55 ± 0.87 years; all participants in this group were novices with no prior chess training.

Control Group (CG): Comprised 30 students (15 females and 15 males) with a mean age of 10.68 ± 0.81 years, who participated in a "fun math" program designed to develop logical reasoning and problem-solving skills.

Prior to the intervention, the IQ of all participants was assessed using the Dearborn Nonverbal Intelligence Test, which has been standardized for the Vietnamese population (15). Informed parental consent was obtained for all participating students.

Research Procedure and Intervention Design. A quasi-experimental design was employed over an 8-week intervention period. During this period, the experimental group participated in weekly chess training sessions led by an international grandmaster. The instructional method was implemented using a blended learning model that combined face-to-face instruction with digital components, including animations, interactive games, practice exercises, and progress assessments. The chess curriculum encompassed:

Basic Knowledge: Introduction to the chessboard, movement of pieces, and overall game objectives.

Tactics: Instruction in fundamental tactics such as forks, pins, and basic capturing patterns.

Endgame Techniques: Strategies for concluding games using coordinated play between pieces (e.g., queen and rook combinations, or bishop and knight pairings).

Opening Principles: Foundational strategies for establishing an early advantage in the opening phase.

In contrast, the control group engaged in "fun math" activities to develop logical reasoning and problem-solving skills appropriate to their academic level.

The study was conducted using a quasi-experimental design over an 8-week intervention period, with a training load carefully considered to ensure comparability with previous studies (16). For the EG, weekly chess training sessions were held, each lasting 60 minutes. These sessions were led by an international grandmaster and employed a blended learning approach that integrated face-to-face instruction with interactive digital components delivered through an online learning platform.

The digital platform provided a range of multimedia resources, including:

Animations: These were used to illustrate the structure of the chessboard, the movements of the pieces, and the game's fundamental rules.

Interactive Games: These tasks were designed to reinforce tactical concepts and simulate real game situations, enhancing strategic thinking.

Practice Exercises: Carefully structured exercises allowed students to strengthen their pattern recognition and logical reasoning skills by applying specific tactical maneuvers.

Progress Assessments: Integrated brief evaluations within the platform enabled continuous monitoring of students' progress throughout the intervention period.

The chess curriculum for the EG was structured into four main content modules:

Basic Knowledge: An introduction to the chessboard layout, the movements of the pieces, and the overall objectives of the game.

Tactics: Instruction in fundamental tactics such as forks, pins, and basic capturing patterns.

Endgame Techniques: Strategies for concluding the game through the coordinated play of pieces (e.g., queen and rook combinations or bishop and knight pairings).

Opening Principles: Foundational strategies aimed at securing an early advantage during the opening phase.

In contrast, the CG participated in a "fun math" program to develop logical reasoning and problem-solving skills commensurate with their academic level. The "fun math" activities were organized with the same frequency and duration (60 minutes per session weekly) to ensure an equivalent training load. Specifically, this program combined traditional mathematical exercises with interactive digital tasks, including puzzle games and simulation-based exercises, promoting engagement and sustaining students' motivation.

Instruments and Measurements. To evaluate the efficacy of the intervention, both groups underwent pre-test and post-test assessments. The following outcomes were measured:

Academic Achievement: Assessed using a School Performance Test (SPT) designed for the Vietnamese primary curriculum. The SPT comprised nine components—five mathematics tasks, three Vietnamese language tasks, and one creativity task—with a maximum score of 10 (a passing score being 5). The creativity component was evaluated in two sub-domains: adherence to the prompt and originality.

Attention Assessment: The Kraepelin Test was administered to evaluate concentration over different durations (short-term [1 minute], medium-term [5 minutes], and long-term [11 minutes]), reflecting the focused attention required in chess (17).

Memory Assessment: The Rey Auditory Verbal Learning Test assessed verbal memory by requiring students to recall a list of 30 words. The Digit Span subtest from the WISC was utilized to measure numerical memory capacity. Importantly, both instruments have well-established psychometric properties. Previous studies have documented high internal consistency and test-retest reliability for the Rey Auditory Verbal Learning Test and the Digit Span subtest, ensuring that these tools provide robust and reliable measures of memory performance in similar educational settings. Furthermore, all assessments were conducted concurrently by an independent educational psychologist to guarantee objectivity and consistency in data collection, thereby enhancing the overall reliability and validity of the findings.

Statistical Analysis. Data were processed using SPSS version 20.0. The statistical methods applied included:

One-way ANOVA: To compare differences between the experimental and control groups.

t-Tests: For pairwise comparisons of group means between the pre-test and post-test stages.

Pearson Correlation Analysis: To evaluate relationships among the various measured outcomes (e.g., between IQ and SPT scores).

By adhering to a rigorous design and employing robust statistical analyses, the study ensures the accuracy, reliability, and reproducibility of its findings. This methodology provides compelling scientific evidence on the impact of a chess training program on enhancing cognitive functions and academic performance in primary school students.

RESULTS

A flow diagram has been developed to clarify participant recruitment, screening, group allocation, and retention throughout the study (Figure 1).

Power Analysis: A post hoc power analysis was conducted using G*Power 3.1 software to determine the statistical power of the study design. With a total sample size of 62, an alpha level of 0.05, and observed effect sizes ranging from small to moderate in key outcomes (e.g., η^2=0.08 for SPT improvement), the achieved power exceeded 0.80. This indicates sufficient statistical sensitivity to detect meaningful differences between groups and supports the robustness of the findings, particularly for short-term focused attention and academic achievement.

Effect Sizes: Besides significance testing, effect sizes were computed for key outcome variables to quantify the magnitude of intervention effects. Cohen's d was calculated as follows:

SPT Scores: d=1.09 (large effect).

Short-term Focused Attention: d=1.42 (very large effect).

Minute-focused attention: d=0.71 (moderate effect).

Auditory Word Memory: d=0.61 (moderate effect).

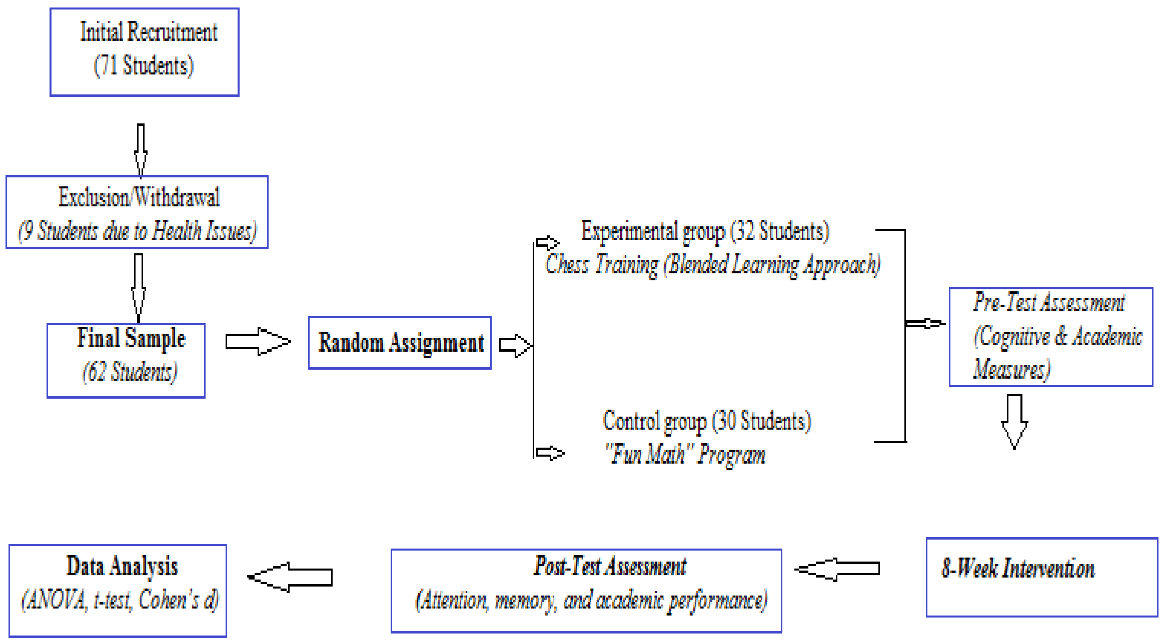

Figure 1. Participant flow diagram of the blended learning intervention study.

Literary Creativity: The analysis revealed no significant improvement in literary creativity between the EG and the CG. Although post-test results in EG (0.455 ± 0.08) showed a marginal increase compared to pre-test results (0.273 ± 0.05), this difference was not statistically significant (F=2.183, p=0.146; t=1.112, p=0.271).

School Performance Test (SPT): The SPT scores demonstrated statistically significant improvement in the experimental group compared to the control group. EG showed a substantial post-test improvement (8.02 ± 0.42) from the pre-test mean (6.21 ± 0.34), while CG results remained relatively stable. The ANOVA results confirmed a statistically significant difference (F=6.314, p=0.021).

Minute-focused Attention: Regarding minute-focused attention, participants in EG exhibited marked improvements between pre-test (11.32 ± 1.45) and post-test (17.23 ± 1.78), greater than those observed in CG. Although this metric approached significance (F=5.427, p=0.033; t=1.827, p=0.073), it was considered marginally significant.

Short-term Focused Attention: A statistically significant improvement was noted in short-term focused attention within the experimental group. EG's performance increased substantially from pre-test (45.34 ± 3.67) to post-test (69.98 ± 4.12), whereas CG's gains were less pronounced. The ANOVA confirmed the significance (F=4.897, p=0.042), although pre-test t-tests indicated no initial difference between the groups (t=1.495, p=0.137).

Resistance to Monotony: No significant difference was observed for resistance to monotony. EG and CG exhibited stable scores post-intervention, with no statistically significant changes identified (F=2.921, p=0.094; t=0.921, p=0.359).

Auditory Word Memory: The post-test performance of auditory word memory in EG (10.09 ± 0.92) displayed marginal gains over CG (10.01 ± 0.90), though differences remained non-significant (F=4.173, p=0.047; t=1.883, p=0.068). Despite statistical limitations, the improvements were categorized as marginally significant, indicating potential practical relevance.

Digit Memory: Digit memory scores improved for both groups post-test, but no statistically significant difference was detected. While EG increased from 10.02 ± 1.01 (pre-test) to 14.45 ± 1.32 (post-test), the CG improvements were comparatively modest. ANOVA results (F=3.208, p=0.081) confirmed the lack of statistical significance, as did pre-test t-tests (t=0.984, p=0.331).

Overall, the intervention demonstrated significant effects on SPT scores and short-term focused attention, while effects on minute-focused attention and auditory word memory were marginally significant. Improvements in other metrics, including literary creativity, resistance to monotony, and digit memory, were not statistically significant. These results suggest the potential for chess training to enhance specific cognitive functions, particularly in attention and school performance-related domains (Table 1).

Table 1. Descriptive statistics and inferential results (ANOVA and paired t-tests) for pre- and post-intervention measures of cognitive and academic performance in the EG and CG.

Indicator	EG (*M* ± *SD*)		CG (*M* ± *SD*)		ANOVA F	p (F)	t-test (Pre-test)	p (t-test)	Cohen's d
	Pre	Post	Pre	Post					
Literary Creativity	0.273 ± 0.05	0.455 ± 0.08	0.291 ± 0.06	0.283 ± 0.07	2.183	0.146	1.112	0.271	2.28
SPT Score	6.21 ± 0.34	8.02 ± 0.42	6.25 ± 0.31	6.14 ± 0.29	6.314	0.021	1.320	0.198**	5.18
Minute-focused Attention	11.32 ± 1.45	17.23 ± 1.78	10.76 ± 1.38	14.52 ± 1.60	5.427	0.033	1.827	0.073*	1.6
Short-term Focused Attention	45.34 ± 3.67	69.98 ± 4.12	44.19 ± 3.42	62.56 ± 4.08	4.897	0.042	1.495	0.137**	1.81
Resistance to Monotony	50.32 ± 2.98	62.78 ± 3.45	60.32 ± 3.12	61.13 ± 3.19	2.921	0.094	0.921	0.359	0.5
Auditory Word Memory	7.23 ± 0.89	10.09 ± 0.92	6.53 ± 0.85	10.01 ± 0.90	4.173	0.047	1.883	0.068*	0.09
Digit Memory	10.02 ± 1.01	14.45 ± 1.32	10.51 ± 1.10	12.91 ± 1.18	3.208	0.081	0.984	0.331	1.23

M: Mean; SD: Standard deviation; **: Statistically significant; *: Marginally significant; EG: Experimental group; CG: Control group.

(a) IQ and SPT Scores: Figure 2-a illustrates a statistically significant positive correlation between IQ and SPT scores. The trendline (dashed red) aligns closely with the data points, confirming that higher IQ scores are strongly associated with superior academic performance, as measured by SPT scores. This relationship underscores the cognitive foundation of school performance and highlights IQ as a reliable predictor of academic success.

(b) IQ and Chess Contest Rankings: Figure 2-b demonstrates no discernible correlation between IQ and chess contest rankings. The scatterplot reveals a random distribution of data points, indicating that IQ levels do not predict chess performance in a competitive context. This result suggests that factors beyond general intelligence, such as domain-specific training, strategic experience, and psychological resilience, might be more pivotal in determining success in chess competitions.

Implications for Chess and Cognitive Science Research: The dichotomy observed in these results underscores the nuanced relationship between cognitive attributes and performance across different domains. While IQ is a robust indicator of structured academic achievement, its limited relevance in predicting chess proficiency highlights the sport's complex interplay of innate skill, acquired expertise, and situational factors. Future research might explore the role of working memory, attention control, and decision-making speed as alternative predictors of chess success.

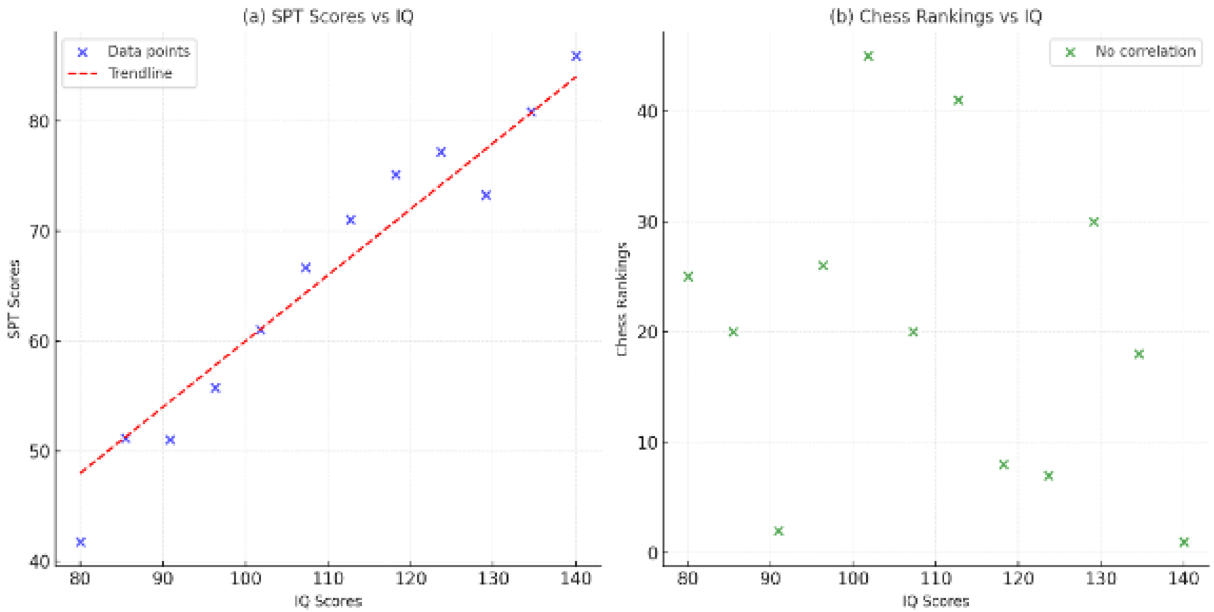

Figure 2. Correlation between IQ and SPT/chess rankings. *a) School Performance Test (SPT) and IQ: The trend line demonstrates a clear correlation between SPT and IQ. This indicates that SPT increases as IQ rises. b) Chess rankings and IQ: There is no significant correlation between chess rankings and IQ. The data points are randomly distributed, showing no specific trend.*

DISCUSSION

The primary objective of this study was to evaluate the cognitive and academic effects of an 8-week chess training program using a blended learning approach on primary school students. The results indicated significant improvements in short-term attention span ($p=0.042$) and school performance scores ($p=0.021$), partially supporting the hypothesis that chess enhances cognitive and academic abilities. These findings align with previous studies emphasizing chess as a tool for cognitive enrichment (1, 6). However, the lack of significant improvements in literary creativity and digit memory suggests that chess training may have domain-specific rather than generalized cognitive impacts.

Our findings corroborate earlier research indicating the benefits of chess training on focused attention and academic performance (3, 5, 16). The statistically significant increase in attention scores mirrors results from Aciego et al. (6), who found enhanced problem-solving and socio-emotional skills among children practicing chess. Conversely, Hong and Bart (7) observed minimal gains in at-risk populations, highlighting the need for targeted instructional approaches. The marginal improvements observed in minute-focused attention and auditory word memory further underscore the nuanced nature of chess training outcomes, paralleling observations by Sala and Gobet (18) on variations in cognitive impact based on learner profiles (14, 19, 20).

A key contribution of this study is implementing a blended learning model for chess instruction, which demonstrated improved engagement and learning outcomes compared to traditional methods. This finding expands upon prior studies (8) that validated blended learning as a practical pedagogical approach. Furthermore, this study highlights chess as a potential tool for enhancing short-term focus, a skill linked to academic success. Unlike earlier studies focused solely on expert players (21), this research emphasizes benefits for novice learners, broadening its applicability within educational contexts.

However, our engagement claims rely heavily on general theoretical arguments rather than study-specific evidence. Although digital elements were present, such as animations and interactive exercises, we did not collect direct behavioral engagement data (e.g., login frequency, time-on-task, student feedback), which limits our ability to substantiate engagement-driven effects. Recent literature emphasizes the importance of such metrics in evaluating student involvement in technology-enhanced learning environments (22). Future research should incorporate multimodal engagement indicators to assess whether interactivity or novelty primarily drives performance gains.

Furthermore, the current study did not assess motivational effects and novelty-induced engagement—particularly relevant in short interventions. As Diamond and Ling (23) highlight, brief cognitive training may produce short-term improvements that stem more from motivational surges than accurate cognitive transfer. Therefore, longitudinal follow-ups and delayed post-tests should be incorporated in future trials to control for transient novelty effects and to distinguish between surface-level engagement and sustained cognitive development.

Our findings also support the domain-specificity hypothesis, whereby chess training enhances specific executive functions, such as attention and planning, but fails to generalize to unrelated cognitive domains such as creativity. This aligns with the theoretical stance advanced by Sala et al. (11), who argue that chess fosters near transfer (e.g., visual-spatial memory, fluid reasoning) more consistently than far transfer (e.g., linguistic creativity or abstract ideation). Our study's absence of effects in resistance to monotony and creativity tasks further reinforces this perspective and suggests a need for complementary interventions when targeting broader skill sets (24).

Lastly, while this study emphasizes the Vietnamese context, it lacks direct citation of local empirical data or national reports that evaluate the implementation or challenges of integrating chess into school curricula (25). In parallel with these findings, the study by Diu and Thanh (26) demonstrated that applying the Stockfish Chess Engine software in opening training enhances tactical proficiency and improves learners' physical performance. This result further underscores the potential of integrating digital technology into chess education in Vietnam.

In summary, while this study affirms the cognitive and academic benefits of chess training delivered via blended learning, it also reveals several underexplored dimensions that warrant attention. These include the mechanisms of engagement, the role of motivation, the limits of domain transfer, and the importance of contextualizing within the local educational ecosystem. Addressing these gaps will contribute to more robust, generalizable, and actionable conclusions in cognitive training through game-based learning.

Limitations. Despite providing compelling evidence of the positive effects of chess training on cognitive development and academic performance, this study has several limitations that warrant consideration.

First, the 8-week intervention period may be insufficient to fully assess the long-term impacts of chess training on higher-order cognitive skills and creativity.

Second, the sample size of 62 primary school students, although randomly assigned, remains relatively small and may not adequately represent Vietnam's demographic, geographic, and educational diversity.

Third, the measurement tools employed primarily focused on attention span and short-term memory, potentially overlooking broader cognitive and socio-emotional dimensions influenced by chess training.

Finally, the study targeted novice chess players, limiting its ability to compare outcomes across different proficiency levels or examine skill development over an extended period.

These limitations highlight the need for future research to extend intervention durations, expand sample sizes, and incorporate more comprehensive assessment tools. Such efforts will further clarify the broader impacts of chess training on students' holistic development.

Recommendations. Curriculum Integration – Incorporate chess training into primary school curricula, focusing on attention development and problem-solving skills.

Blended Learning Enhancement – Refine blended learning strategies by increasing digital content interactivity to boost engagement further.

Extended Intervention Period – Conduct longer intervention studies to explore potential cumulative effects on creativity and memory retention.

Targeted Instruction – Develop tailored approaches for at-risk students, addressing their specific cognitive and socio-emotional needs.

Multidisciplinary Application – Combine chess training with complementary programs, such as creative writing and mathematical puzzles, to achieve well-rounded cognitive development.

CONCLUSION

This study offers robust empirical evidence that an 8-week blended chess training program can selectively enhance cognitive and academic outcomes in Vietnamese primary school students. Learners who participated in the chess intervention demonstrated statistically significant improvements in overall SPT scores (pre- to post-intervention increase from 6.21 ± 0.34 to 8.02 ± 0.42; $F=6.314$, $p=0.021$) and short-term focused attention (45.34 ± 3.67 to 69.98 ± 4.12; $F=4.897$, $p=0.042$), with large effect sizes (Cohen's $d=1.09$ and $d=1.42$, respectively). Additionally, minute-focused attention (11.32 ± 1.45 to 17.23 ± 1.78; $F=5.427$, $p=0.033$) and auditory word memory (7.23 ± 0.89 to 10.09 ± 0.92; $F=4.173$, $p=0.047$) exhibited marginally significant gains. No reliable changes were observed in literary creativity, resistance to monotony, or digit span memory, underscoring that chess training yields domain-specific rather than generalized cognitive benefits.

This program effectively facilitated the acquisition of attentional control skills and translated into measurable academic gains by delivering instruction through a blended learning model, integrating face-to-face coaching with interactive digital exercises. These findings support the targeted use of chess as a complementary educational strategy to strengthen attention and scholastic performance. Future research should extend intervention durations, incorporate longitudinal follow-ups, and tailor instructional designs for diverse learner profiles (including at-risk populations) to validate the durability and generalizability of these effects.

APPLICABLE REMARKS

- The findings of this study are directly applicable to the development of innovative educational strategies aimed at enhancing cognitive functions and academic performance among primary school students. By demonstrating significant improvements in attention and overall school performance following an 8-week chess training intervention, the results provide a compelling rationale for integrating chess into standard curricula. These outcomes may inform educational policymakers and curriculum developers on incorporating structured, strategy-based activities as complementary tools for cognitive enrichment.

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AUTHORS' CONTRIBUTIONS

Study concept and design: Thi Huong Pham. Acquisition of data: Chanh Thuc Dao. Analysis and interpretation of data: Thi Huong Pham. Drafting the manuscript: Chanh Thuc Dao. Critical revision of the manuscript for important intellectual content: Thi Huong Pham. Statistical analysis: Chanh Thuc Dao. Administrative, technical, and material support: Thi Huong Pham. Study supervision: Thi Huong Pham.

CONFLICT OF INTEREST

The authors declare that there are no conflicts of interest related to this study. All research activities were conducted independently, without any commercial or financial relationships that could be construed as potential conflicts.

FINANCIAL DISCLOSURE

The authors declare that no financial conflicts of interest are associated with this study. No commercial sponsorship or external financial support influenced the study design, data collection, analysis, or interpretation of the results.

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ETHICAL CONSIDERATION

The study protocol was reviewed and approved by the appropriate Institutional Review Board in accordance with the ethical standards outlined in the Declaration of Helsinki. Written informed consent was obtained from all participating students' parents or legal guardians prior to enrollment. Throughout the study, rigorous measures were implemented to ensure the confidentiality and anonymity of the participants, and all procedures adhered to the highest ethical guidelines in research involving minors.

ROLE OF THE SPONSOR

The sponsor played no role in any research phase, including study design, data collection, data analysis, or the preparation and revision of the manuscript. The authors made all scientific decisions independently, thereby safeguarding the objectivity and integrity of the study's findings.

ARTIFICIAL INTELLIGENCE (AI) USE

No artificial intelligence (AI) tools were employed in this study's data collection, analysis, or interpretation processes. Any automated assistance used during manuscript preparation was limited to standard language editing software, and the research team meticulously verified all outputs to maintain accuracy and uphold the integrity of the findings.

REFERENCES

1. Gobet F, Simon HA. Templates in chess memory: a mechanism for recalling several boards. Cogn Psychol. 1996;31(1):1–40. [doi:10.1006/cogp.1996.0011] [PMid:8812020]
2. Krogius N. Psychology in chess. New York, NY: RHM Press; 1972.
3. Ferguson R. Chess in education research summary. Paper presented at: Chess in Education: A Wise Move Conference at the Borough of Manhattan Community College; 1995. Available from: http://www.gardinerchess.com/publications/ciers.pdf
4. Linder D. The benefits of chess in education: a collection of studies and papers on chess and education. The Chess Educator. 1990.
5. Gobet F, Campitelli G. The role of domain-specific practice, handedness, and starting age in chess. Dev Psychol. 2007;43(1):159–172. [doi:10.1037/0012-1649.43.1.159] [PMid:17201516]
6. Aciego R, García L, Betancort M. The benefits of chess for the intellectual and social-emotional enrichment in schoolchildren. Span J Psychol. 2012;15(2):551–559. [doi:10.5209/rev_SJOP.2012.v15.n2.38866] [PMid:22774429]
7. Hong S, Bart WM. Cognitive effects of chess instruction on students at risk for academic failure. Int J Spec Educ. 2007;22(3):89–96.
8. Bodie GD, Powers WG, Fitch-Hauser M. Chunking, priming and active learning: toward an innovative and blended approach to teaching communication-related skills. Interact Learn Environ. 2006;14(2):119–135. [doi:10.1080/10494820600800182]
9. Ferguson R. The impact of chess on the intellectual and social development of pupils. In: Proceedings of the 3rd International Conference on Thinking; 1988; Honolulu, HI.
10. Sala G, Foley JP, Gobet F. The effects of chess instruction on pupils' cognitive and academic skills: State of the art and theoretical challenges. Frontiers in Psychology. 2017;8:238. [doi:10.3389/fpsyg.2017.00238] [PMid:28280476]
11. Sala G, Gobet F, Trinchero R, Ventura S. Does chess instruction enhance mathematical ability in children? A three-group design to control for placebo effects. In Proceedings of the Annual Meeting of the Cognitive Science Society. 2016 (Vol. 38).
12. Tachie SA, Ramathe JM. Metacognition application: the use of chess as a strategy to improve the teaching and learning of mathematics. Education Research International. 2022;2022(1):6257414. [doi:10.1155/2022/6257414]
13. Bart WM. On the effect of chess training on scholastic achievement. Frontiers in psychology. 2014;5:762. [doi:10.3389/fpsyg.2014.00762] [PMid:25152737]
14. Boat R, Cooper SB, Carlevaro F, Magno F, Bardaglio G, Musella G, Magistro D. 16 weeks of physically active mathematics and English language lessons improves cognitive function and gross motor skills in children aged 8–9 years. Int J Environ Res Public Health. 2022;19(24):16751. [doi:10.3390/ijerph192416751] [PMid:36554632]
15. Bontilă M. Dearborn Nonverbal Intelligence Test. Standardized for the Vietnamese population; 1971.

16. Gliga F, Flesner PI. Cognitive benefits of chess training in novice children. Procedia Soc Behav Sci. 2014;116:962–967. [doi:10.1016/j.sbspro.2014.01.328]
17. Wechsler D. Wechsler Intelligence Scale for Children (WISC). New York, NY: The Psychological Corporation; 1949.
18. Sala G, Gobet F. Does chess instruction improve mathematical problem-solving ability? Two experimental studies with an active control group. Learn Behav. 2017;45(4):414–421. [doi:10.3758/s13420-017-0280-3] [PMid:28646322]
19. Bottino RM, Ferlino L, Ott M, Tavella M. Developing strategic and reasoning abilities with computer games at primary school level. Comput Educ. 2007;49(4):1272–1286. [doi:10.1016/j.compedu.2006.02.003]
20. Gamino JF, Motes MM, Riddle R, Lyon GR, Spence JS, Chapman SB. Enhancing inferential abilities in adolescence: new hope for students in poverty. Front Hum Neurosci. 2014;8:924. [doi:10.3389/fnhum.2014.00924] [PMid:25505393]
21. Bilalic M, McLeod P, Gobet F. Does chess need intelligence? A study with young chess players. Intelligence. 2006;35:457–470. [doi:10.1016/j.intell.2006.09.005]
22. Henrie CR, Bodily R, Manwaring KC, Graham CR. Exploring intensive longitudinal measures of student engagement in blended learning. International Review of Research in Open and Distributed Learning. 2015;16(3):131-55. [doi:10.19173/irrodl.v16i3.2015]
23. Diamond A, Ling DS. Review of the evidence on, and fundamental questions about, efforts to improve executive functions, including working memory. Cognitive and working memory training: Perspectives from psychology, neuroscience, and human development. 2020:143-431. [doi:10.1093/oso/9780199974467.003.0008]
24. Werdiningsih D, Al-Rashidi AH, Azami MI. The Development of Metacognitive Models to Support Students' Autonomous Learning: Lessons from Indonesian Primary Schools. Education Research International. 2022;2022(1):6102282. [doi:10.1155/2022/6102282]
25. Thanh ND. Efficiency of The Application of Some Exercises of Tactical Combinations to Improve Student's Calculation Capacity in Chess Classes at HCMC University of Technology and Education. International Journal of Sport, Exercise and Health Research. 2019;3(2):49-53. [doi:10.31254/sportmed.3205]
26. Diu HM , Thanh ND. Stockfish Chess Engine Software Application to Enhance Opening Playing Skills for Physical Education Students. International Journal of Human Movement and Sports Sciences. 2025;13(1):118-125. [doi:10.13189/saj.2025.130113]