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Educational Chess in Vulnerable Primary Education: A Neuro-Inclusive Systematic Review of Cognitive and Socio-Emotional Effects (1980–2025)

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Abstract

In the aftermath of the COVID-19 pandemic, primary education systems in vulnerable contexts face learning loss, emotional distress, and declining student engagement, revealing a "double vulnerability" in which academic and socio-emotional difficulties are deeply intertwined. Within this scenario, educational chess emerges as a neuro-inclusive pedagogical strategy capable of fostering both cognitive and socio-emotional development during a critical stage of child development. This study aims to characterize the evolution of scientific publication on educational chess between 1980 and 2025, with a specific focus on vulnerable primary education contexts. A systematic review combined with bibliometric mapping was conducted to identify research trends, methodological approaches, and conceptual connections from a corpus of 31 publications. Findings indicate that educational chess contributes to the development of executive functions such as attention, working memory, cognitive flexibility, and inhibitory control, as well as socio-emotional competencies including self-regulation, decision-making, and resilience. Critically, the "chess effect" requires intentional pedagogical mediation to bridge gameplay with real-life challenges and intellectual agency. These effects are particularly significant in primary education and support inclusion, engagement, and a sense of belonging in vulnerable settings. This study concludes that educational chess is a relevant pedagogical tool to address dual academic and socio-emotional needs as well as highlights the need for integrative research to inform educational policy and practice.

Keywords: Educational Chess, Inclusive Education, Primary Education, Post-Pandemic Education, Socio-Emotional Learning, Vulnerable Contexts

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Abstrak

Pasca pandemi COVID-19, sistem pendidikan dasar di lingkungan yang rentan menghadapi masalah kehilangan pembelajaran, tekanan emosional, dan menurunnya keterlibatan siswa, yang mengungkap adanya "kerentanan ganda" di mana kesulitan akademis dan sosio-emosional saling terkait erat. Dalam skenario ini, catur pendidikan muncul sebagai strategi pedagogis neuro-inklusif yang mampu mendorong perkembangan kognitif dan sosio-emosional selama tahap kritis perkembangan anak. Penelitian ini bertujuan untuk mengkarakterisasi evolusi publikasi ilmiah tentang catur pendidikan antara tahun 1980 dan 2025, dengan fokus khusus pada konteks pendidikan dasar yang rentan. Sebuah tinjauan sistematis yang dikombinasikan dengan pemetaan bibliometrik dilakukan untuk mengidentifikasi tren penelitian, pendekatan metodologis, dan hubungan konseptual dari korpus 31 publikasi. Temuan menunjukkan bahwa catur pendidikan berkontribusi pada pengembangan fungsi eksekutif seperti perhatian, memori kerja, fleksibilitas kognitif, dan kontrol inhibitorik, serta kompetensi sosial-emosional termasuk regulasi diri, pengambilan keputusan, dan resiliensi. Secara kritis, "efek catur" memerlukan mediasi pedagogis yang disengaja untuk menjembatani permainan catur dengan tantangan kehidupan nyata dan inisiatif intelektual. Efek-efek ini sangat terasa di tingkat pendidikan dasar dan mendukung inklusi, keterlibatan, serta rasa memiliki di lingkungan yang rentan. Penelitian ini menyimpulkan bahwa catur pendidikan merupakan alat pedagogis yang relevan untuk memenuhi kebutuhan akademis dan sosio-emosional secara bersamaan, serta menekankan perlunya penelitian terintegrasi guna mendukung kebijakan dan praktik pendidikan.

Kata Kunci: Catur Pendidikan, Pendidikan Inklusif, Pendidikan Dasar, Pendidikan Pasca-Pandemi, Pembelajaran Sosial-Emosional, Lingkungan yang Rentan

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INTRODUCTION

In the aftermath of the COVID-19 pandemic, primary education systems worldwide, particularly in vulnerable contexts, are facing an unprecedented convergence of challenges, including significant learning loss, increased emotional distress, and declining student engagement. Schools operating in areas marked by poverty, exclusion, or high-risk environments now confront a scenario in which academic recovery cannot be addressed independently from students' socio-emotional well-being, especially during the early years of schooling. This situation reveals a condition of "double vulnerability," where cognitive gaps are intertwined with emotional and social difficulties, requiring integrated and developmentally appropriate pedagogical responses.

In recent decades, there has been a growing interest in identifying pedagogical strategies capable of mitigating educational inequalities within such contexts. However, in primary education, the challenge extends beyond improving academic performance to supporting emotional transitions, self-regulation, and character development during a critical stage of child development. As noted by Jean Piaget, this stage is characterized by the transition from concrete operational thinking to the early emergence of formal reasoning, making it particularly sensitive to structured and meaningful learning experiences.

Within this landscape, educational chess has emerged as a compelling pedagogical alternative, uniquely positioned to integrate strategic thinking, creativity, and self-reflection. A growing body of empirical research suggests significant benefits in cognitive domains such as attention and planning, as well as improvements in emotional self-regulation and school climate (Aciego et al., 2012; Ramos et al., 2018). Rather than functioning merely as a strategic game, chess can be understood as a structured, rule-based learning environment that aligns with children's developmental processes while fostering executive functions and socio-emotional competencies.

The significance of chess in the educational sphere is further reinforced by its characterization as a cultural and pedagogical resource capable of articulating cognitive processes, socio-emotional development, and school participation. Current debates, supported by frameworks such as the Index for Inclusion (Booth & Ainscow, 2002), emphasize that schools must create authentic conditions for all students to learn and participate, ensuring that social, economic, or cultural contexts do not become structural barriers (Hernández & Ainscow, 2018). In line with this, structured pedagogical interventions have proven essential for removing learning obstacles and ensuring effective neuro-inclusive participation (Navarro-Arana et al., 2024). From this perspective, educational chess can act as an inclusive pedagogical mediator, facilitating participation without requiring prior expertise and fostering a sense of belonging in primary school students who often experience academic insecurity in vulnerable settings.

The state-of-the-art links chess to socio-emotional learning (SEL) and the development of executive functions; however, this relationship acquires urgency in the post-pandemic context of primary education, where students face heightened levels of emotional dysregulation and disengagement. In this sense, frameworks proposed by the Collaborative for Academic, Social, and Emotional Learning and other benchmark models (Zins et al., 2004; CASEL, 2020) emphasize that socio-emotional competencies are foundational for learning in early schooling rather than secondary outcomes**.** Systematic practice of chess can enhance executive functions such as sustained attention, working memory, cognitive flexibility, and inhibitory control (Sala & Gobet, 2016; Trinchero & Sala, 2016), which are still under active development in primary school children and can be effectively strengthened through structured, rule-based activities that promote anticipation, logical reasoning, and self-regulation**.**

Recent evidence in the Colombian context suggests that emotional intelligence is significantly correlated with academic proficiency, reinforcing the idea that affective factors are inseparable from cognitive success (Garnica-Rey & Navarro-Arana, 2025). This relationship becomes particularly relevant in

marginalized primary education contexts, where students frequently experience the aforementioned "double vulnerability," combining academic difficulties with socio-emotional stressors associated with poverty, exclusion, and instability.

Consequently, chess should not be reduced to a strategic game but rather understood as a neuro-inclusive pedagogical tool capable of mediating both cognitive development and emotional regulation during a critical stage of primary education. Specifically, specialized pedagogical techniques are vital for ensuring cognitive engagement and attention in neurodiverse students (Navarro-Arana et al., 2025). It functions as a pedagogical space that promotes self-regulation, tolerance for uncertainty, and decision-making (Aciego et al., 2012), addressing not only academic outcomes but also emotional development and character formation, which are central to early schooling**.**

Despite these advances, current research remains fragmented and insufficiently responsive to the urgent challenges faced by vulnerable primary education systems in the post-pandemic era. Existing studies are characterized by thematic dispersion and methodological heterogeneity, limiting the construction of an integrated understanding of how educational chess contributes to inclusive and holistic development. There is a pressing need for an updated and systematic synthesis that articulates cognitive and socio-emotional dimensions, specifically within vulnerable primary education contexts, to inform educational policy and pedagogical practice by 2025.

METHODS

This research was conducted as a systematic review and bibliometric analysis aimed at mapping the scientific production on educational chess in vulnerable contexts. The procedure followed a structured, multi-stage approach based on international reporting standards for systematic reviews (PRISMA). In addition to descriptive mapping, the review incorporated an analytical lens that conceptualizes educational chess as a "mental laboratory" in primary education, understood as a structured pedagogical environment where children develop impulse control, decision-making, and self-regulation through guided practice. This perspective informed both the selection and interpretation of the studies.

The study included peer-reviewed scientific publications, including empirical articles, theoretical works, and literature reviews, published between 1980 and 2025. The inclusion criteria targeted works in English, Spanish, and Portuguese that explicitly addressed chess for educational purposes among primary and secondary students in contexts of social vulnerability or educational risk. Attention was given to studies conducted in primary education settings, where chess is used as a mediating tool for behavioural regulation and cognitive development. Exclusion criteria were applied to studies focused solely on competitive sports performance, technological developments without pedagogical intent, unpublished theses, and documents with incomplete bibliographic metadata.

The primary bibliographic search was executed in the Scopus database. Scopus was selected as the principal source due to its extensive coverage of high-impact international journals and its robust bibliometric tools, which are essential for mapping global scientific production. To ensure comprehensive coverage, supplemental searches were conducted in the Web of Science Core Collection, ERIC, and SciELO. The inclusion of SciELO was particularly relevant to incorporate research from Latin America and other Global South contexts, thus reducing geographical bias and ensuring the representation of educational experiences from vulnerable settings that are often underrepresented in major international databases. Additionally, a manual review of references within selected documents and an exploratory search in Google Scholar were performed to minimize the omission of relevant literature.

Search equations utilized Boolean operators to combine terms related to chess, education, and inclusion. In Scopus, the following string was applied: ("chess" OR "educational chess" OR "game-based learning") AND ("education" OR "pedagogy" OR "school") AND ("vulnerable contexts" OR "social risk" OR "low-income" OR

"marginalized") AND ("inclusion" OR "equity" OR "resilience" OR "executive functions").

The selection process followed a systematic progression. Initially, 624 records were identified across all sources. After removing 217 duplicates, 407 documents underwent independent title and abstract screening. Consistency during this phase was ensured through cross-verification between the researcher and the thesis committee. Subsequently, 55 full-text articles were evaluated for eligibility, resulting in a final corpus of 31 publications relevant to the analytical objectives (see Figure 1). Discrepancies during selection were resolved through discussion and consensus.

Figure 1 shows the PRISMA 2020 flow diagram of the systematic review process. The diagram illustrates the identification, screening, and inclusion phases, resulting in a final corpus of 31 publications.

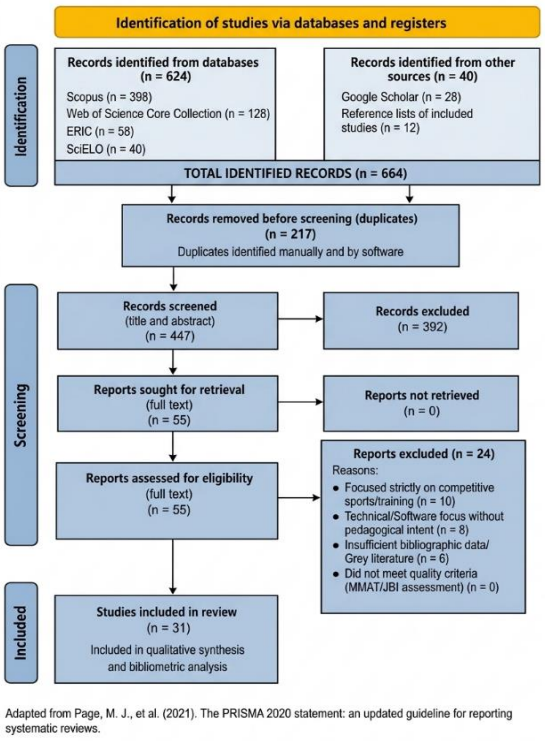

Figure 1. PRISMA 2020 Flow Diagram of the Systematic Review Process

To address the "methodological weaknesses" often cited in chess literature, a rigorous Quality Assessment (QA) was performed on the final 31 articles. We utilized the Mixed Methods Appraisal Tool (MMAT) for empirical studies and the Joanna Briggs Institute (JBI) critical appraisal checklists for theoretical and qualitative works. Each study was evaluated based on:

1. Methodological Rigour: Sample representativeness and risk of bias.
2. Pedagogical Intentionality: Explicit description of the teacher's role as a mediator.
3. Contextual Relevance: Applicability of findings to vulnerable primary education settings.

This assessment ensured that the synthesis was not merely a summary of findings but a critical evaluation of how chess functions as a behavioural laboratory for character development and emotional transition in marginalized areas.

In addition, complementary criteria from CASP were also used. The evaluation considered research design clarity, methodological coherence, sample characteristics, data collection procedures, validity of instruments, and consistency of reported findings. Each study was classified into three levels (high, moderate, and low quality), and only those meeting minimum quality standards were retained for analysis. Additionally, a risk of bias assessment was performed, examining potential sources of selection bias, measurement bias, and reporting bias within each study. This process strengthened the reliability of the synthesis and supported the identification of methodological limitations discussed in the results section.

Finally, the analytical phase was guided by a conceptual shift from traditional IQ-centred perspectives toward a neuroeducation and social justice framework. This allowed the interpretation of educational chess not merely as a tool for cognitive enhancement, but as a neuro-inclusive pedagogical strategy that addresses both executive functions and socio-emotional development in vulnerable primary education contexts.

RESULTS AND DISCUSSION

Bibliometric Trends and Temporal Evolution

The analysis of the included studies reveals that scientific production on educational chess in vulnerable contexts has

grown steadily between 1980 and 2025. Initially, research was limited and primarily exploratory, characterized by isolated publications with little thematic continuity. From 2010 onwards, a gradual increase in the number of studies is observed, a trend that becomes significantly more consistent after 2018. During this latter period, production became more regular and gained greater visibility in indexed databases. This shift suggests an incipient consolidation of the field; educational chess is no longer viewed merely as a specific didactic resource but as a legitimate object of study linked to broader educational challenges (see Table 1).

Table 1. Included Studies on Educational Chess

Author (Year) / Country	Design (Educational Level)	Cognitive Dimension (Executive Functions)	Socio-emotional Dimension	Type of Relationship	Reciprocal Cognitive–Socio-emotional Dynamics (explicit mechanism)	Quality Assessment (JBI/ MMAT)
Integrated (Bidirectional / Direct Relationship)						
Aciego et al. (2012) / Spain	Quasi-experimental (Primary education)	Reasoning, planning	Emotional adjustment	Direct integration (simultaneous)	Cognitive planning enhances emotional adjustment during problem-solving, while emotional stability sustains effective reasoning performance (bidirectional feedback)	High
Baig et al. (2025) / Spain	Experimental (Primary education)	Executive functions (global)	Emotional regulation	Bidirectional relationship	Executive functions improve emotional regulation, and improved regulation reduces cognitive interference, reinforcing executive performance	High
Rossini et al. (2020) / Multi-country	Controlled experimental (Primary education)	Executive functions	Emotional variables	Integrated relationship	Simultaneous development of executive control and emotional variables suggests mutual reinforcement during learning tasks	Moderate
Williams et al. (2025) / Multi-country	Neuro-educational (Primary education)	Brain activation	Emotional regulation	Neurocognitive integration	Overlapping neural systems support both executive control and emotional regulation, indicating reciprocal neurocognitive processing	High
Hernández et al. (2024) / Multi-country	Neuro-educational review (School context)	Cognitive processes	Emotional processes	Integrative framework	Cognitive and emotional systems operate as interdependent processes where changes in one domain directly influence the other	Moderate
Interdependent / Functional Relationship						
Ramos et al. (2018) / Argentina	Comparative (Primary education)	Working memory, flexibility	Self-regulation	Functional interdependence	Improved working memory and flexibility enable better emotional self-regulation, which in turn supports sustained cognitive engagement	Moderate
Chitiyo et al. (2020) / USA	Longitudinal (Primary education)	Sustained improvement	Self-esteem	Progressive relationship	Cognitive improvement increases self-esteem, and higher self-esteem promotes continued cognitive effort over time	Moderate
Chitiyo et al. (2021) / USA	Qualitative (Basic Education)	Cognitive development	Not analyzed	Historical cognitive focus	Early research does not consider emotional variables, limiting reciprocal interpretation	Low

Hong & Bart (2007) / USA	Correlational (At-risk students)	Cognitive improvement	Reduced academic failure	Compensatory relationship	Cognitive gains reduce emotional distress and perceived failure, which in turn facilitates further cognitive engagement	Moderate
Ferguson (2000) / USA	Longitudinal (Public schools)	Reading performance	Persistence	Mediated academic transfer	Emotional persistence sustains cognitive improvement in reading, while cognitive success reinforces persistence	Low
Reluz (2019) / Peru	Quasi-experimental (Public primary education)	Attention	Behavioral control	Direct behavioral relationship	Improved attention enhances behavioral control, and increased behavioral control allows better cognitive focus in tasks	Moderate
Mediated / Facilitated Relationship						
Islam et al. (2021) / Bangladesh	Quasi-experimental (Primary education)	Cognitive outcomes	Academic motivation	Emotion-mediated learning	Motivation mediates cognitive performance, and successful cognitive outcomes reinforce motivation (feedback loop)	High
Jerrim et al. (2016) / United Kingdom	Randomized Control Trial (RCT) (Primary education)	Cognitive performance	Motivation	Emotion-mediated learning	Motivation facilitates engagement in cognitive tasks, and improved performance strengthens motivational levels	High
Pham & Dao (2025) / Vietnam	Quasi-experimental (Primary education)	Cognitive performance	Motivation	Facilitating relationship	Motivation facilitates engagement in cognitive tasks, and improved performance strengthens motivational levels	High
Lituma et al. (2025) / Multi-country	Quasi-experimental (Basic education)	Digital cognition	Motivation	Technology-mediated relationship	Digital environments integrate motivation and cognition, where engagement enhances performance and vice versa	Moderate
Korzeniowski (2017) / Argentina	Quasi-experimental (Public schools)	Academic performance	School attitude	Context-mediated relationship	Positive school attitudes enhance cognitive performance, and improved performance reinforces positive attitudes toward learning	Moderate
Ye (2025) / China	Quasi-experimental (Early childhood education)	Cognitive development	Socialization	Early-stage integration	Early social interaction supports cognitive development, while cognitive gains facilitate social participation	Moderate
Partial or Limited Relationship						
Sala & Gobet (2016) / Multi-country	Meta-analysis (School education)	Limited cognitive transfer	Not significant	Indirect relationship	No consistent evidence of reciprocal influence; cognitive effects do not systematically translate into socio-emotional outcomes	High
Sala & Gobet (2017) / Multi-country	Systematic review (Formal education)	Cognitive gains	Limited emotional evidence	Fragmented relationship	Cognitive improvements occur without consistent emotional impact, indicating weak or absent reciprocity	High
Sala et al. (2017) / Multi-country	Updated review (School education)	Cognitive skills	Weak emotional evidence	Partial relationship	Limited interaction between domains; cognitive gains show minimal emotional reinforcement	High
Bart (2014) / USA	Systematic review (Formal education)	Academic achievement	Inconclusive	Weak relationship	Evidence does not support a stable reciprocal mechanism between cognition and emotion	Moderate

Hammond (2014) / Multi-country	Integrative review (Formal education)	Cognitive outcomes	Socio-emotional outcomes	Suggested relationship	Cognitive and emotional outcomes co-occur, but reciprocal mechanisms remain unclear	Moderate
Sankalaite et al. (2021) / Multi-country	Systematic review (Formal education)	Cognitive outcomes	Well-being	Emerging relationship	Early evidence suggests potential reciprocity, but mechanisms are not yet fully established	Moderate
Cognitive-focused / No socio-emotional analysis						
Grabner et al. (2007) / Austria	Comparative (Primary education	Intelligence	Not analyzed	Not assessed	No socio-emotional variables included reciprocal interaction cannot be determined	Moderate
Gliga & Flesner (2014) / Multi-country	Observational (School chess players)	Cognitive skills	Not clear	Limited relationship	Insufficient data to determine interaction between cognitive and emotional domains	Moderate
Subia et al. (2019) / Multi-country	Systematic review (School context)	Mathematics performance	Not included	Isolated cognitive focus	Exclusive cognitive focus prevents analysis of reciprocal dynamics	Moderate
Christiaen & Verhofstadt (1981) / Belgium	Observational (Basic education)	Cognitive development	Not analyzed	Historical cognitive focus	Early research does not consider emotional variables, limiting reciprocal interpretation	Low
Theoretical / Conceptual Studies						
Gobet & Campitelli (2006) / United Kingdom	Critical review (Formal education)	Cognitive perspective	Not evaluated	Methodological critique	Highlights absence of integrated cognitive–emotional models in existing research	Low
Karakuş (2023) / Multi-country	Systematized theoretical review (Formal education)	Cognitive framework	Not evaluated	Conceptual approach	Proposes cognitive frameworks but lacks empirical validation of reciprocal processes	Low
Luna (2025) / Venezuela	Systematized documentary review (Basic education)	Cognitive aspects	Socialization	Contextual relationship	Suggests contextual interaction between cognition and socialization without empirical testing	Low
Additional Empirical Study						
Barrero & Motoya (2025) / Colombia	Correlational (Secondary education)	Executive functions	Emotional intelligence	Correlational relationship	Statistical association indicates that higher executive functioning is linked to greater emotional intelligence, suggesting potential bidirectional influence	High

Table 1 illustrates that most studies report a bidirectional relationship between cognitive and socio-emotional development, supporting the idea that both dimensions are mutually reinforcing rather than independent. The table highlights the integrated contributions of educational chess to cognitive and socio-emotional development. The "Type of Interaction" column indicates whether the relationship between both dimensions is bidirectional, unidirectional, or limited, based on the findings reported in each study.

Geographical Distribution and Collaboration Networks

Research activity is concentrated within a limited number of countries and research groups. Geographically, Western Europe represents the highest scientific output, particularly in Spain, Italy, and the United Kingdom. In Latin America, Brazil, Argentina,

and Colombia emerge as relevant contributors, although with less dense publication networks. Network analysis reveals three relatively stable co-authorship clusters focused on executive functions, inclusive education, and pedagogical design. However, inter-cluster connectivity remains moderate, indicating that the field is still predominantly structured around national or regional research agendas rather than consolidated global collaboration networks. Importantly, this fragmentation reinforces the need to understand that the effects of chess are not automatic, but depend on pedagogical mediation, particularly the teacher's role as mediator of meaning.

Thematic Analysis of Analytical Dimensions

Following the established methodology, the corpus was organized into three analytical dimensions that explain the impact of chess in vulnerable educational contexts. However, a cross-cutting finding emerges: the effects of chess are not automatic, but mediated by pedagogical action, especially the teacher's role as mediator of meaning.

Cognitive Development and Executive Functions

The reviewed studies report slight to moderate improvements in executive functions such as working memory, planning, sustained attention, and reasoning. This dimension represents the most densely populated area of the literature, reflecting a growing neuroeducation orientation. Findings suggest that chess operates as a structured cognitive laboratory in which students are required to inhibit impulsive responses, evaluate alternatives, and anticipate consequences.

These processes are particularly relevant for learners with self-regulation difficulties or low academic performance, suggesting that chess may compensate for insufficient early cognitive stimulation in high-risk environments. However, these cognitive effects do not emerge automatically from the game; they are the result of pedagogical mediation, where the teacher actively structures, guides, and scaffolds learning processes. These executive functions must be explicitly linked to the elementary curriculum**,** particularly to basic literacy (reading comprehension, sequencing, and narrative organization) and numeracy (problem-solving, multi-step operations, and logical reasoning).

Socio-Emotional Learning and Resilience

Evidence shows consistent improvements in emotional regulation, perseverance, frustration tolerance, and resilience. In vulnerable contexts marked by chronic stress, chess functions as an emotional scaffolding tool that allows students to experience failure within a structured and safe environment. Through repeated cycles of decision-making, loss, and reflection, students gradually develop coping strategies that are transferable beyond the classroom. This process strengthens self-efficacy and supports the transition from passive learners to active decision-makers, reinforcing the emergence of intellectual agency. This transformation is not inherent to chess; it is enabled through pedagogical mediation, where the teacher acts as a facilitator of emotional meaning-making. The literature consistently indicates that emotional regulation is a prerequisite for success in mathematics and language learning, as it enables sustained attention, persistence, and cognitive control.

Inclusion and Educational Equity

The reviewed studies converge on the idea that chess-based pedagogical practices contribute to educational equity by offering an accessible learning activity that does not require prior socio-economic or cultural capital. However, inclusion is not automatic. Its impact depends on intentional curricular integration and pedagogical mediation by the teacher. In these conditions, chess becomes a situated educational practice rather than an extracurricular activity. A key finding is the transformation of the teacher's role: from instructor to mediator of meaning within a horizontal pedagogical relationship between teacher and student. This horizontal relationship reconfigures classroom dynamics, positioning students as active participants in knowledge construction rather than passive recipients. Consequently, chess strengthens school belonging, reduces exclusion, and fosters more equitable learning environments.

Discussion

The findings of this systematic review suggest that educational chess is a comprehensive pedagogical practice intersecting with debates on equity and inclusion. The results reveal a convergence between cognitive development tracks and those prioritizing social well-being, reinforcing the premise that chess operates across multiple planes simultaneously; however, this operation is not intrinsic to the game but depends fundamentally on pedagogical conditions and contextual mediation**.**

The results of this study align with the findings of Aciego et al. (2012) and Sala & Gobet (2016), who identified significant improvements in cognitive domains and emotional self-regulation. Like the state-of-the-art presented in the introduction, this review confirms that chess serves as a cultural mediator facilitating participation in settings marked by chronic stress. However, while previous research, such as Trinchero & Sala (2016), focused heavily on the transfer of mathematical skills, this study finds a distinct shift in recent literature (2020–2025) toward a neuroeducation and socio-ecological paradigm. Unlike earlier studies (pre-2020), which tended to attribute cognitive gains directly to chess practice, recent research emphasizes mediated learning processes, teacher intentionality, and classroom contextualization as key variables explaining outcomes**.** This shift is also associated with the expansion of digital learning environments, hybrid classrooms, and structured pedagogical scaffolding.

A critical explanation for the divergence between classical studies and 2020–2025 research lies in the transformation of classroom practices and the integration of digital chess platforms. While earlier interventions relied mainly on face-to-face instruction and limited instructional design, recent programs incorporate platforms such as online chess training environments, gamified learning systems, and adaptive feedback tools, which enhance metacognitive engagement and allow individualized pacing. These technological changes have modified the nature of cognitive transfer, making learning more situated and less automatic than previously assumed.

A significant difference noted in this review compared to the general literature is the role of intentionality. While some classic studies suggest that the game itself produces benefits, the synthesis of the 31 analyzed publications demonstrates that the chess effect is contingent upon situated pedagogical mediation. This finding directly addresses the methodological skepticism in previous systematic reviews, which often reported weak or absent reciprocity between cognitive and emotional domains due to fragmented instructional contexts (Sala & Gobet, 2017). This supports the theoretical framework of Booth & Ainscow (2011) regarding the removal of obstacles to participation, as chess provides a structured environment to test decisions and anticipate consequences without the exclusionary pressure of traditional competitive logic. Therefore, the so-called “chess effect” must be interpreted as a mediated pedagogical outcome rather than an inherent property of the game.

Regarding the La Jugada del Rey initiative, it is necessary to clarify that its discussion must be supported by empirical indicators rather than descriptive or promotional language. Available data from implementation reports (e.g., participation rates, frequency of instructional sessions, and observed behavioural engagement indicators) suggest positive trends; however, these results remain preliminary and context dependent. Consequently, this initiative should be interpreted as a case of situated educational innovation rather than as evidence of generalized effectiveness.

This research contributes to the existing body of knowledge by providing a bibliometric mapping that was previously absent in studies of vulnerable contexts. By identifying three specific clusters—cognitive architecture, socio-emotional regulation, and inclusive equity—this study organizes a fragmented field into a coherent framework. Furthermore, it situates educational chess initiatives, including La Jugada del Rey, not as isolated interventions, but as part of an international trend that conceptualizes structured play as a pedagogical resource

aligned with social justice and Sustainable Development Goal 4 (SDG 4).

From a critical perspective, the concept of IQ improvement frequently associated with chess interventions requires reevaluation. In elementary school contexts, particularly in vulnerable settings, the primary educational value of chess should not be reduced to instrumental cognitive gains such as IQ increases. Instead, the evidence suggests that its more relevant contributions lie in the development of resilience, self-regulation, attention control, and intellectual agency. This perspective is supported by evidence that emotional intelligence and affective factors are more significant predictors of academic success in vulnerable contexts than isolated cognitive measures (Garnica-Rey & Navarro-Arana, 2025). Thus, the emphasis should shift from psychometric enhancement to capability formation within socio-emotional and adaptive learning frameworks.

Building on this, a key finding in this review is the central role of the teacher as a "mediator of neuro-inclusive learning experiences" rather than merely an instructor of procedural gameplay**.** The data indicate that the presence of chess in classrooms does not automatically produce gains in executive functions or socio-emotional development. What is required is a form of neuro-inclusive mediation, in which teachers actively design connections between cognitive processes in the game and diverse learning profiles, including students with different neurodevelopmental conditions and socio-emotional needs. In this sense, the application of specialized pedagogical techniques is essential to sustain cognitive engagement and attention across diverse student profiles (Navarro-Arana et al., 2025). This pedagogical bridge is what enables meaningful learning transfer (far transfer) from the chessboard to academic, social, and everyday decision-making contexts.

Another central limitation in the literature concerns far transfer. Although many studies assume that skills acquired on the chessboard naturally transfer to real-life problem solving, the evidence remains weak and inconsistent. Far transfer is highly dependent on explicit pedagogical mediation that connects in-game strategies with real-world decision-making contexts. In elementary education, especially in vulnerable environments, many chess programs fail precisely because teachers do not establish this cognitive bridge, resulting in strong in-game performance but limited behavioural generalization outside the classroom.

Accordingly, teacher training must be reconceptualized. It should not be limited to operational aspects such as "how to teach chess" or game rules, but must instead focus on neuro-inclusive pedagogical mediation. This includes understanding cognitive diversity, designing inclusive scaffolding strategies, and translating strategic thinking in chess into adaptive learning pathways for heterogeneous classrooms.

The role of digital chess platforms is particularly relevant in addressing educational inequalities. In vulnerable areas, these platforms can partially mitigate the digital divide by providing access to structured practice, interactive tutorials, and adaptive learning environments. Recent studies suggest that these digital environments can effectively integrate motivation and cognition, provided there is high engagement and instructional scaffolding (Lituma et al., 2025). However, their effectiveness is conditioned by infrastructure availability, teacher digital literacy, and equitable access to devices. Without these conditions, digitalization risks reinforcing rather than reducing educational gaps.

Despite the burgeoning interest, the empirical base necessitates cautious interpretation due to methodological heterogeneity. This diversity reflects the adaptation of chess to varied educational landscapes but highlights a lack of common evaluative frameworks. A critical gap identified is the scarcity of longitudinal research; the absence of long-term follow-up prevents a deep understanding of whether benefits are sustained over time. Additionally, the predominance of quasi-experimental designs restricts the ability to establish robust causal relationships.

At a policy level, the findings support the inclusion of chess as a low-cost, high-impact educational resource aligned with SDG 4. However, policymakers should avoid standardized or purely symbolic

implementations. Instead, they should prioritize: (1) teacher training in pedagogical mediation strategies, (2) integration of chess into broader curricular goals rather than extracurricular isolation, (3) investment in digital infrastructure to support hybrid chess learning environments, and (4) development of monitoring systems that evaluate not only cognitive outcomes but also socio-emotional and agency-based indicators.

Future studies should explore the processes through which these effects are produced, combining quantitative and qualitative approaches to foster a more equitable and inclusive education, with special attention to mediation mechanisms, contextual variability, and the long-term sustainability of cognitive and socio-emotional outcomes.

CONCLUSION

This study has successfully characterized the scientific production of educational chess in vulnerable contexts, providing a structured vision for a previously fragmented field. However, the significance of this review transcends the mere identification of 31 high-impact publications; it reveals a fundamental shift in how educational science perceives the intersection between play, cognition, and social justice. The findings demonstrate that educational chess has evolved from a simple didactic tool into a sophisticated mental laboratory where cognitive architecture, socio-emotional regulation, and inclusive equity converge.

The most critical insight derived from this synthesis is that the chess effect is not an inherent or automatic property of the board and pieces. Instead, it is a result of intentional pedagogical mediation. This unifies the bibliometric trends, cognitive clusters, and inclusion frameworks into a single premise: the effectiveness of chess in schools depends on how it is pedagogically situated within the lived realities of each educational community.

The implications of this research are particularly relevant for educational equity. In contexts of structural poverty and limited cultural capital at home, chess emerges as a compensatory pedagogical resource that fosters intellectual agency, decision-making autonomy, and emotional regulation. Rather than being viewed as a recreational activity, chess should be recognized as a structured educational intervention that contributes to reducing inequities in access to cognitive enrichment opportunities.

For this reason, chess should be integrated into the inclusive curriculum or formal enrichment programs, rather than being treated as a peripheral extracurricular activity. Embedding chess within curricular structures ensures pedagogical continuity, institutional legitimacy, and equitable access for all students, particularly those in vulnerable educational contexts.

This study aligns with the global mandate for inclusive and equitable quality education. By identifying chess as a low-cost, high-impact resource, this review provides evidence supporting its contribution to Sustainable Development Goal 4 (SDG 4), especially in marginalized regions where access to enriched learning environments is limited. Initiatives such as La Jugada del Rey should therefore be understood not as isolated interventions, but as contextually situated educational models consistent with global equity agendas.

Finally, this work demonstrates that the field is in a process of consolidation but still faces important methodological and conceptual challenges. Beyond the need for longitudinal research, future studies must adopt multi-layered research designs that integrate: (1) longitudinal tracking of cognitive and socio-emotional development, (2) evaluation of neuro-inclusive pedagogical mediation practices in real classrooms, and (3) comparative analyses of digital versus face-to-face chess instruction in diverse socioeconomic contexts. Further research should critically examine the role of digital chess platforms in vulnerable areas, assessing whether they effectively reduce educational gaps or unintentionally reinforce the digital divide due to unequal access to technology and teacher training. Ultimately, this study provides an analytical foundation to reconceptualize the chessboard not merely as a learning tool but as a pedagogically mediated instrument of social justice**,** capable of expanding intellectual opportunity for children who lack socioeconomic and cultural capital in their home environments.

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