Critical thinking development in mathematics education from an inclusive education perspective: A systematic literature review using PRISMA methodology

DOI: 10.5281/zenodo.18649832

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Abstract

The purpose of this article is to analyze the role of critical thinking in the development of mathematical skills within the context of inclusive education, through a systematic review of the literature based on the PRISMA guidelines. The review was conducted using a qualitative approach to document analysis and followed the phases of identification, screening, eligibility, and inclusion. The search was conducted in the indexed databases Scopus, Redalyc, SciELO, and Dialnet, considering articles published between 2020 and 2025. The inclusion criteria considered peer-reviewed empirical and theoretical studies related to critical thinking, inclusive education, and mathematics teaching, while duplicate documents and studies without thematic relevance were excluded. The selection process identified emerging categories linked to critical thinking as a mediator of mathematical learning, the use of inclusive pedagogical strategies, and contextualized problem solving. The results showed that the integration of critical thinking promotes logical reasoning, decision-making, and the active participation of students with diverse educational needs. Therefore, it can be inferred that the systematic incorporation of critical thinking into the mathematics curriculum contributes to improving educational quality and strengthening practices.

Keywords
critical thinking; mathematics education; inclusive education

INTRODUCTION

The strengthening of mathematical competencies within inclusive educational settings has emerged as a priority in contemporary educational research, responding to the growing diversity in educational institutions and the necessity of guaranteeing equitable, high-quality education. In this scenario, critical thinking has established itself as a transversal axis for cognitive development and active student participation; it is defined as a complex cognitive process oriented toward action and problem-solving in students (Ennis, 2011).

Traditionally, mathematics instruction has been characterized by models focused on the transmission of abstract content and the repetition of algorithmic procedures. However, various contemporary pedagogical approaches have challenged this perspective, proposing instruction oriented toward conceptual understanding, contextualized problem-solving, and the active participation of the student in the construction of knowledge. According to Guerrero et al. (2025), applied mathematics constitutes a fertile field for the development of critical thinking, given that the problems presented require the transfer of theoretical knowledge into practical situations, thereby moving beyond purely rote-learning approaches.

The aforementioned points underscore the importance of critical thinking as a transversal competency that enables the analysis of information, the argumentation of ideas, the making of informed decisions, and the evaluation of solutions in diverse mathematical situations. In this sense, critical thinking in mathematics education is conceived as a complex cognitive process that integrates skills in logical reasoning, analysis, interpretation, and metacognition, all fundamental for a deep understanding of mathematical concepts (Ennis, 2018). Within inclusive educational contexts, these skills take on special relevance, as they facilitate the adaptation of flexible pedagogical strategies that respond to classroom heterogeneity and promote the equitable participation of students with varying abilities, learning styles, and paces. Recent studies provide evidence that integrating critical thinking into the mathematics curriculum contributes significantly to the development of mathematical competencies and the improvement of academic performance in diverse contexts.

Nonetheless, despite extensive research on critical thinking, mathematics education, and educational inclusion, there remains a persistent need to rigorously systematize and analyze the scientific production that articulates these constructs. Therefore, the objective of this article is to analyze, through a systematic literature review based on the PRISMA guidelines, the role of critical thinking in the development of mathematical competencies within inclusive educational contexts. This aims to identify research trends, theoretical contributions, and empirical evidence to guide the strengthening of inclusive and high-quality pedagogical practices.

MATERIALS AND METHODS

The present study was conducted under a qualitative approach, utilizing a systematic literature review design. This approach aimed to rigorously identify, analyze, and synthesize scientific production related to the development of critical thinking within mathematical competencies from an inclusive education perspective. This design facilitates the consolidation of relevant theoretical and empirical evidence through an exhaustive analysis of specialized literature, ensuring methodological robustness, process traceability, and the academic validity of the findings.

To achieve the stated objective, the study adopted the PRISMA 2020 (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines, which provide a structured and transparent methodological framework for conducting systematic reviews (Page et al., 2021). This approach enables the systematic collection, organization, and synthesis of findings from individual studies that address a clearly defined research question. Furthermore, the PRISMA checklist guided the definition of eligibility criteria, the search strategy, the study selection process, and the analysis procedures, thereby strengthening the traceability and scientific rigor of the study (Page et al., 2020).

The bibliographic search was carried out across high-impact academic databases and repositories: Scopus, Redalyc, SciELO, and Dialnet, selected for their relevance in the educational field and their coverage of indexed scientific journals. To locate the studies, Boolean operators (AND, OR) were employed using key descriptors such as critical thinking, mathematics education, and inclusive education, tailored to the specificities of each database.

The methodological process was developed in three phases. First, the identification and initial selection of potentially relevant documents was conducted based on the defined search strategy. Second, an eligibility assessment followed, involving the review of titles, abstracts, and full texts to determine the thematic, methodological, and conceptual relevance of the studies, prioritizing publications in indexed journals. Finally, the selection and quality analysis were performed, resulting in the final set of articles that met the established criteria, ensuring scientific consistency and a significant contribution to the subject of study.

To ensure quality and comprehensive scope, specific inclusion and exclusion criteria were defined. Inclusion criteria comprised open-access scientific articles, publications indexed in Scopus, Dialnet, Redalyc, and SciELO, studies published between 2020 and 2025, and research within the field of education, particularly those addressing critical thinking in mathematics from inclusive perspectives. Exclusion criteria included documents that were not scientific articles (e.g., reports, conference papers, non-peer-reviewed essays), publications prior to 2020, and research focused exclusively on mathematical performance without considering critical thinking or inclusive education frameworks.

Information was collected using a documentary analysis matrix. Through a systematic and transparent procedure, the search in Scopus, Dialnet, Redalyc, and SciELO yielded a highly relevant record. Subsequently, a review of titles and abstracts was conducted, discarding duplicate documents and studies that did not align with the research objectives. In the eligibility phase, a full-text reading was performed, allowing for the exclusion of documents that were not scientific articles or failed to address critical thinking in mathematics teaching from an inclusive perspective. Finally, the defined set of studies that met the methodological, thematic, and scientific quality criteria was selected, forming the corpus of analysis used for the synthesis of results and the discussion (see Table 1).

Table 1.

Bibliographic search matrix.

Database	Boolean Operators and Variables	Years Searched	Records Found	Selected Records (Inclusion

				Criteria)
Dialnet	Pensamiento crítico AND matemáticas AND inclusión	2020 - 2025	27	6
Redalyc	inclusive education" OR "inclusive mathematics" OR "equity" OR "diversity" OR "inclusive pedagogy"	2020 - 2025	166	7
Scielo	"Inclusive education" OR "inclusive mathematics" OR "equity" OR "inclusive pedagogy" AND "critical thinking" OR "higher order thinking" OR "cognitive skills"	2020 - 2025	15	6
Scopus	Critical thinking OR math AND inclusive education.	2020 - 2025	72	5

Note. Source: Own elaboration (2026).

The matrix presents a systematized search process that initiated with 280 records and was progressively refined to yield a final sample of 24 pertinent studies. This reduction was achieved through the rigorous application of previously defined inclusion and exclusion criteria, prioritizing scientific relevance and the contribution of each study to the research field.

Furthermore, to systematize the data obtained and ensure a rigorous analysis of the selected studies, a qualitative information analysis matrix was developed. This tool enabled the organization, comparison, and interpretation of relevant findings from each article included in the review. This matrix integrated pre-defined categories such as critical thinking, mathematical competencies, inclusive education, pedagogical strategies, and the role of the teacher. Using this instrument, data related to the study's approach, educational context, and primary findings were recorded, facilitating the identification of patterns, regularities, and conceptual trends (see Table 2).

Table 2

Texts analysed

Author(s) / Year	Study Title	Database	Main Category	Relevant Findings
Parra (2024)	Design of a mathematical strategy to develop critical thinking in secondary students with intellectual disabilities.	Dialnet	Critical Thinking - Inclusion	Students with mild intellectual disabilities can strengthen complex skills like analysis and metacognition through adapted games, promoting autonomy and active participation.
Arboleda (2023)	Pedagogical practices, motivation, and	Dialnet	Pedagogical Strategies	Pedagogical practices considering emotions and student contexts

	critical thinking.			promote participation and argumentation, strengthening critical thinking in inclusive environments.
Casado & Checa (2023)	Creativity, critical thinking and teamwork in Primary Education: an interdisciplinary approach through STEAM projects.	Dialnet	Mathematical Competencies	Strategies centered on dialogue and contextualized problem-solving promote participation by respecting learning rhythms and styles.
Pallo & Fiallos (2025)	Use of interactive games for the development of mathematical competencies in basic education.	Dialnet	Pedagogical Strategies	Critical thinking should be developed from basic education as a key inclusion strategy, articulating reflective practices with student-centered teaching.
Parra P. (2023)	Development of critical thinking in secondary students with mild intellectual disabilities in Bogotá through play as a strategy for teaching multiplication and division.	Dialnet	Critical Thinking - Inclusion	Critical thinking acts as a key inclusion strategy when articulating reflective pedagogical practices centered on classroom diversity.
Camacho et al. (2024)	Active methodologies in teaching matrix calculus for students with mild intellectual disabilities in high school.	Dialnet	Teacher Role - Inclusion	Active methodologies enable the participation of students with intellectual disabilities, promoting reflection and collaborative work with the teacher as a mediator.
Prieto & Torres (2023)	Issues of diversity and democracy in a regular mathematics classroom with deaf students.	Redalyc	Inclusive Education	Inclusion is based on recognizing linguistic diversity and social justice, allowing deaf and hearing students to build knowledge in equality.
Acevedo et al. (2021)	Research on autism spectrum disorder: an analysis of the teaching/learning processes of mathematics.	Redalyc	Critical Thinking	Strategies like FOPS mnemonics and visual supports favor the transition to critical thinking in students with ASD, promoting cognitive autonomy.
Broitman et al. (2020)	A study on the teaching of mathematics to students with disabilities in special and common education schools.	Redalyc	Inclusive Education	Authentic inclusion ensures equitable access to mathematical ideas; didactics must eliminate barriers so disability does not limit school success.
Andrade et al. (2020)	From normality to the production of	Redalyc	Inclusive Education	To guarantee real inclusion, it is necessary to deconstruct

	diversity in mathematics education.			"normality" and stop standardizing individuals, which only produces "pathological" exclusion.
Arteaga & Ortega (2022)	Contributions of experimental activity to the scientific thinking of students with functional diversity.	Redalyc	Critical Thinking & Inclusion	Exploratory experimentation allows students with functional diversity to be protagonists, developing critical thinking and self-esteem through physical phenomena.
García-Oliveros (2022)	Possibilities of diversity: a critical perspective in mathematics education through the social inequality approach.	Redalyc	Pedagogical Strategies - Inclusion	Proposes a transformative vision that questions mathematical standardization, promoting critical thinking through the analysis of social realities.
Mancera et al. (2022)	Critical paradigm of research and mathematical modeling: transformations that challenge social vulnerability conditions.	Redalyc	Critical Thinking	Mathematical modeling as a means of social justice promotes critical thinking by analyzing and transforming reality in vulnerable contexts.
Radzi N & Mahmud M. (2025)	Inclusive Mathematics Pedagogy: A Systematic Literature Review of Practices, Innovations, and Equity in Primary Schools.	Scielo	Pedagogical Strategies - Inclusion	Accessible technology and culturally relevant pedagogy promote equity; simulations reduce barriers and guarantee critical thinking as a universal right.
Büscher & Prediger (2024)	Teachers' practices of integrating challenging demands of inclusive mathematics education in a professional development program.	Scielo	Critical Thinking	Integrating critical thinking into inclusive practices based on collaboration and teacher mediation recognizes it as a social competence that reduces inequality.
Vodičkov & Slavíčková M. (2023)	Supportive Factors in Inclusive Mathematics Education: Mathematics Teachers' Perspective.	Scielo	Mathematical Competencies	Universal Design for Learning (UDL) promotes inquiry and metacognition, ensuring equitable participation in reflective environments.
Permatasari et. al. (2025)	The Impact of Teaching Strategies on Critical Thinking in Mathematics Education: A	Scielo	Critical Thinking	Critical thinking is an emancipatory practice linked to inclusion, fostering dialogue and recognizing cultural diversity to democratize knowledge.

	Systematic Literature Review.			
Bayore N. & Cajandig A (2025)	Enhancing Critical Thinking and Creativity in Mathematics: An Explanatory Sequential Investigation of Teachers' Instructional Strategies.	Scielo	Pedagogical Strategies - Inclusion	Strategies alone do not ensure critical thinking; trust and timing are key. Inclusion is strengthened by integrating multiple voices in equitable approaches.
Rojas, J. et. al. (2025)	The teaching of mathematics as a tool for the development of critical thinking.	Scielo	Critical Thinking - Inclusion	Inclusion is an active practice based on dialogue and socio-cultural analysis, where diversity is a resource that drives argumentation.
Yurt & Kara (2025)	The Influence of Parental Attitude, School Climate, and Classroom Management on Critical Thinking: The Significance of Inclusive Classrooms in Higher Education.	Scopus	Pedagogical Strategies - Critical Thinking	Critical thinking arises from the interaction between family support, school climate, and classroom management in inclusive settings.
Bhuttah et. al (2025)	Enhancing student critical thinking and learning outcomes through innovative pedagogical approaches in higher education: the mediating role of inclusive leadership.	Scopus	Critical Thinking	Active methodologies and contextualized problems promote critical thinking by recognizing diverse learning rhythms and fostering cognitive participation.
Espinoza et. al. (2025)	Design and validation of a questionnaire to identify training needs in inclusive mathematics education.	Scopus	Critical Thinking - Inclusion	The relationship between inclusion and critical thinking arises from teacher reflection on practices, allowing for the identification of barriers.
Hariyanto et al (2025)	Enhancing Critical Thinking and Collaboration Skills Through Interactive Teaching Methods: A Qualitative Study in Higher Education.	Scopus	Pedagogical Strategies - Critical Thinking	Development depends on the articulation between interactive methodologies, safe classroom climates, and the teacher as a facilitator.
Sumandya et. al. (2025)	Development of an instrument to measure students' and teachers' perceptions of understanding by	Scopus	Teacher Role - Inclusion	Critical thinking in inclusive contexts is enhanced when teaching is oriented toward solving complex problems and metacognitive reflection.

design-based
mathematics learning
evaluation in
inclusive schools.

RESULTS

The systematic literature review identified consistent findings regarding the role of critical thinking in the development of mathematical competencies within inclusive education contexts. The analysis of the selected studies revealed conceptual, methodological, and pedagogical trends, which were organized into several analytical axes.

In the first instance, the results indicate that critical thinking acts as a pivotal axis for inclusive mathematical learning. Various studies concur that analysis, argumentation, and reflection foster active student participation, including for students with mild intellectual disabilities, deafness, and autism spectrum disorder (Peralta, 2023; Muntaner et al., 2022). In this sense, critical thinking allows for the transcendence of approaches focused on the mechanical repetition of procedures, promoting a profound understanding of mathematical concepts and strengthening cognitive autonomy.

A second axis of results highlights the effectiveness of inclusive didactic strategies for the simultaneous development of critical thinking and mathematical competencies. The reviewed literature emphasizes the use of adapted games, active methodologies, Project-Based Learning (PBL), mathematical modeling, and contextualized problem-solving as strategies that enhance reasoning, metacognition, and decision-making (Oñate, 2025; Camacho et al., 2022). These strategies are characterized by their flexibility and their recognition of individual learning rhythms and styles, thereby ensuring equitable participation in the classroom.

The third axis relates to inclusive education from a critical and social justice perspective. The findings demonstrate that mathematics instruction, when oriented toward critical thinking, challenges the processes of standardization and normalization of learning. Instead, it recognizes social, cultural, and cognitive diversity as a pedagogical resource (Permatasari et al., 2025). Within this framework, critical thinking is configured as a tool for interpreting reality, engaging in collective deliberation, and taking a stance on social issues through mathematical reasoning.

Consequently, the results underscore the role of the teacher and the institutional context in strengthening critical thinking within inclusive classrooms. Pedagogical mediation, teacher reflection on practice, classroom climate, and inclusive leadership emerge as determining factors for the development of critical mathematical competencies (Booth & Ainscow, 2016; Sánchez, 2025). The studies agree that critical thinking does not develop through isolated strategies but through a systematic articulation of inclusive practices, classroom management, and institutional support.

DISCUSION

The findings of this systematic review confirm that critical thinking plays a central role in the development of mathematical competencies within inclusive education contexts, aligning with the study's primary objective. In accordance with previous research, the results demonstrate that mathematical learning acquires greater significance when oriented toward reflection, argumentation, and contextualized problem-solving, particularly in settings characterized by student diversity (Ennis, 2018).

From a theoretical perspective, these results align with critical mathematics education

frameworks, which conceive critical thinking as a socially situated practice linked to principles of equity and social justice. Authors such as Hariyanto and Haryanto (2025) argue that mathematics can become an empowerment tool when it enables students to analyze their reality and question structures of inequality. The findings of this study reinforce this stance by demonstrating that educational inclusion is strengthened when critical thinking is explicitly integrated into mathematics instruction.

On a practical level, the results have significant implications for teaching practices. The evidence suggests that developing critical thinking in mathematics requires flexible, diversity-sensitive active methodologies, as well as intentional teacher mediation that promotes dialogue, collective reflection, and collaborative work (Sánchez et al., 2022). In this regard, the importance of continuous teacher training is emphasized, focusing not only on pedagogical self-reflection but also on the design of diverse learning environments that foster equitable cognitive participation.

In this vein, the findings provide evidence that educational inclusion cannot be reduced solely to physical access to the classroom; it must offer a genuine opportunity to participate in the construction of mathematical knowledge. In this sense, critical thinking constitutes a bridge between inclusive education and the development of high-level mathematical competencies, allowing all students—based on their individual specificities—to argue, reflect, and make informed decisions.

Finally, this review opens future lines of research aimed at deepening the longitudinal impact of inclusive strategies on the development of mathematical critical thinking. It also suggests the construction of curricular models that explicitly integrate inclusive education and critical thinking as structuring axes. Collectively, the results reinforce the idea that critical thinking not only enhances mathematical competencies but also constitutes an essential pillar for the consolidation of high-quality inclusive educational practices.

CONCLUSIONS

The systematic literature review demonstrates that critical thinking constitutes a fundamental axis for the development of mathematical competence within inclusive education contexts, as it fosters processes of analysis, argumentation, reflection, and meaningful problem-solving. The findings confirm that mathematics instruction becomes more significant when oriented toward pedagogical practices that recognize student diversity and promote active cognitive participation.

Furthermore, it is concluded that inclusive didactic strategies, such as active methodologies, the use of adapted games, mathematical modeling, and contextualized problem-solving, create favorable conditions for strengthening critical thinking. These strategies allow for the transcendence of traditional approaches centered on the standardization of learning, thereby guaranteeing equitable access to mathematical content and the development of higher-order skills in students with diverse abilities, learning rhythms, and styles.

From a critical perspective, the results indicate that inclusive education in mathematics transcends mere physical integration in the classroom; it is consolidated when diversity is recognized and utilized as a pedagogical resource. Consequently, critical thinking emerges as an emancipatory tool that enables students to interpret their reality, engage in collective deliberation, and take a stand on social issues, contributing to the formation of autonomous and participatory individuals.

Moreover, the role of the teacher and the institutional context are highlighted as determining factors in the development of inclusive critical thinking. Reflective pedagogical mediation, a democratic classroom climate, inclusive leadership, and

continuous teacher professional development are configured as key elements for the effective implementation of inclusive mathematical practices oriented toward critical thinking.

Finally, this systematic review highlights the need for further research to analyze the longitudinal impact of inclusive strategies on the development of mathematical critical thinking, as well as the construction of curricular models that explicitly integrate critical thinking and inclusive education as structuring axes. Collectively, this study reaffirms that critical thinking not only enhances mathematical competencies but also serves as an essential pillar for strengthening high-quality inclusive education oriented toward equity and social justice.

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