ISSN 1982-5587

Articles

Chess: building a connection between game and education

Ajedrez: un puente entre el juego y la educación

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HOW TO CITE: CASTRO-GUERRA, M.; GRINSPUN SIGUELNITZKY, N.; CLEMENTE-VERGARA, R. Chess: building a connection between game and education. **Revista Ibero-Americana de Estudos em Educação**, Araraquara, v. 21, e18541, 2026. e-ISSN: 1982-5587. DOI: https://doi.org/10.21723/riaee.v21i00.1854102

Abstract

This essay examines the relationship between chess and its application in school settings, addressing its use as an instructional resource integrated into active-participatory methodologies such as gamification. It explores the articulation among education, psychology, and neuroscience in order to explore the effectiveness and relevance of chess as an instructional resource for stimulating and developing executive functions in the classroom. Through the analysis of educational experiences and the practical implications of chess in education, the essay highlights benefits associated with the development of cognitive and socio-emotional skills, as well as the effectiveness of gamification as a strategy for fostering student motivation and engagement. In conclusion, chess is positioned as an effective instructional resource for promoting cognitive and socio-emotional skills in the classroom. Its potential for implementation in educational institutions is also recognized, together with the need for further research on its methodological implications in order to empirically support its effectiveness and relevance in school contexts.

Keywords: education; chess; educational games; cognitive psychology; interdisciplinarity.

Resumen

El presente ensayo analiza la relación entre el ajedrez y su aplicación en contextos escolares, abordando su uso como recurso didáctico integrado en metodologías activo-participativas, como la gamificación. Se examina la articulación entre educación, psicología y neurociencias con el propósito de explorar la eficacia y pertinencia del ajedrez como recurso didáctico para la estimulación y el desarrollo de funciones ejecutivas en el aula. Mediante el análisis de experiencias e implicancias prácticas del ajedrez en educación, se destacan beneficios asociados al desarrollo de habilidades cognitivas y socioemocionales, así como la efectividad de la gamificación como estrategia para favorecer la motivación y el compromiso del estudiantado. En conclusión, el ajedrez se posiciona como un recurso didáctico efectivo para promover habilidades cognitivas y socioemocionales en el aula. Asimismo, se reconoce su potencial de implementación en establecimientos educacionales y la necesidad de profundizar en investigaciones sobre sus implicancias metodológicas, con el fin de respaldar empíricamente su efectividad y pertinencia en contextos escolares.

Palabras clave: educación; ajedrez; juego educativo; psicología cognitiva; interdisciplina.

INTRODUCTION

Educational models are permeated by economic, social, and political factors that influence their functioning, mainly associated with policies and strategies aimed at reducing the impact of social and economic inequalities, ensuring an equitable distribution of opportunities both within and among schools, and promoting social mobility. In Latin America, as a strategy to address these factors, educational policy seeks to foster a multidimensional engagement of the student, facilitating the application of skills developed across different domains and orienting actions toward active, contextualized, and relevant learning processes—promoting equitable distribution of resources and effective leadership (Moreira-Arenas, 2021).

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Submitted: January 27, 2024
Reviewed: August 25, 2025
Approved: September 02, 2025

Financial support: nothing to declare.

Conflicts of interest:
There are no conflicts of interest.

Ethics committee approval:
Not applicable.

Data availability:
No research data were used.
Study conducted at Universidad Metropolitana de Ciencias de la Educación (UMCE), Santiago, Chile.

In Chile, despite declared efforts to foster active learning processes, consolidate prior experiences, and promote meaningful interactions between students and teachers, no substantial improvements in student performance have been observed, nor significant implementation of educational innovations (Moreira-Arenas, 2021). This lack of coherence between stated intentions and actual practices may be explained by the limited systematic use of teaching strategies that meaningfully impact the teaching–learning process (Araya-Crisóstomo; Urrutia, 2022), as well as by the discontinuous and unsustainable nature of many innovations, often lacking a solid theoretical foundation, curricular adaptation, teacher training, and adequate evaluation and monitoring tools (Moreira-Arenas, 2021).

A possible approach to address these challenges within the educational system lies in the implementation of active participatory methodologies that stimulate the development of executive functions (EF), understood as psychological processes that enable individuals to plan, monitor, and regulate conscious thoughts, actions, and emotions (Rosas et al., 2019). Within these active participatory methodologies, various approaches can be identified, such as Project-Based Learning (PBL), Cooperative Learning, Problem-Based Learning, Flipped Classroom, and Gamification, among others (Araya-Crisóstomo; Urrutia, 2022). The central aim of these methodologies is to consolidate the student's role in the learning process, fostering participation, autonomy, and motivation.

The presence of a wide variety of methodologies and approaches allows for diversification and innovation in the use of different didactic tools; however, it is essential to consider several factors related to the development of EF and the challenges posed by the school context. In this sense when seeking an instructional resource that involves executive functions and can be integrated into educational settings chess emerges as an attractive option, given its potential for self-regulated learning, ease of implementation, low material cost, and historical relationship with educational practice (Aciego et al., 2016).

Historically regarded as a complex intellectual sport requiring systematic practice to achieve competence, chess has been increasingly recognized as a pedagogical tool in school contexts—potentially effective in developing cognitive, emotional, and social skills (Aldeán-Riofrío et al., 2022). Research reports positive effects of chess on cognitive functions such as memory, attention, strategic thinking, and pattern recognition (Aciego et al., 2016; Aldeán-Riofrío et al., 2022). While some studies suggest a possible transfer of these benefits to academic performance (Gindi; Pilpel, 2020), significant limitations persist: most research does not delve deeply into the didactic or methodological conditions required for such transfer to occur meaningfully and sustainably in the classroom.

This paper adopts a narrative and argumentative theoretical review. Empirical and conceptual studies published between 2011 and 2023 were selected from databases such as Scopus, SciELO, Redalyc, and Google Scholar. Descriptors included: "Chess and Executive Functions," "Game-Based Learning," "Active Learning Methodologies," and "Gamification in Education," among others. These sources were complemented by foundational theoretical works corresponding to the perspectives addressed in the article. Priority was given to research addressing the impact of chess in school contexts, the development of executive functions, and its relationship with innovative pedagogical approaches.

The objective of this article is to provide a critical analysis of the relationship between chess and its applications in the educational field, offering theoretical support for its use as a didactic resource that integrates contributions from education, cognitive psychology, and the neuropsychological study of EF, as well as its articulation with gamification within active participatory methodologies. This theoretical framework may contribute to establishing research guidelines for examining the effectiveness and relevance of chess in school contexts.

CHESS WITHIN GAMIFICATION AND ACTIVE PARTICIPATORY LEARNING METHODOLOGIES

Active learning processes are methodological constructions centered on the student's protagonism throughout the various stages of the teaching–learning process. They foster peer interaction, playfulness, material manipulation, and problem-solving based on contextualized experiences. The development and deployment of these processes are related to contributions from different pedagogical and psychological traditions, including constructivism, the historical-cultural perspective, educational pragmatism, and the theory of structural cognitive modifiability, implying the use of innovative didactic tools to enrich and strengthen educational practices (Araya-Crisóstomo; Urrutia, 2022).

Active participatory learning methodologies represent pedagogical approaches that aim to promote and consolidate the active engagement of students in a constructive learning process. The foundation of these methodologies lies primarily in the centrality of the student within didactic interactions, allowing for the construction of knowledge through dialogue, curiosity, critical and reflective thinking, and autonomy (Moreira-Arenas, 2021). Students are thus involved in a wide range of practical activities that enable them to develop projects and solve context-based problems.

Among these methodologies, Gamification stands out as a strategy focused on applying game elements and mechanics in non-playful contexts (Aldeán-Riofrío et al., 2022). Through this approach, classroom dynamics seek to enhance motivation, engagement, and participation, fostering a playful learning environment that encourages active involvement and the achievement of objectives through challenges and rewards (Torres-Toukoumidis; Romero-Rodríguez, 2018).

The connection between chess, gamification, and active-participatory learning methodologies is supported by its playful, challenging, and potentially motivating nature. As a structured game, chess can be used as a learning resource in the classroom and can be articulated with gamification strategies when its teaching incorporates mechanics such as progressive challenges, levels, feedback, rewards, or achievement goals linked to curricular objectives. From a pedagogical perspective, chess-related activities can foster problem-solving and social interaction through predefined, comprehensible, and progressively challenging rules. Likewise, planning, strategic thinking, and decision-making are abilities involved in both the teaching and practice of chess, which is consistent with the principles of active-participatory learning methodologies.

In a study involving 170 students aged between six and sixteen, researchers compared the impact of chess against other extracurricular activities within the same school. Significant differences were found at the cognitive level—including attention, self-control, perceptual organization, processing speed, planning, and foresight—as well as in social interactions, favoring those students who participated in a weekly chess program compared to those who practiced football or basketball (Aciego et al., 2016).

At the classroom level, another study used chess to teach mathematical problem-solving strategies, involving 931 primary school students divided into two experimental groups (each with distinct didactic approaches) and one control group. Results indicated that one of the experimental groups performed significantly better in problem-solving tasks, suggesting that chess instruction explicitly guided by heuristic strategies may foster transfer to mathematical problem-solving (Trinchero; Sala, 2016). This type of experience allows for comparative analysis of the cognitive, emotional, and social impact of chess relative to other activities and team sports.

Within the framework of active participatory methodologies, the goal is to enhance students' active involvement in the teaching–learning process, and Gamification emerges as an effective strategy to achieve this (Torres-Toukoumidis; Romero-Rodríguez, 2018). Chess, as a meaningful tool within this pedagogical approach, may contribute to the development of cognitive, emotional, and social abilities. The inclusion of chess as a didactic resource diversifies the classroom environment, generates motivation, enriches learning spaces, strengthens critical thinking, and fosters collaborative engagement among students.

NEUROCOGNITIVE ASPECTS OF CHESS WITHIN ACTIVE LEARNING

There are multiple definitions of Executive Functions (EF); however, consensus has been reached regarding their central importance in human development (Diamond, 2013), the need to design programs that stimulate them from early childhood, and the relevance of early-emerging components such as inhibitory control, working memory, and cognitive flexibility (Rosas et al., 2019).

Inhibitory control can be understood as the cognitive ability that allows individuals to consciously direct thoughts, behaviors, and emotions according to contextual demands (Diamond, 2013). Working memory refers to the capacity to hold and manipulate previous and new information simultaneously (Rosas et al., 2019). Cognitive flexibility, in turn, involves the capacity to shift thoughts, emotions, and actions in response to environmental characteristics quickly and effectively (Rosas et al., 2019).

Various interventions focusing on the development and stimulation of EF have been implemented, though more in-depth research is required to evaluate their efficacy (Rosas et al., 2019). The relevance of EF in educational contexts lies in their association with skills and knowledge that enable effective social and cognitive interactions throughout the lifespan (Diamond, 2013).

The regular practice of chess in school settings has been associated with favorable results in EF, such as planning (Ramos et al., 2018), inhibitory control and attention (Gindi; Pilpel, 2020), and working memory stimulation (Sandoval-Tipán; Ramos-Galarza, 2020).

In the study by Gindi and Pilpel (2020) in Israel, conducted with 107 male students aged 11 to 12, those who played chess performed better on tasks related to inhibitory control than those who did not. Although interactions were identified among chess practice, ADHD diagnosis and medication use as additional variables, the correlational nature of the study prevents causal effects from being attributed to chess.

In Argentina, Ramos et al. (2018) analyzed the performance of 65 students aged 8 to 12 (both sexes) on tests assessing planning, inhibition, working memory, and cognitive flexibility. Those who practiced chess obtained higher scores in the assessed domains compared to those who did not.

Similarly, in Ecuador, Sandoval-Tipán and Ramos-Galarza (2020) compared control and experimental groups comprising a total of 60 students (both sexes). Significant differences in normalized scores were observed, with the chess-practicing group performing better overall.

Furthermore, in school settings, studies have reported favorable findings associated with chess in relation to critical thinking, planning, problem-solving, mathematical reasoning, cognitive development, discrimination skills, spatial–temporal orientation, analytical capacity, and synthesis (Aldeán-Riofrío et al., 2022; Trinchero; Sala, 2016). The consistent presence of research focused on school-age populations underscores the growing interest in chess as a potentially relevant tool for stimulating EF.

While questions remain regarding the transferability of chess-related skills to other academic areas (Sala; Gobet, 2016), studies such as Trinchero and Sala (2016) and Aciego et al. (2016) highlight the importance of interaction, mediation, and the pedagogical use of resources in the teaching–learning process to foster outcomes under specific pedagogical conditions. Such interactions provide students with a solid foundation to face academic and social challenges.

PRACTICAL IMPLICATIONS FOR EDUCATION

The previous sections addressed the connection between chess, active participatory learning methodologies, Gamification, and the impact on Executive Functions (EF), emphasizing the potential of chess for neurocognitive development. To understand this relationship more deeply, it is necessary to explore the theoretical frameworks of Feuerstein (Feuerstein et al., 2006;

Kozulin et al., 2010) and Vygotsky (Nieva Chaves; Martínez Chacón, 2019; Bodrova; Leong, 2012; Vygotsky, 1978, 1984) and to establish conceptual bridges linking education and chess pedagogy. This section examines these theoretical perspectives from psychology, their relevance for chess instruction, and their practical implications for educational practice.

From Feuerstein's Structural Cognitive Modifiability Theory, we find a valuable matrix for understanding the cognitive processes involved in learning and teaching chess. According to this framework, learning requires dynamic interaction between the individual and the environment, with a central emphasis on the capacity for cognitive modifiability through mediated learning experiences (Feuerstein et al., 2006; Kozulin et al., 2010). This implies that effective learning occurs when reciprocal interaction exists between the learner and the mediator.

In chess instruction, the quality of the pedagogical relationship becomes fundamental. This interactive space between teacher and student becomes a medium for stimulating critical thinking and problem-solving, given that chess's strategic and tactical logic requires decision-making in complex situations (Aldeán-Riofrío et al., 2022). The role of the mediator (teacher) must be infused with strategies that enrich learning, both through materials and discourse. Effective mediation translates into well-structured actions, didactic resources, and materials adapted to students' developmental characteristics.

The mediator acts as a facilitator and guide, supporting learning by stimulating strategic thinking and creating cognitively challenging situations that transform the game into a meaningful and stimulating experience. This process involves giving clear instructions, providing problem-solving strategies, offering age-appropriate theoretical content, and delivering constructive feedback (Aldeán-Riofrío et al., 2022). Such actions foster the progressive and sustained growth of students' cognitive and emotional skills, both in the game itself and in their broader learning processes.

Empirical evidence supports these practical implications. Ramos et al. (2018) identified higher scores in planning, inhibition, and working memory among students who practiced chess regularly, compared to those who did not. Similarly, Gindi and Pilpel (2020) reported associations between chess practice and better performance on inhibitory control tasks, although the correlational design of the study prevents causal relationships from being established. Additionally, Rosas et al. (2019) demonstrated that systematic play-based interventions can strengthen executive functions in early childhood. These studies underscore the need for structured didactic approaches that enhance the potential contributions of chess in classroom contexts.

From Vygotsky´s historical-cultural perspective, learning is shaped through social interaction and the mediation of cultural tools, and it can promote development when activities are situated within the Zone of Proximal Development (ZPD) (Nieva Chaves; Martinez Chacón, 2019; Bodrova; Leong, 2012; Vygotsky, 1978, 1984). Learning thus occurs within the Zone of Proximal Development (ZPD)—the gap between what an individual can achieve independently and what can be achieved with guidance from a more capable peer or teacher. From this perspective, human nature is defined not merely by response to stimuli but by the ability to act and transform reality. In this sense, chess instruction may focus on problem-solving strategies and fostering social interaction through predefined and accessible guidelines.

The social and collaborative dimension of chess aligns directly with Vygotsky's concept of the ZPD. The game inherently requires interaction between two or more individuals, generating feedback among players of different levels and making mediation an essential component of the learning process (Aldeán-Riofrío et al., 2022). This collaborative learning environment enables students to face complex challenges, internalize strategic and tactical concepts, and progressively develop more advanced playing and reasoning skills. As a result, chess may contribute to both cognitive and socio-emotional growth.

Another practical implication concerns the design and use of appropriate didactic resources. Teaching chess requires the use of language, materials, and methods tailored to each learner's abilities.

Examples include the structured sequencing of activities, promotion of active participation, and explicit use of key concepts and strategies (Aldeán-Riofrío et al., 2022). Planning and organization of instructional activities should provide opportunities for interaction, play, reflective practice, decision-making, and problem-solving.

Despite the promising educational potential of chess, several challenges remain regarding its integration into school curricula. On one hand, many teachers lack adequate training in using chess as a pedagogical tool, and when training exists, it is often isolated or limited in scope (Aldeán-Riofrío et al., 2022). On the other hand, it is necessary to adapt curricula and establish evaluation frameworks for assessing the impact of chess-based interventions (Ramos et al., 2018).

Nevertheless, implementation prospects are encouraging. Ongoing research reveals growing collaboration among teachers, researchers, and educational stakeholders, oriented toward the development of professional training programs, the implementation of effective methodologies, and the consolidation of empirical evidence supporting the inclusion of chess within active learning methodologies.

CONCLUSIONS

First, this article sought to establish a critical analysis of the relationship between chess and its applications in the educational field. In doing so, it provided theoretical grounding from developmental, cognitive, and educational psychology, as well as from pedagogy. Alongside these theoretical dimensions, it explored the connection between Gamification and active participatory methodologies. This conceptual framework may serve as a foundation for future research aimed at examining the effectiveness and relevance of chess in school contexts.

The articulation of chess with active participatory learning methodologies and Gamification enhances its relevance as a didactic resource in educational environments. Chess may constitute an interactive tool that fosters participation, problem-solving, teamwork, decision-making, and deeper engagement of students in the teaching–learning process. Through Gamification, playful elements are integrated into classroom interactions, generating dynamic and stimulating learning environments.

From the historical-cultural and structural cognitive modifiability perspectives, chess fosters meaningful interactions within the learning process. Given the progressive and cumulative nature of chess learning, the mediator's role is essential in constructing knowledge, requiring effective and contextually relevant strategies to achieve pedagogical objectives. In this context, the game may serve as a means of fostering cognitive reorganization and development through mediated learning experiences. Both Feuerstein's theory of mediated learning and Vygotsky's sociocultural theory highlight chess's potential as a tool for cognitive and socio-emotional development.

The practical implications of incorporating chess into education reveal substantial potential for its implementation. The strengthening of cognitive skills—such as problem-solving and decision-making—together with the promotion of socio-emotional development and collaborative work underscores the interdisciplinary nature of chess as an educational practice. Although further studies are required to deepen the methodological and epistemological dimensions of this integration—such as curricular adaptation, learning mechanisms, long-term assessment, teacher training, and instructional strategies— the current state of knowledge supports further research toward more robust and evidence-based implementation in school contexts.

In conclusion, this critical analysis allows chess to be situated within active participatory methodologies and gamification as a potential resource for fostering cognitive and socio-emotional skills. Nevertheless, additional research is needed to systematize pedagogical practices and didactic interactions that may support its systematic integration. For chess to be successfully implemented in school environments, it is essential to establish clear pedagogical guidelines, effective teaching methods, curricular adaptations, and continuous evaluation mechanisms. Consequently, the potential contributions of chess depend not only on its incorporation into school settings, but also on the quality of its pedagogical design, teacher mediation, and the methodological and institutional conditions under which it is implemented.

ACKNOWLEDGMENTS

Extraordinary Scholarship Program UMCE 2022-00-1176. National Center for Artificial Intelligence (CENIA), FB210017, BASAL, ANID granted to R. C. V.

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Authors contribution
MCG: Conceptualization, Methodology, Theoretical data analysis, Validation, Visual data preparation, Writing – original draft, Project administration. NGS: Theoretical orientation, Critical review of the manuscript, Approval of the final version for publication. RCV: Academic supervision, Methodological orientation, Critical review of the manuscript, Approval of the final version for publication.

Editor: Prof. Dr. José Luís Bizelli

Deputy Executive Editor: Profa. Dra. Flavia Maria Uehara