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THE PEDAGOGY OF CHESS IN THE CONTEXT OF INCLUSIVE EDUCATION: AN INTEGRATIVE REVIEW OF CONTRIBUTIONS AND ADAPTATIONS FOR STUDENTS WITH AUTISM SPECTRUM DISORDER

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Abstract:
Inclusive education in Brazil, supported by the Law of Guidelines and Bases (LDB) and the Brazilian Law of Inclusion (LBI), faces practical challenges in the schooling of students with Autism Spectrum Disorder (ASD). This article presents a theoretical review that investigates the contributions of chess instruction for these students, as well as the methodological adaptations necessary to enhance their cognitive and social development. Methodologically, an integrative review was conducted in the SciELO, Google Scholar, and CAPES Journals databases (2015–2025), using combined search strings for chess and ASD, with data processed via content analysis. The results indicate that chess serves as an effective mediator in strengthening executive functions such as focused attention, working memory, and strategic planning. Owing to its rule-based and predictable nature, the game offers an emotionally safe environment that favors inhibitory control and reduces anxiety in autistic individuals. The relevance of integrating the principles of Universal Design for Learning (UDL) and gamification is noted to promote multisensory engagement and student motivation. It was concluded that adapted chess is a low-cost, high-impact pedagogical tool capable of promoting

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equity in opportunities and compliance with legal guidelines for inclusion. However, the effectiveness of the intervention depends on intentional teacher mediation and the use of visual support and systematic instruction. This study reinforces the need to expand empirical research in the Brazilian context to consolidate chess as an accessibility resource applicable in both Specialized Educational Assistance (AEE) and regular classrooms through Universal Design for Learning (UDL).

Keywords: executive functions; gamification; pedagogical accessibility; neurodiversity; specialized educational support

1. Introduction

Inclusive education in Brazil has made considerable progress in terms of access, supported by legal frameworks such as Law No. 9,394/1996, Guidelines and Bases of National Education (LDB) (Brazil, 1996), and Law No. 13,146/2015, Brazilian Law of Inclusion (LBI) (Brazil, 2015). However, the major contemporary challenge lies in the retention and academic achievement of students with Autism Spectrum Disorder (ASD), who present unique characteristics in communication, social interaction, and sensory processing (Glat, 2018). In the school context, students with ASD require strategies that emphasize predictability and structure, reducing anxiety and supporting engagement in curricular activities.

In this context, school chess emerges as a promising pedagogical mediator that promotes the development of executive functions such as logical-mathematical reasoning, focused attention, working memory, and strategic planning. Evidence involving schoolchildren, especially in mathematics, supports these effects, although controlled trials are still needed to strengthen causal inference and to define the timing, intensity, and forms of implementation more precisely (Ramos & Krumm, 2017; Ramos *et al.*, 2017). For autistic students, the game offers an environment with rigid rules and logical consequences, functioning as a cognitive "*safe harbor*" where social interactions occur in a controlled and predictable manner (Sousa & Góes, 2018; Bornstein & Cunningham, 2023). Several studies point to a lack of specific instruments and curricular protocols for students with ASD in basic education, which compromises the quality of inclusion (Rocha *et al.*, 2019; Silva *et al.*, 2025). This is analogous to what occurs with chess: there is recognition of its general benefits, but almost no systematization of adapted methods for this audience.

Research on the inclusion of students with ASD shows that practices are still highly standardized, creating barriers when functional profiles and individual needs are not considered (De Oliveira *et al.*, 2025; Tanaka *et al.*, 2024; Magalhães *et al.*, 2017). Teachers report difficulties in adapting activities, explaining content, and mediating communication with autistic students, even when using recognized methods (ABA, PECS) (Magalhães *et al.*, 2017). The studies agree that planned teacher mediation is

decisive: the levels of engagement and learning among students with disabilities or ASD depend directly on the quality of mediation and curricular adaptations (Rigoletti & Deliberato, 2020; Lima & Pletsch, 2018; Tanaka *et al.*, 2024).

Reviews of resources for neurodivergent students highlight that visual materials, assistive technologies, games/gamification, and adapted educational materials are crucial for access to the curriculum and meaningful participation (De Morais *et al.*, 2025; Silveira *et al.*, 2025; Silva *et al.*, 2025). For ASD, visual resources (pictograms, diagrams, and step-by-step support) facilitate understanding, communication, and routine organization (De Morais *et al.*, 2025; Silveira *et al.*, 2025). The statement that the effectiveness of chess in special education depends on mediations sensitive to neurodiversity, with visual support and accessible language, is strongly consistent with the literature on ASD and inclusion. The innovative aspect of this study is the application of these principles specifically to chess, an area where research is still scarce.

Considering this issue, the present article proposes a theoretical review aimed at investigating the theoretical contributions of chess instruction for students with ASD and identifying the methodological adaptations necessary for its implementation in the Brazilian context. This analysis seeks to integrate the principles of Universal Design for Learning (UDL) and gamification, aiming to provide a framework that enhances the holistic development of these students from an inclusive and equitable perspective..

2. Literature Review

2.1 The Paradigm of Inclusive Education and Legal Support

The construction of an inclusive educational system presupposes a profound change in school culture, shifting from a space of homogenization to an environment that embraces and values diversity. In Brazil, this process has been marked by conceptual advances and a legal framework aimed at ensuring the constitutional right to education for all.

2.1.1 Evolution of the Concept: From Integration to Full Inclusion

Understanding the trajectory of people with special needs in Brazilian education reveals a shift in perspectives from purely discriminatory and segregationist views to interactionist and human rights-based approaches. This process is not linear and involves significant political and social tensions, as educational inclusion is often driven by social movements that challenge state planning and capital relations (Sanfelice, 2006).

Historically, the school integration model, which prevailed until the 1990s, was based on the idea that students with disabilities should adapt to the regular school system. In this paradigm, the focus was on the student's "*deficit*"; if the student was unable to keep up with the pace of the regular class, they were referred to special classes or schools. Mendes (2010) strongly criticizes this model, characterizing it as a "*subtle mechanism of exclusion*." According to the author, integration strengthened parallel and segregated systems that, while promoting the idea of socialization, did not offer real

political or academic benefits, keeping atypical students on the margins of the common curriculum.

The transition to full inclusion reverses this trend. Under the paradigm of inclusion, it is no longer the individual who must change to adapt to society, but rather society and institutions that must adjust and remove barriers to ensure the development of all individuals (Glat & Pletsch, 2012). This concept is anchored in the recognition of diversity as an intrinsic value of the human experience, and not as an inequality to be eliminated.

The Salamanca Statement (Brazil, 1994) consolidated this understanding at the international level by advocating that schools should organize themselves to welcome all children, regardless of their physical, intellectual, social, or linguistic conditions. In Brazil, this movement implies that inclusion goes far beyond mere physical access to the classroom. According to Glat (2018), the implementation of this paradigm requires a "*restructuring of all constitutive aspects of the school*," which involves everything from deconstructing negative social representations to changing educators' attitudes and the organization of pedagogical work.

Therefore, the evolution of the concept of full inclusion defines the school as a naturally democratic and welcoming space where equity replaces formal equality. In this context, adapted pedagogical strategies, such as teaching chess with specific mediation, cease to be a concession and become a fundamental right that guarantees students with ASD access to complex knowledge and the development of their potential (Mendes, 2010; Silva *et al.*, 2023).

2.1.2 Regulatory Frameworks: Law of Guidelines and Bases (LDB) 9,394/96 and the Impact of the Brazilian Law of Inclusion (LBI)

The Brazilian legal framework for educational inclusion is the result of a prolonged process of social struggle and ratification of international treaties. The foundation of this system lies in the Constitution of the Federative Republic of Brazil (Brazil, 1988), which establishes education as the right of all and the duty of the State, guaranteeing "*specialized educational assistance for people with disabilities, preferably within the regular education system*" (Art. 208). However, it is in subconstitutional legislation that the mechanisms of access and teaching strategies take on a practical form.

The Law of Guidelines and Bases of National Education (LDB) (Brazil, 1996) consolidated the national system's commitment to diversity in education. Article 59 of the LDB stipulates that education systems must ensure students with disabilities, pervasive developmental disorders, and high abilities specific curricula, methods, techniques, educational resources, and organization to meet their needs. This provision is fundamental to the justification of this study, as it legitimizes the search for differentiated tools, such as adapted chess, to ensure that education is not merely a physical presence but an effective learning process.

Complementing this scenario, the National Policy on Special Education from the Perspective of Inclusive Education (Brazil, 2008) redefined the role of mainstream schools, guiding the universalization of access and institutionalization of Specialized Educational Assistance (AEE). This policy emphasizes that the organization of schools must be reconsidered to address specific needs, requiring profound structural and cultural change. More recently, the National Education Plan (PNE 2014–2024) (Brazil, 2014) reinforced these goals by providing increased funding and teacher training for inclusive education.

However, the most disruptive legal framework in the contemporary context is the Brazilian Inclusion Law (LBI) (Brazil, 2015), also known as the Statute for Persons with Disabilities. The LBI definitively breaks away from the medical model of disability (focused on the organic "*defect*") and adopts the Social Model, in which disability is understood as the result of the interaction between physical or mental impairments and the barriers imposed by society (LBI, Art. 2).

In the educational context, Article 28 of the LBI (Brazil, 2015) prohibits any form of discrimination and requires educational institutions to adopt measures of "*architectural accessibility, in transportation, devices, systems, and means of communication and information*." Crucially for pedagogical practice, the law mandates the provision of accessibility services and resources to eliminate pedagogical and attitudinal barriers. This means that schools should not merely enroll students with ASD but must actively remove obstacles that hinder their learning by providing flexible and adaptive teaching strategies that respect their cognitive profile.

Therefore, the current legislation not only allows but also requires the educational system to reinvent itself. The implementation of gamification strategies and the use of chess as an educational mediator fall within this legal duty to provide "*quality and inclusive education*," capable of respecting individual learning rhythms and processes (Santana & Santos, 2022; Silva *et al.*, 2023).

2.1.3 The Role of the Teacher and the Need for Continuing Education

The implementation of inclusive education does not depend solely on the existence of laws and regulations; it is realized in everyday pedagogical practice, with teachers as the main transformative agents. According to the National Policy on Special Education (Brazil, 2008), the classroom teacher is responsible for instructing all students, including those with specific educational needs.

Research in different contexts indicates that the primary responsibility for the learning of all students in a regular classroom falls on the classroom teacher, even when special education support is available (Dewi & Arnawa, 2023; Berry, 2021; Losberg & Zwozdiak-Myers, 2021; Berry, 2021). The teacher is seen as a central figure in organizing the environment, interactions, and curricular adaptations necessary for students with specific educational needs to participate both academically and socially (Gaitas *et al.*, 2024; Nafisyah & Sari, 2025; Mrema, 2024).

Simultaneously, studies warn that placing responsibility solely on the individual teacher may obscure the need for institutional support, public policies, and collaborative work among teachers, administration, families, and specialists (Shutaleva *et al.*, 2023; Albuquerque *et al.*, 2025; Marmos *et al.*, 2025).

Accounts of inclusive practices show that the teacher's role shifts to: Mediator of experiences and relationships – promoting cooperation among peers, reorganizing seating/partnerships, and creating interactions that combat isolation and marginalization (Gaitas *et al.*, 2024; McDevitt, 2021; Losberg & Zwozdiak-Myers, 2021; Barreto *et al.*, 2024); Architect of pedagogical accessibility – differentiating tasks, making the curriculum more flexible, varying forms of presentation, expression, and evaluation, in line with Universal Design for Learning (UDL) principles (Mrema, 2024; Nijakowska & Guz, 2024; Nafisyah & Sari, 2025); and Facilitator of inclusion and advocate for rights – preventing bullying and discrimination, articulating resources, and engaging in dialogue with families and other professionals (Losberg & Zwozdiak-Myers, 2021; Abrol, 2023; Shutaleva *et al.*, 2023; Albuquerque *et al.*, 2025; Nafisyah; Sari, 2025; Nuraini *et al.*, 2025).

However, the reality in schools reveals a concerning gap between the legislation's requirements and professionals' actual preparation. Silva *et al.* (2023) emphasize that the learning difficulties faced by atypical students highlight the urgency of public policies that prioritize not only access but also quality training. There is a clear discrepancy between the competencies required by the National Common Curricular Base (BNCC) and the initial training provided in teacher education programmes, which still present significant gaps regarding working with diversity and adaptive strategies (Tavares *et al.*, 2016).

Thus, continuing education is an indispensable requirement for overcoming attitudinal and pedagogical barriers. It should not be seen as a one-off or fragmented stage but rather as a continuous process of critical reflection on one's own beliefs and prejudices (Glat & Pletsch, 2012). For tools like school chess to be used with didactic intention, teachers need to develop skills that combine theoretical knowledge with inclusive practice, learning to adapt language, simplify instructions, and use visual supports tailored to the specific needs of individuals with Autism Spectrum Disorder (ASD).

In addition to the technical dimension, it is necessary to consider the emotional impact and mental health of the educators. Teacher overload, resulting from a lack of resources and limited support, is a constant obstacle that compromises the quality of inclusion in the classroom. As Silva *et al.* (2023) stated, the responsibility for inclusion should be shared among teachers, the educational system, and society. Only through continuous training programs, integrated with support networks and Specialized Educational Assistance (AEE), will it be possible to ensure that teachers feel confident to innovate in their methodology and promote the holistic development of all students.

2.2 School Chess: Cognition, Gamification, and Universal Design (dua)

When intentionally integrated into the curriculum, school chess ceases to be a mere pastime and becomes a powerful pedagogical strategy. Its effectiveness lies in its ability to combine playfulness and intellectual challenge, serving as a laboratory for the practice of critical thinking and the resolution of complex problems in the context of Inclusive Special Education.

2.2.1 Executive Functions: Attention, Working Memory, and Planning

From the perspective of cognitive neuropsychology, chess acts as a powerful mediator in the development of executive functioning, a set of cognitive processes that enable individuals to direct goal-oriented behaviors, assess the effectiveness of their actions, and adjust as needed according to the context. In the school environment, chess ceases to be mere entertainment and becomes a constant and highly meaningful exercise that requires students to manage multiple variables simultaneously.

Attention and concentration are the primary skills required in the game. During matches, players must maintain a continuous focus on the board, monitor the positioning of the pieces, and ignore irrelevant stimuli, which involves sustained and selective attention. Studies with elementary school children found significant improvement in standardized focused attention tests after months of chess classes (Atashafrouz, 2019; Velea, 2019; Stegariu & Abalașei, 2022; Velea, 2022; Vus *et al.*, 2023).

Research has shown that chess requires selecting, among many visual stimuli, only the pieces and squares critical to the immediate strategy, which is precisely what selective attention means (Stegariu & Abalașei, 2022; Velea, 2022; Küchelmann *et al.*, 2024). It should also be considered that more rigorous studies sometimes do not find clear effects on attention or other skills after a year of school chess (Islam *et al.*, 2020; Choi *et al.*, 2025) and that there are also reviews highlighting methodological biases and recommending caution when attributing significant academic gains directly to chess (Sala & Gobet, 2016; Blanch, 2022).

Working memory is activated when a child needs to mentally recall the rules, envision future scenarios, and keep sequences of moves in mind while evaluating the opponent's response. This skill is essential for students to learn how to interpret complex situations and analyze the patterns. While playing, the student not only memorizes the content but also manipulates information in real time, developing sequential reasoning and logical-mathematical thinking.

Games that require students to follow rules, update information, and choose responses involve central components of working memory (storing, updating, and manipulating information) and other executive functions such as inhibition and flexibility (Menon, 2016; Unger *et al.*, 2016; Estrada-Plana *et al.*, 2024). In-game tasks or rule hierarchies, children need to select which rule to use, keep it active, and adjust it to the context — a process explained by "*gating*" mechanisms in working memory that become more refined from childhood to adolescence.

Working memory supports both the initial acquisition of numerical concepts and the development of problem-solving strategies, especially when the child needs to break the problem into steps and follow a sequence of actions. Updating sequences (for example, "*my move – opponent's move – next response*") is like working memory updating tasks that predict skills such as basic arithmetic and logical visuospatial reasoning in number series and patterns (Menon, 2016; Hu *et al.*, 2023).

Regarding planning and organization, chess challenges students to formulate and evaluate hypotheses in practice. Researchers have argued that the need to anticipate moves and evaluate consequences enhances cognitive flexibility. The student learns that an ill-considered move can lead to defeat, which strengthens their inhibitory control. This process of self-monitoring, the act of reflecting before touching the piece, is fundamental for emotional regulation and building intellectual autonomy.

The literature supports the idea that chess fosters planning, cognitive flexibility, and some degree of inhibitory control, although not all studies find broad or generalized effects. Planning, organization, and hypothetical thinking: Studies with children who play chess show superior performance in classic planning tests (Tower of London) compared to non-players (Grau-Pérez & Moreira, 2017); educational reviews highlight that, by "*making a plan, testing it, and seeing the result*," students develop a systematic mechanism of mental control and critical thinking, which aligns precisely with the idea of formulating hypotheses and verifying them in practice (Karakuş, 2023; Rosa *et al.*, 2020) present a systematic review describing chess as being associated with planning, decision-making, logical-mathematical reasoning, and metacognition when used as a pedagogical tool.

Regarding cognitive flexibility and inhibitory control, the works of Grau-Pérez and Moreira (2017) and Hepsert *et al.* (2024) indicate that for students, playing chess is linked to higher scores of cognitive flexibility in specific tests. Hepsert *et al.* (2024), in a study with 200 students (aged 9–14), found that chess players had significantly higher cognitive flexibility scores than non-players. In turn, Darwish *et al.* (2025) observed that among adolescents, higher proficiency in chess was positively correlated with performance on the trail-making test (flexibility) and fewer errors in the Stroop test, indicating better inhibitory control. Shahar and Avital (2020) report that in a "*touch-move*" task inspired by the "*touch piece, move piece*" rule, chess players made fewer inhibitory errors (less impulsivity) than non-players, suggesting precisely this kind of training to "*think before touching the piece*."

Regarding emotional regulation and autonomy, studies in early childhood and primary education have shown gains in patience, self-discipline, resilience to frustration, and management of emotions in the face of victory or defeat (Daniyarova *et al.*, 2022; Ye, 2025). There are also school chess programs that report increased self-control, self-assessment, and methodical organization of studies, elements closely related to the intellectual autonomy mentioned above (Pavlovskaya, 2020; Rosa *et al.*, 2020; Karakuş, 2023). Silva (2023) emphasizes that by internalizing this reflective attitude, students begin

to demonstrate greater self-confidence and an increased ability to manage frustrations in the face of mistakes and failures, reframing mistakes as a necessary step in active learning.

Thus, chess acts as a symbolic mediator that facilitates the transition between concrete and abstract thinking. The executive functions strengthened on the board become transversal skills, helping the student plan their daily tasks, organize scientific thinking, and solve problems in their school life, ethically and creatively.

2.2.2 Gamification in Special Education: Motivation and Engagement in Atypical Students

Gamification, defined as the application of game design elements in non-game contexts, has emerged as a high-value active methodology for teaching students with neurodiverse profiles, such as those with Autism Spectrum Disorder (ASD). Unlike simple "play," pedagogical gamification uses mechanics such as immediate feedback systems, progress bars, symbolic rewards, and narratives to transform cognitive effort into an engaging and meaningful experience (Tabosa & Costa, 2023).

Motivation is a critical factor for students with ASD and often an obstacle to engaging in conventional school activities. In this context, gamification provides dynamic emotional support. According to recent research on Digital Game-Based Learning (DGBL), affective components integrated into teaching help balance the level of challenge with the student's ability, preventing sensory overload and early frustration. By transforming learning into a structured journey, gamification fosters assertiveness and positive self-perception, which are vital elements for students who face behavioral challenges (Antonopoulou *et al.*, 2022).

In chess education, gamification enhances engagement through adaptations that make learning more concrete and less intimidating to students. Strategies such as the use of avatars, point systems for completed tasks (like "*solving three diagrams*"), or personalized challenges allow students to visualize their progress in a tangible way. Tabosa and Costa (2023) argue that this approach directly contributes to the development of autonomy, as the student begins to manage their own goals within the game, making the teaching-learning process more meaningful and personalized.

In addition to individual gains, gamification in chess can serve as a bridge for developing social skills. By participating in controlled gamified competitions or cooperative matches, students with ASD practice patience, turn-taking, and sportsmanship in a mediated manner. The predictability of chess rules, combined with the motivational stimulus of gamification, creates a safe environment where students feel encouraged to communicate and interact with their peers, mitigating the social communication difficulties characteristic of the spectrum (Koumpouros, 2024).

2.2.3 Chess for All: The application of Universal Design for Learning (UDL) Principles

The implementation of inclusive education requires pedagogical planning that goes beyond the barrier of individualized curricular adaptations, which often stigmatizes atypical students. In this context, Universal Design for Learning (UDL) emerges as a fundamental approach, proposing that knowledge be accessible to everyone from the outset through flexible methods and materials (Santana & Santos, 2022). In Chess for All education, the application of UDL, the concept of "*Chess for All*", is structured on three main pillars: multiple means of representation, action/expression, and engagement.

The first pillar, multiple means of representation, focuses on the "*what*" of learning. For students with ASD, who may have different sensory processing profiles and difficulties with abstract concepts, chess should be introduced in a multisensory way. This includes the use of tactile or high-contrast boards, pieces with different textures, and pictograms and visual supports to explain piece movements. As highlighted by Koumpouros (2024), the use of assistive technologies and augmented reality can provide concrete representations that facilitate the understanding of complex strategies, reducing students' cognitive load and anxiety.

The second pillar refers to multiple means of action and expression (the "*how*"). UDL assumes that there is no single way to demonstrate one's knowledge. In adapted chess, students can express their understanding in numerous ways: physically moving the pieces, using software and digital platforms such as Lichess.org or Chess.com, which offer customizable interfaces (Santana & Santos, 2022), or even participating in cooperative matches where the student can explain their intended move to a mediator. The use of Augmentative and Alternative Communication (AAC) technologies allows verbally challenged students to actively engage in the social dynamics of the game, practicing communication and turn-taking (Farzana *et al.*, 2025).

Finally, multiple means of engagement address the "*why*" of learning. Chess, under the principles of UDL, should offer options that spark students' interest and persistence. This is achieved through gamification and personalizing the levels of challenge, ensuring that the activity is stimulating but not frustrating for the user. By providing autonomy in the choice of study topics or by participating in workshops based on playful narratives (such as using storytelling to explain the rules), the teacher fosters an environment of emotional safety and a sense of belonging. Thus, the convergence between the cognitive benefits of chess and the principles of UDL creates a platform of equity, where diversity is valued, and each student is encouraged to reach their full potential (Chen *et al.*, 2021a; Chen *et al.*, 2021b).

2.3 The Student with ASD and Chess Practice

The application of chess as a pedagogical tool for students with Autism Spectrum Disorder (ASD) is based on the convergence between the intrinsic characteristics of the game and the neurobiological profile of these students. By providing an environment

with low sensory noise and high logical organization, chess presents an activity that respects neurodiversity while challenging cognitive potential.

2.3.1 Neurobiological Profile and Learning: Routines and Predictability

Autism Spectrum Disorder (ASD) is a neurodevelopmental condition characterized by persistent difficulties in communication and social interaction, as well as restricted and repetitive patterns of behavior (APA, 2014). The use of the term "*spectrum*" is justified by the wide variability in manifestations and levels of support, ranging from highly functional individuals to those with severe intellectual and language impairments (Lima *et al.*, 2025).

From a neurobiological perspective, research indicates that ASD involves changes in critical areas of the brain, such as the thalamus, amygdala, and prefrontal cortex, which explains difficulties in emotional regulation and stimulus processing (Iidaka *et al.*, 2019; Yang *et al.*, 2023; Suprunowicz *et al.*, 2025).

One of the most striking cognitive markers is the absence or delay in the development of Theory of Mind, the ability to imagine and understand another person's perspective, intentions, and feelings. This limitation compromises social reciprocity and often causes interactions with peers to occur in atypical or inappropriate ways. Empirical evidence strongly supports the idea that delays in Theory of Mind (ToM) are linked to difficulties in social reciprocity, friendship, and peer acceptance throughout development. In typically developing children, better ToM predicts greater peer acceptance, less rejection, and less "*friendlessness*" (absence of reciprocal friendships) during the early school years (Caputi *et al.*, 2012; Ronchi *et al.*, 2020). Caputi *et al.* (2012) considered that ToM is linked to more prosocial behaviors, which mediate the relationship between mind understanding and better peer status.

Peterson *et al.* (2016), in studies with typically developing children, children with autism, and children with deafness, found that higher ToM predicts better social competence with peers (leadership, joining groups), even when controlling for age, language, and gender. However, in children with autism, the link between ToM and peer skills is indirect and strongly mediated by language, suggesting that understanding another's mind is not enough if communicative resources are lacking to use that understanding in real interactions (Hughes & Leekam, 2004; Peterson *et al.*, 2016).

In the context of learning, this neurobiological configuration translates to an incessant search for routines and predictability. For students with ASD, the conventional school environment, full of auditory stimuli and fluid social interactions, can be perceived as chaotic and threatening. Researchers have highlighted that mental inflexibility and a preference for fixed routines function as defence mechanisms against anxiety caused by unpredictable situations. When the environment is structured and the rules are clear, the cognitive load on the student is reduced, allowing them to focus on the educational task.

Reviews on the "*unpredictable world*" in autism suggest that many characteristics of ASD stem from difficulties in generating and using predictions about the environment, making new or volatile situations more stressful and leading to a strong "*need for sameness*" to exert control and reduce anxiety (Gomot & Wicker, 2012; Cannon *et al.*, 2021; Sapey-Triomphe *et al.*, 2021). Children with autistic traits show an attentional preference for repetitive and predictable stimuli rather than new or random ones, reinforcing the idea of seeking predictability as a regulatory strategy (Gomot & Wicker, 2012; Omori, 2025). Cognitive learning studies indicate inflexible strategies (persevering on known rules, difficulty in shifting strategies), clinically related to "*insistence on sameness*" (Liu *et al.*, 2023; Cording *et al.*, 2025; Jyoti & Kajal, 2025).

Reviews on sensory processing and attention in ASD describe that typical classrooms can be perceived as overloaded and chaotic environments, making it difficult to filter out irrelevant stimuli and maintain a focus on academic content (Banire *et al.*, 2020; Mallory & Keehn, 2021). Students with ASD are particularly vulnerable when the environment imposes high sensory and attentional demands; it is recommended that noise be reduced, routines be clarified, and spaces be made more predictable to decrease stress and allow attention to be directed toward educational tasks (Mallory & Keehn, 2021; Fitri *et al.*, 2025; Jyoti; Kajal, 2025). Models of "*autism-friendly schools*" with sensory adjustments (noise control, lighting, calm areas) and clear rules have shown significant improvement in focus, emotional self-regulation, and reduction in hyperactivity and challenging behaviors (Fitri *et al.*, 2025; Jyoti & Kajal, 2025).

Mello (2007) emphasizes that the preference for controlled environments and the difficulty in dealing with sudden changes in plans require the educator to use visual and sequential strategies. Therefore, successful learning for students with ASD depends on a pedagogy that turns the abstract into the concrete, offering a setting where the student knows exactly what to expect and how to act, making predictability a support for the development of their potential (Lima *et al.*, 2025; Mello, 2007).

2.3.2 Why Chess? The Rule-Based Nature as a Safe Harbor

The choice of chess as a pedagogical tool and mediator for students with ASD is based on the compatibility between the game's structure and the mental functioning of these individuals. Chess is a purely logical, rule-based system in which all information is visible, and the consequences of each action stem from immutable laws. This characteristic offers what Sousa and Góes (2018) describe as an interesting pathway to socialization, as it enables atypical students to interact with others through a clear and objective code.

Many people with ASD face difficulties in fluid social environments because of challenges in interpreting nonverbal cues, metaphors, or ambiguous intentions. In chess, this barrier is mitigated: "*many people with ASD feel more comfortable when they understand clearly explained rules*" (Sousa & Góes, 2018). The objectivity of the game, where a knight always moves in an "L" shape, and checkmate ends the match, provides a sense of

mastery and security that reduces the anxiety generated by unpredictable situations (Van Delft& Van Delft, 2010).

Bornstein and Cunningham (2023) reinforce this perspective by highlighting that structured and cognitive activities, such as chess, are ideal because they reduce unpredictable sensory stimuli. In a match, the focus is on the board; social noise is minimized, and silence is the norm, favoring inhibitory control and focused attention. Chess thus acts as a "*safe harbor*" or a cognitive refuge: while the outside world may seem chaotic, the universe of 64 squares is governed by order and predictability.

In addition to emotional security, the rule-based nature of chess encourages the internalization of abstract concepts concretely. As there is no element of luck, students with ASD perceive a direct relationship between cause and effect (Bornstein & Cunningham, 2023). This clarity allows the game to serve as a low-cost, high-impact cognitive therapeutic strategy, acting as a bridge for students to develop confidence in their intellectual abilities before expanding their interactions to broader and more complex social contexts (Sousa & Góes, 2018).

2.3.3 Observed Benefits: Resilience, Focus, and Socialization

The benefits of chess for students with ASD are evident in multiple dimensions of human development, offering gains that go beyond the chessboard and are reflected in both school and social behaviors. The literature highlights that when properly facilitated, games serve as a catalyst for fundamental skills that foster the autonomy of atypical students.

The first major benefit lies in the management of frustration and the development of resilience. For children with ASD, mistakes or defeat can trigger intense emotional reactions due to cognitive rigidity and difficulty coping with changes in plans (Mello, 2007). However, because chess is a game of explicit opposition, where conflict is governed by rules, it provides a controlled environment for emotional management.

Chess helps participants cope with losses and accept mistakes as a natural part of the learning process, fostering the development of patience and persistence in the face of challenges. Teacher mediation transforms moments of frustration into educational opportunities, encouraging students to reflect and improve (Sargsyan & Gharakhanyan, 2024). Studies have shown that even professional players make mistakes, which can lead to a temporary decline in performance (tilt) and disciplined learning after serious errors (Adhikari *et al.*, 2024). The game stimulates cognitive and socio-emotional skills, such as resilience and emotional control, which are important for psychological well-being, especially in vulnerable contexts (Lastima & Gayoles, 2020). Furthermore, chess promotes the ability to think strategically and anticipate consequences, making it easier to accept defeat with dignity and learning (Newman & Newman, 2016; Rogmark & Lynøe, 2021). Therefore, chess is an effective tool for teaching how to deal with losses and mistakes constructively in an educational environment.

In the cognitive domain, increased focus time and enhanced sustained attention are among the most well-documented outcomes. Bornstein and Cunningham (2023) demonstrated that young people with ASD show measurable improvements in working memory and attentional capacity after structured chess programs. The game requires the student to maintain attention to monitor the board and ignore external distractors, functioning as an "*attentional anchor*." This required concentration reduces stress and helps mitigate repetitive behaviors, as it channels the student's mental energy into an activity with clear objectives and logical consequences (Bornstein & Cunningham, 2023).

Chess offers a structured and predictable platform for the socialization of people with Autism Spectrum Disorder (ASD), facilitating social interaction through adherence to rules, such as taking turns, which is less overwhelming than spontaneous conversations. This mediation allows participants to practice social skills in a controlled environment, promoting cooperation, sharing of strategies, and the development of friendships, as well as a sense of belonging and inclusion in groups or school clubs (Lok *et al.*, 2022; Sargsyan *et al.*, 2025).

Serious games, including chess, have shown potential for improving social skills in children and adolescents with ASD, such as emotional recognition, affective regulation, and joint attention (Azadboni *et al.*, 2024; Carneiro *et al.*, 2024). Gamified interventions have also demonstrated positive effects on communication and social interaction, reinforcing engagement and personalized learning in this population (Gao *et al.*, 2025; Wang *et al.*, 2025). Although the results are promising, more rigorous research is needed to fully validate these benefits and adapt strategies to the individual needs of autistic people (Walsh *et al.*, 2024; Sargsyan *et al.*, 2025). Thus, chess may be seen not only as a solitary game but also as a valuable tool for promoting ethical communication and social coexistence among people with ASD.

3. Methodology

The present investigation is a qualitative, exploratory study conducted through an integrative literature review. According to Gil (2002), this procedure enables the construction of a consistent theoretical framework based on published material, facilitating the analysis of complex phenomena, such as the intersection between chess instruction and autism.

The corpus for this research was assembled between August 2025 and January 2026 using databases recognized for their scientific rigor: Scientific Electronic Library Online (SciELO), Google Scholar, and the Periodicals Portal of the Coordination for the Improvement of Higher Education Personnel (CAPES). The search was structured to identify academic works addressing the pedagogical use of chess in the context of special and inclusive education, with a preferred period from 2015 to 2025, aiming to capture publications after the Brazilian Inclusion Law was enacted.

The selection criteria were based on a combination of descriptors and keywords in both Portuguese and English, using Boolean operators (AND and OR). The search keys used were: ("Xadrez Pedagógico" OR "Ensino de Xadrez") AND ("TEA" OR "Autismo") AND ("Educação Inclusiva" OR "AEE"); and in English: ("Chess Pedagogy" OR "Chess Instruction") AND ("ASD" OR "Autism"). Scientific articles and regulatory documents presenting evidence of methodological adaptations, cognitive benefits, or engagement strategies aimed at individuals with ASD were included.

The treatment of the collected data followed the content analysis technique suggested by Bardin (2016), organized into three fundamental stages: 1) pre-analysis (preliminary reading and establishment of the corpus); 2) exploration of the material (coding and categorization by themes such as executive functioning, UDL, and gamification); and 3) treatment of the results (inference and critical interpretation). This methodological approach ensured the triangulation of theoretical sources and the validity of the conclusions presented in this review, allowing for the identification of the main pedagogical contributions of chess practice for school inclusion.

4. Results and Discussion

The synthesis of the theoretical and normative findings of this review points to a consensus: chess has an elective affinity with the cognitive profile of students with ASD, offering the predictability and logical challenge necessary for their development. However, the transition from "*playing for the sake of playing*" to a tool for full inclusion requires what we can call an Adapted Chess Pedagogy, guided by intentionality and universal accessibility.

4.1 Teacher Mediation as a Critical Success Factor

One of the most compelling conclusions of recent literature is that chess, although it has a logically favorable structure for the autistic profile, does not operate in an isolated or automatic manner. The transition from a board game to an inclusive pedagogical intervention depends on the quality of teacher mediation. The effectiveness of chess in Special Education relies heavily on the teacher's role as a conscious mediator who goes beyond teaching the rules to interpret students' responses and adapt the methodology in real time.

Teachers need creative, flexible, and cooperative approaches to engage children with special educational needs (SEN) and adjust chess tasks according to the individual abilities of students (Kostanyan & Charchyan, 2022). Effective mediation contributes to the cognitive, social, and emotional development of these students, promoting greater participation and inclusion in the classroom. Research indicates that gaps still exist in knowledge about specific pedagogical strategies for teaching chess to students with SEN, highlighting the need for ongoing teacher training and the development of adapted methods (Charchyan & Karapetyan, 2022; Sargsyan *et al.*, 2025). Additionally, mediated

techniques, such as the use of playful resources or tools (e.g., puppets), can increase the quality of mediation and student engagement (Tzuriel & Remer, 2018). Therefore, the role of the mediating teacher is fundamental to transforming chess into an effective educational tool in Special Education.

The role of the teacher-mediator in the context of ASD primarily involves emotional regulation. For students who exhibit cognitive rigidity, mistakes and failure are often processed as catastrophic faults, which can lead to anxiety crises (Mello, 2007). At this point, mediation becomes vital: the teacher should function as a support, helping the student to reframe mistakes as logical pieces of information within the system. By asking "*what happened to your piece?*" Instead of simply pointing out the loss, the teacher shifts the focus from feelings of failure to the process of cause and effect, encouraging mental flexibility and tolerance to frustration (Van Delft & Van Delft 2010).

In addition to the emotional dimension, pedagogical mediation supports the development of the Theory of Mind. Many students with ASD face difficulties anticipating their opponent's intentions, focusing only on their own pieces. The mediator thus acts as a "*social translator*," encouraging the student to look at the board from the other person's perspective. Mediating questions such as "*what do you think your classmate wants to do with that move?*" prompt the child to move beyond egocentric thinking and develop skills for mediated social interaction (Sousa & Góes, 2018).

Finally, mediation aligned with the principles of Universal Design for Learning (UDL) requires the teacher to remove barriers even before the game begins. This includes personalizing the pace, simplifying narratives, and providing constant visual support. As Santana and Santos (2022) state, teachers should not simply "*hand over the game*," but rather create an environment where the plurality of learning methods guides the process. Without this active and intentional mediation, chess runs the risk of becoming an exclusionary activity, reinforcing the isolation of atypical students instead of promoting their autonomy and engagement in the Science and Math curriculum (Santana & Santos, 2022).

4.2 Adaptation Strategies: From Concrete to Abstract

The implementation of chess in the context of ASD requires teachers to translate the game's abstract complexity into concrete and sequential stimuli. This transition is essential for students who have difficulty processing long verbal instructions or visualizing hypothetical scenarios without external support to learn effectively. Therefore, adaptation strategies should be based on multisensory resources that serve as scaffolding for logical reasoning.

Teaching by breaking down rules into small, sequential steps while respecting the individual pace of each student is an effective strategy for facilitating learning. This approach, which may include the use of mini games focused on specific aspects (such as basic piece movement), helps students internalize fundamental concepts before moving on to more complex content, thereby reducing cognitive load and avoiding

discouragement caused by initial overloading. Studies have indicated that sequencing instruction from simple to complex improves understanding and promotes better adaptation of problem-solving strategies (Van Patten *et al.*, 1986; Ai *et al.*, 2022).

Moreover, structured methods, such as Peyton's four-step approach, have proven effective for skill acquisition by dividing procedures into clear and comprehensible steps (Giacomino *et al.*, 2020). The internalization of rules occurs when students can mentally simulate the instructions received, gradually transferring the responsibility for learning to themselves (Paulson, 2024). Therefore, organizing content into small sequential parts and using specific activities promotes more efficient and motivating learning.

Visual support is fundamental in adapted pedagogy for autistic students, as many have a more efficient visual processing profile than an auditory one. The use of diagrams, pictograms, and cards with visual cues functions as an external memory, making it easier to understand and perform tasks by clearly illustrating the permitted movements for each piece or action (Asher, 2017; Tatel, 2025). Studies have shown that these visual resources increase communication, classroom engagement, and behavioral regulation, as well as promote greater autonomy for students with autism (Rutherford *et al.*, 2019; Tatel, 2025). The adaptation of the classroom's visual environment, including adjustments to the layout and lighting, also helps improve attention and information processing for these students (Martin & Wilkins, 2021). In addition, inclusive infographics and interactive visual aids have proven effective in reducing cognitive load and increasing motivation during the learning process (Hayes *et al.*, 2010; Lukitasari, 2025). The successful implementation of these resources depends on proper teacher training, family involvement, and consistency between school and home environments (Rutherford *et al.* 2019; De Morais *et al.* 2025). Physical materials, such as boards with high visual contrast or enlarged pieces, make handling and tactile recognition easier, meeting both motor needs and sensory particularities (Santana & Santos, 2022).

Furthermore, introducing playful and motivational tools can ease the transition to abstract learning. The use of resources such as the "Chess Die" or software with avatars and symbolic rewards introduces elements of gamification that make learning more concrete and dynamic. According to Tabosa and Costa (2023), these tools help with the assimilation of basic rules and increase engagement, allowing mistakes to be seen as a logical outcome of the die or system rather than as a personal failure.

By aligning these strategies with the principles of Universal Design for Learning (UDL), the teacher ensures that these adaptations are not just isolated interventions for students with ASD but improvements that benefit the understanding of all students (Santana & Santos, 2022). Transforming chess into an activity "*from concrete to abstract*" means respecting neurodiversity and providing the atypical student with the necessary sense of security so that they feel capable of mastering the complexity of the chessboard (Sousa & Góes, 2018).

4.3 Chess at the Intersection of Science and Mathematics

The use of chess in the context of Science Teaching and Mathematics Education goes beyond the mere application of a board game, serving as a practical laboratory for the development of scientific thinking. In the case of students with ASD, who often show an affinity for logical and structured systems, chess acts as a bridge between concrete thinking and the abstraction required for mastery of the exact sciences (Tabosa & Costa, 2023).

In the context of Mathematics Education, the board is a physical representation of the Cartesian plane. Algebraic notation (columns "a" to "h" and rows from "1" to "8") requires the constant use of coordinates and spatial locations. Furthermore, geometry is present in the movement of the pieces, diagonals, straight lines, and the knight's "L" shaped move, requiring students to process concepts of angles, symmetry, and vectors in a playful manner.

The game promotes problem-solving through experimentation and analysis of alternatives, allowing abstract mathematical concepts, such as probability and combinatorial analysis, to be experienced in a concrete and tangible way. Educational games, especially those based on board games or digital platforms, encourage the development of creative problem-solving skills by engaging students in active testing and hypothesis formulation processes (Spires *et al.*, 2011; Chen *et al.*, 2021b). Experimentation within the game enables students to explore different strategies, evaluate outcomes, and adjust their decisions, which is essential for understanding future calculations and probabilities (Kiili, 2007; Liu & Israel, 2022).

Furthermore, educational games create a motivating and interactive environment that stimulates critical thinking and the analysis of alternatives, making it easier to internalize complex mathematical concepts (Cai *et al.*, 2025; Sihombing *et al.*, 2025). Game-based learning also encourages collaboration and reflection on the strategies adopted, deepening students' understanding of the topics covered (Kiili, 2007). Finally, evidence indicates that combining games with appropriate pedagogical strategies significantly enhances the development of problem-solving skills (Cai *et al.*, 2025).

From the perspective of Science Education, the practice of chess simulates the scientific method itself. When faced with a position on the board, the student is encouraged to observe the facts (the arrangement of the pieces), formulate a hypothesis (game plan), anticipate the results (predicting the opponent's responses), and draw conclusions after making a move (logical consequence). This cycle of trial, error, and correction strengthens sequential reasoning and promotes intellectual autonomy. Silva (2023) notes that this dynamic increases students' interest in classes, as knowledge is constructed through an activity that values logical rigor and persistence.

This intersection is particularly inclusive for students with ASD. Chess offers a universal, unambiguous language in which the mathematical "*truth*" of the board replaces the uncertainties of verbal communication. By mastering chess strategies, atypical students develop problem-solving skills that are fundamental to scientific

learning, reducing the educational gap and promoting equity. Thus, adapted chess ceases to be a mere pedagogical accessory and becomes an instrument of curricular justice, ensuring that neurodiversity has full access to the competencies of the third millennium (Tabosa & Costa, 2023; Silva, 2023).

5. Recommendations

Based on the theoretical review, it is recommended that the implementation of chess for students with ASD be guided by intentional pedagogical mediation rather than by the mechanical practice of the game. Theoretically, there is a need for a deeper integration between the neurobiology of ASD and the cognitive architecture of chess, particularly by investigating how the logical structure of the game can serve as a non-verbal code of communication.

In practice, it is suggested that educators adopt a scaffolding approach, in which the complexity of instructions is gradually increased based on individual sensory and cognitive profiles. The use of visual support, such as movement diagrams, pictograms, and high-contrast boards, should be standard, following the principles of Universal Design for Learning (UDL). Additionally, gamification elements (rewards, levels, and narratives) should be used to maintain engagement and reduce anxiety associated with competition.

Longitudinal studies are needed to assess the long-term impact of chess on the social autonomy of students with ASD outside the school environment. There is also a significant gap in studies on teacher training; therefore, developing specific training modules for Special Education teachers in chess mediation is a priority.

From a social and cultural perspective, chess should be promoted as a low-cost, high-impact tool for democratization and inclusion. However, concerns remain about sensory overload; it is vital that the playing environment is controlled for noise and excessive visual stimuli to prevent it. Finally, it is recommended that chess be integrated into the STEM curriculum (Science, Technology, Engineering, and Mathematics) for special education, using the board as a concrete laboratory for mathematical and scientific reasoning.

6. Conclusions

This integrative review consolidates the perception that school chess, when imbued with pedagogical intentionality and supported by accessibility strategies, constitutes an exceptionally valuable tool for inclusive education. The findings confirm that the affinity between the logical structure of the game and the neurobiological profile of students with ASD allows chess to act not only as content but also as a mediator of executive functions, promoting gains in focused attention, working memory, and inhibitory control.

Regarding the objective of identifying methodological adaptations, the study showed that the effectiveness of the intervention does not lie in the mechanical practice of the game, but in the systematic application of three pillars: conscious teacher mediation (acting as a social translator), the use of visual support and sequenced instructions (scaffolding), and the integration of gamification and UDL. These elements transform the board into an environment with low sensory overload and high predictability, turning abstract concepts into concrete and manageable stimuli for the user.

The analysis indicates that adapted chess meets the requirements of the Brazilian Inclusion Law (LBI) by removing attitudinal and communication barriers and fostering emotional regulation in the face of frustration. Furthermore, its potential stands out as a practical laboratory for teaching Science and Mathematics, reducing the educational gap, and promoting equity of opportunity within the STEM curriculum.

However, progress in legal frameworks and theoretical recognition still contrasts with the lack of validated protocols and ongoing training programs for teachers in Brazil. Therefore, it is concluded that the consolidation of the "Adapted Chess Pedagogy" depends on expanding longitudinal empirical research that monitors the social and academic impact of these workshops. Chess for students with ASD proves to be a viable and low-cost path to ensure that school inclusion goes beyond physical access and becomes a process of genuine human development and civic participation in the community.

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Conflict of Interest Statement
The authors declare no conflicts of interest.

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