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Inclusive Mathematics Pedagogy: A Systematic Literature Review of Practices, Innovations, and Equity in Primary Schools

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Abstract. Inclusive mathematics pedagogy has gained prominence as educators work toward equitable learning environments accommodating diverse student needs. However, challenges remain in implementing inclusive strategies, utilising technological advancements, and ensuring equity. Based on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework, this systematic literature review examines pedagogical practices, technological innovations, and equity in primary school mathematics education through an analysis of 22 studies from Scopus and Web of Science. Findings suggest that professional development programs focused on inclusion significantly enhance teaching methods and student outcomes. Moreover, virtual simulations and interactive platforms improve engagement and accessibility, particularly for students with special needs. Culturally responsive teaching and ethical decision-making are crucial in addressing inequities in mathematics education. Despite these advancements, policy constraints, instructional challenges, and limited resource accessibility impede widespread implementation. This study underscores the importance of a comprehensive approach integrating pedagogical strategies, technological tools, and social justice principles to strengthen inclusive mathematics education. The insights gained provide valuable guidance for educators, policymakers, and researchers in designing sustainable interventions that expand inclusive pedagogy in primary schools, ultimately fostering a more equitable and accessible learning experience for all students.

Keywords: pedagogy; mathematics; inclusive; teacher; learning

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1. Introduction

Inclusive education has become a significant focus in contemporary pedagogical discourse, particularly in primary school mathematics education. Mathematics is a fundamental subject that develops students' logical reasoning, problem-solving skills, and analytical thinking (Bakhmat et al., 2022; San Martin et al., 2021). However, conventional teaching methods in mathematics often fail to address the diverse learning needs of students, particularly those with disabilities, learning difficulties, or socio-economic disadvantages (Balabuch & Rasoarifetra, 2023; Scherer & Bertram, 2024). In response to these challenges, inclusive mathematics pedagogy has gained prominence as an educational framework that promotes equity, responsiveness, and sustainability, ensuring that all students, regardless of their backgrounds and abilities, have access to meaningful learning experiences (Cobian et al., 2024; Prieto-Saborit et al., 2022).

The growing emphasis on inclusive mathematics education is reinforced by global commitments to ensuring equitable and high-quality education, particularly within the framework of Sustainable Development Goal 4 (SDG 4), which underscores the role of inclusive education in fostering sustainable social and economic development (United Nations, 2015). Research has demonstrated that inclusive teaching strategies designed to accommodate student diversity can improve academic outcomes and facilitate social integration in the classroom (Zerai et al., 2023). For instance, differentiated instruction and collaborative learning have been identified as effective methods for meeting the needs of diverse learners. At the same time, the Universal Design for Learning (UDL) framework provides a structured model for enhancing accessibility and student engagement in mathematics education (Harbour et al., 2022). These approaches strengthen students' mathematical competencies and contribute to developing essential social skills such as empathy, resilience, and critical thinking (Acharya et al., 2021). Thus, inclusive pedagogical practices hold significant potential in fostering academic success and holistic student development.

Despite the growing recognition of inclusive mathematics pedagogy, several challenges hinder its effective implementation. One of the primary obstacles is the lack of policy support and inadequate teacher training, which limits educators' ability to adopt inclusive teaching methodologies (Bessarab et al., 2023). Additionally, many teachers report insufficient access to learning resources and instructional materials designed for diverse learners, further constraining the implementation of inclusive pedagogical strategies (Faragher et al., 2016). Moreover, rigid curricula and inflexible assessment frameworks often fail to accommodate students' varying abilities, limiting inclusive education's effectiveness (Ketenoglu Kayabası, 2020). While research has focused mainly on inclusive mathematics pedagogy in well-resourced educational settings, there remains a gap in understanding its applicability in low-resource schools or marginalised communities, where factors such as socio-economic disparities and technological limitations may impact the feasibility of inclusive strategies (Johari et al., 2022).

Another critical challenge is the lack of empirical evidence on how professional development programs influence teachers' ability to sustain inclusive pedagogical practices in mathematics education over time. While some studies have explored the role of teacher training in fostering inclusive teaching, research remains limited on how educators adapt and implement inclusive methodologies in diverse classroom settings (Faragher et al., 2016). Additionally, with the increasing integration of technology in education, further research is needed to understand how digital tools and pedagogical innovations can enhance the accessibility and effectiveness of inclusive mathematics instruction (Harbour et al., 2022). The potential of assistive technologies, adaptive learning platforms, and digital instructional resources in supporting inclusive education has been widely acknowledged. However, their impact on fostering equity and engagement in mathematics classrooms remains underexplored. Addressing these gaps requires a multifaceted approach that considers teacher training, curriculum adaptability, and the role of technological interventions in promoting inclusivity.

To address these critical issues, this study aims to explore the following three research questions: How do professional development programs influence primary school teachers' inclusive pedagogical practices in mathematics education? What is the impact of technological and pedagogical innovations on fostering inclusive mathematics teaching in primary schools? How do inclusive pedagogical strategies promote equity and diversity in mathematics education? By synthesising existing research and assessing the effectiveness of current interventions, this study seeks to provide practical insights that will support educators, policymakers, and researchers in enhancing inclusive mathematics pedagogy at the primary school level. Fostering a more inclusive approach to mathematics education requires systemic changes in teacher training, curriculum design, and technological integration, ensuring that all students, regardless of their backgrounds or learning needs, can fully participate and thrive in mathematics learning environments.

2. Literature Review

Inclusive mathematics pedagogy in primary schools ensures that all students have access to high-quality mathematics education regardless of their abilities or backgrounds. This approach is grounded in the principle that every student can develop mathematical proficiency with appropriate support and learning opportunities (Acharya et al., 2021). Effective inclusive practices necessitate the adaptation of teaching methodologies, instructional materials, and classroom environments to accommodate diverse learning needs. The research underscores the significance of systemic, teacher-related, and student-related factors in establishing an inclusive learning environment (Ahmed Alnaim & Sakiz, 2023).

A key challenge in inclusive mathematics education is addressing the diverse learning needs of students, particularly those with special educational needs (SEN) and mathematical learning difficulties (SMLD). Teachers must modify instructional strategies and implement individualised approaches to effectively support these students (Ahmed Alnaim & Sakiz, 2023; Jablan et al., 2010). The co-teaching model has been identified as a practical approach in inclusive

classrooms, allowing educators to collaborate and provide targeted support for students with SEN (Carty & Marie Farrell, 2018). Additionally, incorporating manipulative activities, interactive teaching aids, and game-based learning has enhanced students' mathematical proficiency and attitudes toward the subject (Russo et al., 2024).

Inclusive mathematics pedagogy is also shaped by cultural and educational contexts, which differ across school systems. For example, Norwegian teachers adopt ability-based grouping to tailor instruction to students' needs (Xenofontos et al., 2024). In Denmark, the MINK project highlights the role of teacher professional development and classroom experimentation in enhancing inclusive mathematics instruction (Lindenskov & Lindhardt, 2020). These examples emphasise the necessity of culturally responsive teaching that aligns with student's unique learning requirements and educational contexts.

Research demonstrates that inclusive education positively influences the mathematical achievement of students with intellectual disabilities (ID). A comparative study found that students with ID in inclusive classrooms exhibited more significant progress over a year than their peers in special education settings (Vodickova et al., 2023). These findings highlight the role of inclusive education in supporting academic growth and promoting equity in mathematics learning (Chanda & Sekher, 2023; Erin B, 2023).

Inclusive mathematics pedagogy in primary schools is a multifaceted approach that necessitates careful consideration of teacher preparedness, instructional strategies, and cultural influences (Padilla et al., 2024; Scherer & Bertram, 2024). Although challenges persist in its implementation, existing research offers valuable insights into practical strategies for fostering inclusive learning environments. Future studies should continue to explore innovative approaches and develop practical recommendations to aid teachers in creating equitable mathematics classrooms. By embracing inclusive pedagogy, educators can ensure that all students, regardless of their learning needs, have equal opportunities to succeed in mathematics (Cobian et al., 2024; Faragher et al., 2016).

3. Methodology

3.1 Research Approach

The PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) framework is a widely recognised standard for conducting systematic literature reviews, ensuring transparency, comprehensiveness, and methodological rigour (Page et al., 2021). By adhering to PRISMA guidelines, researchers can enhance the accuracy and reliability of their analyses through a structured process of identification, screening, eligibility assessment, and data extraction. This approach facilitates the systematic selection of relevant studies while mitigating bias, mainly by including randomised controlled trials (RCTs), strengthening evidence validity.

In this study, Web of Science and Scopus were utilised for their extensive coverage and high reliability in providing quality academic sources. The identification

phase involved a comprehensive database search, followed by screening to exclude non-relevant or low-quality studies based on predefined criteria. The eligibility phase ensured that selected studies met the inclusion criteria, leading to the data extraction phase, where key findings were systematically synthesised. This structured methodology enhances the credibility and applicability of systematic reviews, offering valuable insights for researchers, policymakers, and practitioners in advancing evidence-based research and practice.

3.2 Procedure

3.2.1 Identification

This study employed a structured, systematic review methodology to compile a substantial body of relevant literature. The process began with identifying key search terms, followed by systematically refining related terms using dictionaries, thesauri, encyclopedias, and prior research. All relevant terms were carefully selected, and comprehensive search strings were formulated for database queries. These search strings were then applied to Web of Science and Scopus, ensuring a rigorous and targeted literature retrieval (as detailed in Table 1). As a result, the initial search yielded 2,185 publications relevant to the study's scope from both databases.

Table 1. The search string

Database	The search string
Scopus	TITLE-ABS-KEY ((inclusive OR inclusion) AND (pedagogy OR teaching) AND mathematic*) AND (LIMIT-TO (SUBJAREA , "MATH")) AND (LIMIT-TO (DOCTYPE , "ar")) AND (LIMIT-TO (PUBYEAR , 2022) OR LIMIT-TO (PUBYEAR , 2023) OR LIMIT-TO (PUBYEAR , 2024)) AND (LIMIT-TO (LANGUAGE , "English")) Date of Access: December 2024
Web of Science (WOS)	((inclusive OR inclusion) AND (pedagogy OR teaching) AND mathematic*) (Topic) and 2025 or 2024 or 2023 (Publication Years) and Article (Document Types) and English (Languages) and Education Educational Research (Research Areas) and Education Educational Research or Education Special (Web of Science Categories) and Article (Document Types) and 6.11 Education & Educational Research (Citation Topics Meso) and Education Educational Research (Research Areas) and 2024 (Publication Years) and Open Access and 04 Quality Education (Sustainable Development Goals) Date of Access: December 2024

3.2.2 Screening

In the screening phase of the systematic review, all potentially relevant research items were assessed manually in the Web of Science and Scopus databases to ensure their alignment with the predetermined research questions. Selection criteria during this stage were based on key themes, including inclusivity, pedagogy, and mathematics. To refine the dataset, duplicate records were removed, and 2,108 publications were excluded based on specific inclusion and exclusion criteria. This resulted in a final selection of 77 papers for further analysis, as outlined in Table 2.

The initial exclusion process prioritised relevance and methodological quality, ensuring that only high-quality and contextually appropriate literature was retained. Studies were excluded if they were non-English, published before 2022, unrelated to mathematics, or categorised as conference papers, book chapters, or review articles not part of the most recent empirical research. The review focused exclusively on English-language publications from 2022 to 2024 in mathematics, which were considered most pertinent to the study's objectives. By implementing these rigorous selection criteria, the final dataset comprised a focused, high-quality collection of studies, ensuring that current, discipline-specific research insights informed the analysis and effectively addressed the study's research question.

Table 2. The inclusion and exclusion criteria

Criteria	Inclusion	Exclusion
Language	English	Non-English
Timeline	2022-2024	< 2022
Subject Area	Mathematics	Besides Mathematics
Literature type	Journal (Article)	Conference, Book, Review

3.2.3 Eligibility

During the eligibility phase of the systematic review, an initial assessment was conducted on 71 articles to evaluate their suitability for inclusion. This stage involved a comprehensive review of each article's title, abstract, and key content to ensure alignment with the study's research objectives and inclusion criteria. Following this evaluation, 49 articles were excluded due to various factors, including irrelevance to the research field, insignificant titles, abstracts misaligned with the study's objectives, or the unavailability of full-text articles supported by empirical evidence. These exclusions were essential to maintaining the review's rigour, relevance, and methodological integrity.

This rigorous selection process identified 22 articles that met the eligibility criteria and subsequently included them in the qualitative analysis. These selected articles constitute the core dataset for further examination, as they closely align with the research objectives and offer empirical insights essential to the study. By ensuring that only high-quality and relevant studies are retained, this meticulous selection

process strengthens the foundation for qualitative analysis, enabling the derivation of robust and meaningful conclusions.

3.2.4 Data Abstraction and Analysis

This study employed an integrative analysis approach as the primary assessment strategy to critically examine and synthesise findings from various research designs, particularly emphasising quantitative methodologies. The primary objective was identifying key topics and subtopics within the study's scope. The data collection phase constituted the initial step in theme development, during which 22 publications from primary data sources were meticulously analysed to extract assertions and content pertinent to the study's focus areas. Figure 1 PRISMA flow diagram illustrates this process, demonstrating how the authors critically evaluated significant studies related to inclusivity, pedagogy, and mathematics. To further contextualise the analysis, Table 3 shows the number and details of the primary studies database and presents a comprehensive overview of the total number of studies collected, including 22 primary data sources retrieved from Web of Science and Scopus. This table provides a detailed summary of the distribution of primary studies, facilitating a thorough evaluation of the validity and reliability of the sources incorporated in this systematic review.

The methodologies and findings of the selected studies were rigorously examined to ensure a holistic and comprehensive understanding of the subject matter. Following this analysis, the authors collaborated with co-researchers to develop themes rooted in empirical evidence from the reviewed studies. A detailed log was systematically maintained throughout the data analysis process to document observations, interpretations, methodological challenges, and reflections related to data interpretation. The authors systematically compared their findings to enhance analytical consistency and methodological rigour, identifying and addressing discrepancies in theme development. In instances of conceptual divergence, structured discussions were conducted among the authors to reach a consensus, ensuring the robustness and reliability of the final themes. This collaborative and systematic approach reinforced the validity and methodological integrity of the study's findings, offering valuable contributions to inclusive mathematics pedagogy.

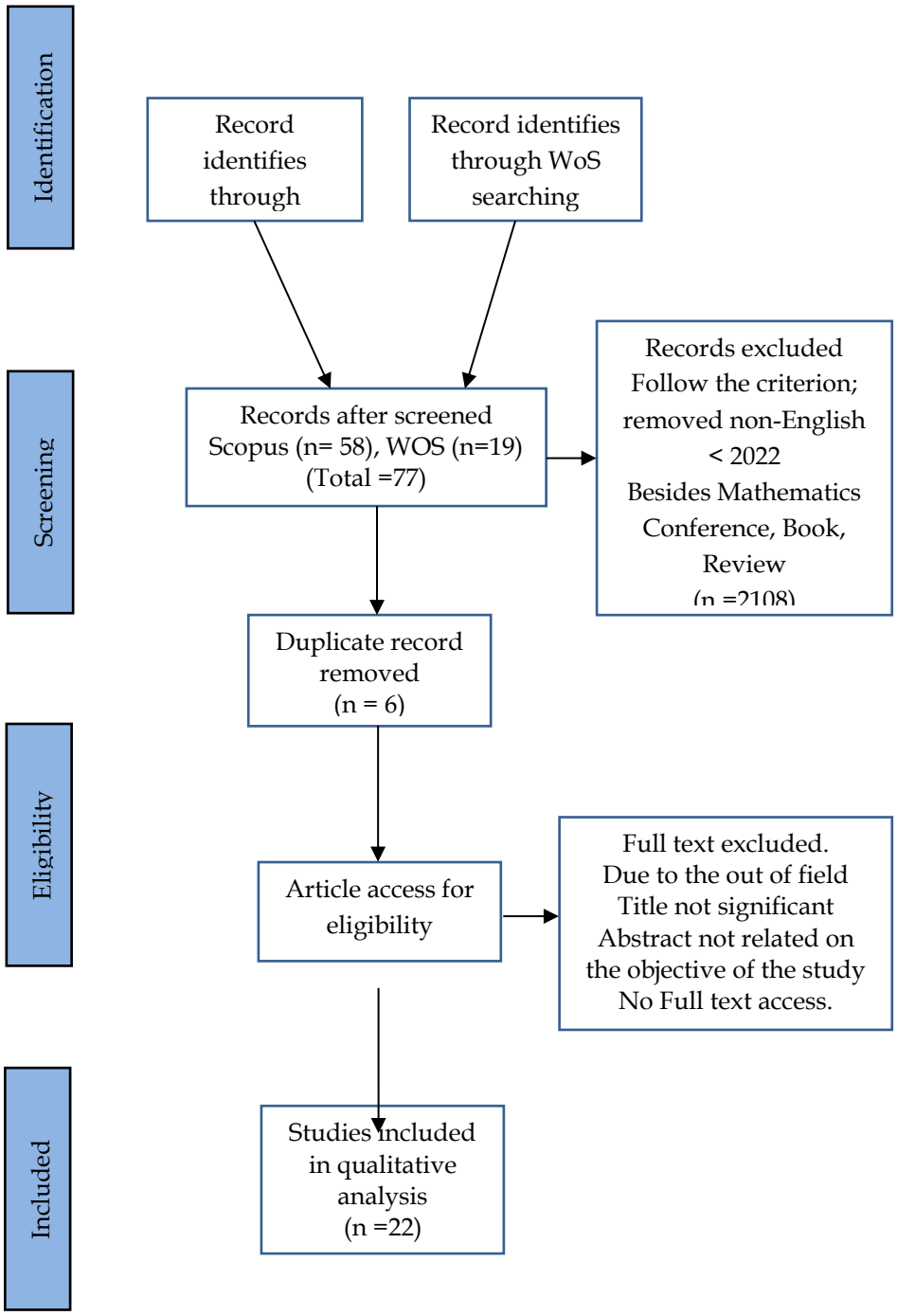

Figure 1: ***PRISMA Flow Diagram***

Note. The PRISMA statement is used to report systematic reviews and meta-analyses of studies. The flow diagram depicts the study selection process with the numbers described in the methodology. Liberati et al. (2009).

Table 3: Number and details of Primary Studies Database

No	Authors	Title	Year	Journal	Scopus	WOS
1	Bertram J.; Rolka K.	Teachers' Content-Related Learning Processes: Teachers' Use of Professional Development Content on Teaching Approaches to Inclusive Mathematics Education	2022	Mathematics Teacher Education and Development	/	
2	Buscher C.; Prediger S.	Teachers' Practices of Integrating Challenging Demands of Inclusive Mathematics Education in A Professional Development Program	2024	Journal of Mathematics Teacher Education	/	
3	Rodrigues T.D.; da Rosa F.M.C.; Manoel A.P.	Exclusion And Inclusion Processes in Mathematics Classrooms: Reflections on Difference, Normality and Cultural Issues Within Three Different Contexts	2022	Mathematics Enthusiast	/	
4	Healy L.; Nardi E.; Biza I.	Interdependency, Alternative Forms of Mathematical Agency and Joy as Challenges to Ableist Narratives About the Learning and Teaching Of Mathematics	2024	ZDM – Mathematics Education	/	/
5	Lloyd M.E.R.	Mathematical Practices Are Everywhere: The Intersections of Pre-Service Teacher Claims, Non-Mathematics-Education Faculty Claims, And Observable Actions	2024	School Science and Mathematics	/	/
6	Berisha F.; Vula E.	Introduction Of Integrated STEM Education to Pre-Service Teachers Through Collaborative Action Research Practices	2024	International Journal of Science and Mathematics Education	/	
7	Zhou L.	Fostering Preservice Teachers' Mathematical Discourse Through Virtual Simulation Teaching	2024	International Journal of Mathematical Education in Science and Technology	/	

8	Giberti C.; Arzarello F.; Beltramino S.; Bolondi G.	Mathematical Discussion in Classrooms as A Technologically Supported Activity Fostering Participation and Inclusion	2024	Educational Studies in Mathematics	/	/
9	Padilla A.; Lambert R.; Tan P.; White-Smith K.	Conceptualizing Political Knowledges Needed to Teach Inclusive Mathematics: Theorizing Through Counterstories	2024	ZDM – Mathematics Education	/	
10	Gardesten M.; Palmér H.	Students' Participation in Mathematics in Inclusive Classrooms: A Study of The Enacted Mathematical and Relational Knowing of Teachers	2023	Mathematical Thinking and Learning	/	
11	Harbour K.E.; Livers S.D.; McDaniel S.C.; Gleason J.; Barth J.M.	Professional Development to Support Elementary Mathematics and Co-teaching Practices: Collaborations Between General and Special Education	2022	Mathematics Teacher Education and Development	/	
12	Rossi G.; Fornaro C.	Enhancing Math Education for Visually Impaired Students: Alternative Text Implementation In LATEX, MATHJAX, MATHML and LAMBDA	2024	Communications in Applied and Industrial Mathematics	/	
13	Abtahi Y.; Planas N.	Mathematics Teaching and Teacher Education Against Marginalisation, Or Towards Equity, Diversity and Inclusion	2024	ZDM – Mathematics Education	/	/
14	Chow S.-M.; Lee J.; Park J.; Kuruppumullage Don P.; Hammel T.; Hallquist M.N.; Nord E.A.; Oravecz Z.; Perry H.L.; Lesser	Personalized Education through Individualized Pathways and Resources to Adaptive Control Theory-Inspired Scientific Education (iPRACTISE): Proof-of-Concept Studies for Designing and Evaluating Personalized Education	2024	Journal of Statistics and Data Science Education	/	

	L.M.; Pearl D.K.				
15	Hunt J.H.; Martin K.; Patterson B.; Khounmeuang A.	Special Educators' Knowledge of Student Mathematical Thinking	2022	Journal of Mathematics Teacher Education	/
16	Nuhrenborger M.; Wember F.B.; Wollenweber T.; Frischemeier D.; Korten L.; Selter C.	Development Of Teachers' Attitudes and Self-Efficacy Expectations for Inclusive Mathematics Instruction: Effects of Online and Blended Learning Programs	2024	Journal of Mathematics Teacher Education	/
17	Sun K.L.; Ruef J.L.	Examining And Conceptualizing the Relationship Between Teacher Praise and The Co-Construction of Mathematical Competence in Classrooms	2023	Journal of Mathematical Behavior	/
18	Soboleva E.V.; Zhumakulov K.K.; Umurkulov K.P.; Ibragimov G.I.; Kochneva L.V.; Timofeeva M.O.	Developing A Personalised Learning Model Based on Interactive Novels to Improve the Quality of Mathematics Education	2022	Eurasia Journal of Mathematics, Science and Technology Education	/
19	Scherer P.; Bertram J.	Professionalisation For Inclusive Mathematics — Teacher Education Programs and Changes in Pre-Service Teachers' Beliefs and Self-Efficacy	2024	ZDM – Mathematics Education	/
20	Naftaliev E.; Barabash M.	Teachers' Professional Development for Inclusion of Experimental Mathematics and Interactive Resources in The Classroom	2024	ZDM – Mathematics Education	/

21	Risdiyanti I.; Zulkardi; Putri R.I.I.; Prahmana R.C.I.	Mathematical Literacy Learning Environment for Inclusive Education Teachers: A Framework	2024	Journal on Mathematics Education	/	
22	Roos H.; Bagger A.	Ethical Dilemmas and Professional Judgment as A Pathway to Inclusion and Equity in Mathematics Teaching	2024	ZDM – Mathematics Education	/	/

4. Quality of Appraisal

According to the guidelines proposed by Kitchenham and Charters (2007), once primary studies have been identified, researchers must assess the quality of the selected studies and conduct a quantitative comparison of their findings. In this study, quality assessment (QA) was conducted using the approach proposed by Abouzahra et al. (2020), which includes six quality assessment questions (QAs) specifically designed for systematic literature reviews (SLRs). The scoring framework consists of three categories: "Yes" (Y), assigned a score of 1 when the criterion is fully met, "Partly" (P), assigned a score of 0.5 when the criterion is met but contains some limitations, and "No" (N), assigned a score of 0 when the criterion is not met.

Each expert independently evaluates the study based on these predefined criteria, and the scores are then aggregated across all evaluators to determine the overall quality score. To advance to the next phase of the review process, a study must achieve a total score exceeding 3.0, calculated by summing the individual scores from all three experts. This threshold criterion ensures that only studies meeting a minimum quality standard proceed further, thereby maintaining the rigor, accuracy, and validity of the systematic literature review. By implementing this quality assessment process, researchers ensure methodological consistency and derive robust, evidence-based conclusions to address the study's research questions.

5. Results

Based on the quality assessment results, Table 4 presents the performance evaluation of the selected primary studies. The analysis indicates that most studies demonstrated high performance, with scores ranging from 83.33% to 100%. Studies in this category showcased innovative approaches and demonstrated effectiveness in enhancing mathematics teaching and learning. For instance, Nieminen et al. achieved a perfect score (100%) by focusing on the experiences of students with disabilities, while Ledezma et al. (91.67%) emphasized pedagogical reflection through mathematical modeling. Additionally, studies by Sun et al. and Scherer et al. (both scoring 83.33%) examined teacher professional development and inclusive education, illustrating

success in bridging theoretical concepts with practical applications. Conversely, some studies exhibited moderate to lower performance (58.3% to 75%), highlighting challenges in achieving a significant impact on mathematics education. For example, Rodrigues et al. (58.3%) explored inclusion and exclusion issues but lacked practical recommendations for implementation.

Similarly, Lloyd (66.7%) investigated the intersection of mathematical and non-mathematical contexts but encountered limitations in applicability. Although lower-performing studies indicate areas for improvement, most of the research successfully contributes to the advancement of mathematics pedagogy, particularly within inclusive and innovative educational contexts. The theme development process underwent multiple refinements to ensure consistency and conceptual clarity. The selection of themes was conducted collaboratively by the author and co-author, both of whom specialize in mathematics education, to validate the relevance and rigor of the identified issues. The expert review phase played a crucial role in ensuring clarity, significance, and domain validity of each sub-theme, confirming its appropriateness within the scope of the study. The authors systematically compared findings, addressing any discrepancies in the theme development process through discussion and consensus-building.

Table 4. The result of assessment performance for selected primary studies

Author	Title	QA 1	QA 2	QA 3	QA 4	QA 5	QA 6	Total Mark	%
Bertram J.; Rolka K.	Teachers' Content-Related Learning Processes: Teachers' Use Of Professional Development Content	1	1	1	1	0.5	0.5	5	83.3
Buscher C.; Prediger S.	Teachers' Practices Of Integrating Challenging Demands Of Inclusive Mathematics Education In A Professional	1	1	1	0.5	0.5	0.5	4.5	75
Rodrigues T.D.; da Rosa F.M.C.; Manoel A.P.	Exclusion And Inclusion Processes In Mathematics Classrooms: Reflections On Difference, Normality	1	1	0.5	0.5	0.5	0	3.5	58.3
Healy L.; Nardi E.; Biza I.	Interdependency, Alternative Forms Of Mathematical Agency And Joy As Challenges To Ableist Narratives	1	1	1	1	0.5	0.5	5	83.3

Lloyd M.E.R.	Mathematical Practices Are Everywhere: The Intersections Of Pre-Service Teacher Claims, Non-Mathematics	1	0.5	1	0.5	0.5	0.5	4	66.7
Berisha F.; Vula E.	Introduction Of Integrated STEM Education To Pre-Service Teachers Through Collaborative Action.	1	1	1	1	0.5	0	4.5	75
Zhou L.	Fostering Preservice Teachers' Mathematical Discourse Through Virtual Simulation Teaching	1	1	1	1	0.5	0.5	5	83.3
Giberti C.; Arzarello F.; Beltramino S.; Bolondi G.	Mathematical Discussion In Classrooms As A Technologically-Supported Activity Fostering	1	1	1	1	1	0.5	5.5	91.7
Padilla A.; Lambert R.; Tan P.; White-Smith K.	Conceptualizing Political Knowledges Needed To Teach Inclusive Mathematics: Theorizing Through	1	1	1	1	0.5	0.5	5	83.3
Gardesten M.; Palmér H.	Students' Participation In Mathematics In Inclusive Classrooms: A Study Of The Enacted Mathematical	1	1	1	1	0.5	0.5	5	83.3

Harbour K.E.; Livers S.D.; McDaniel S.C.; Gleason J.; Barth J.M.	Professional Development To Support Elementary Mathematics And Co-Teaching Practices	1	1	1	1	0.5	0.5	5	83.3
Rossi G.; Fornaro C.	Enhancing Math Education For Visually Impaired Students: Alternative Text Implementation In LATEX	1	1	0.5	1	1	0.5	5	83.3
Abtahi Y.; Planas N.	Mathematics Teaching And Teacher Education Against Marginalisation, Or Towards Equity, Diversity And Inclusion	1	1	0.5	1	1	0.5	5	83.3
Chow S.-M.; Lee J.; et al.	Personalized Education Through Individualized Pathways	1	1	1	1	0.5	0.5	5	83.3
Hunt J.H.; Martin K.; et al.	Special Educators' Knowledge Of Student Mathematical Thinking	1	1	1	1	1	0.5	5.5	91.7
Nührenbörger M.; Wember F.B.; et al.	Development Of Teachers' Attitudes And Self-Efficacy Expectations	1	1	1	1	0.5	0.5	5	83.3
Sun K.L.; Ruef J.L.	Examining And Conceptualizing The Relationship Between Teacher Praise	1	1	1	1	0.5	0.5	5	83.3

Sobolev a E.V.; Zhumak ulov K.K.; et al.	Developing A Personalised Learning Model Based On Interactive Novels	1	1	1	1	1	0.5	5.5	91.7
Scherer P.; Bertram J.	Professionalisation For Inclusive Mathematics Teacher Education Programs	1	1	1	1	0.5	0.5	5	83.3
Naftalie v E.; Barabas h M.	Teachers' Professional Development For Inclusion Of Experimental Mathematics	1	1	1	1	1	1	6	100
Risdiya nti I.; Zulkard i; et al.	Mathematical Literacy Learning Environment For Inclusive Education Teachers	1	1	1	1	1	0.5	5.5	91.7
Roos H.; Bagger A.	Ethical Dilemmas And Professional Judgment As A Pathway To Inclusion	1	1	1	1	0.5	0.5	5	83.3

Ultimately, three core themes were established: (1) Professional Development and Teacher Practices, (2) Technological and Pedagogical Innovations, and (3) Equity, Diversity, and Inclusion in Mathematics Education. These themes underwent refinements based on expert feedback, ensuring their conceptual robustness and alignment with the study's objectives. The final selection reflects a comprehensive analytical framework that provides valuable insights into the role of inclusive mathematics pedagogy, technological advancements, and equitable educational practices in fostering effective mathematics instruction.

5.1 Professional Development and Teacher Practices

Professional development programs are crucial for equipping teachers with inclusive teaching strategies while maintaining academic rigor in mathematics education. Bertram and Rolka (2022) and Buscher and Prediger (2024) highlight that professional development enhances teachers' ability to implement differentiated instruction and balance collective learning with individualized support. Case vignette analyses (Bertram & Rolka, 2022) and integrated inclusive teaching practices (Buscher & Prediger, 2024) have proven effective in fostering

inclusive pedagogy. Beyond skill development, professional training significantly improves teacher self-efficacy and attitudes toward inclusivity. Nuhrenborger et al. (2024) found that blended learning models integrating workshops and collaboration enhance teacher confidence. Similarly, pre-service education programs (Bertram & Rolka, 2022; Scherer & Bertram, 2024) shift beliefs toward inclusive practices, aligning with Harbour et al. (2022) findings that co-teaching initiatives improve pedagogical knowledge and student engagement (Mahmud et al. 2021).

Interdisciplinary approaches and innovative pedagogical strategies further strengthen inclusive mathematics instruction. Lloyd (2024) advocates for breaking structural barriers in teacher training, linking mathematics to broader contexts. Erin B (2023) emphasize the challenges of diverse learning needs, underscoring the necessity of innovative teaching methods. Similarly, Hunt et al. (2021) highlight neurodiversity-focused training, improving pre-service teachers' adaptability to varied problem-solving approaches. The development of frameworks and tools is essential for sustaining inclusive mathematics education. Risdiyanti et al. (2024) propose a structured model incorporating curriculum design, social media, and community engagement to enhance mathematical literacy. Additionally, Graven et al. (2023) analyze assessment practices, demonstrating their role in shaping inclusive pedagogy. These findings underscore the need for systemic reforms in teacher training, curriculum development, and assessment strategies to advance inclusive mathematics education.

5.2 Technological and Pedagogical Innovations

The incorporation of technology in mathematics education has significantly contributed to fostering inclusivity and enhancing student engagement, as evidenced by the research of Berisha and Vula (2024) and Zhou et al. (2023). Berisha and Vula (2024) emphasized the role of interdisciplinary collaboration between mathematics and science educators in strengthening STEM education, which has been shown to improve pre-service teachers' motivation and comprehension of inclusive teaching methodologies (Mahmud et al. 2022). Similarly, Zhou et al. (2023) investigated the efficacy of virtual simulations, which enable pre-service teachers to develop pedagogical adaptability and enhance mathematical discourse in preparation for real-world instructional challenges. Technological advancements have also played a pivotal role in improving accessibility for students with diverse learning needs. According to Giberti et al. (2024), digital platforms such as Padlet have been instrumental in facilitating student engagement by accommodating various learning preferences. Furthermore, Rossi and Fornaro (2024) underscored the significance of alternative text formats, including LATEX, MathJax, and MathML, in supporting visually impaired students in mathematics instruction and ensuring equitable access to mathematical content.

Moreover, the adoption of personalized and adaptive learning models has been recognized as an effective approach to addressing the needs of diverse learners in mathematics education. Chow et al. (2024) introduced iPRACTISE, an innovative

web-based instructional platform designed to provide personalized mathematics instruction tailored to individual student needs. This adaptive tool enables customized learning experiences, allowing educators to adjust instructional content and pace based on students' unique learning profilesAdditionally, Soboleva et al. (2022) explored the potential of interactive learning through customized digital novels, which demonstrated a significant improvement in mathematical concept comprehension among students in experimental settings. These findings collectively underscore the transformative role of technological integration in mathematics education, not only in enhancing teaching efficacy but also in addressing the diverse needs of learners. Consequently, technology serves as an essential component of inclusive mathematics pedagogy, facilitating greater accessibility and promoting equitable learning experiences for all students.

5.3 Equity, Diversity, and Inclusion in Mathematics Education

Ensuring equity, diversity, and inclusion (EDI) in mathematics education requires systemic interventions to eliminate barriers and promote equal participation among marginalized student populations. Rodrigues et al. (2022) identified cultural and structural inequalities as key factors limiting access to mathematics education, particularly among Afro-Brazilian and Indigenous communities. Similarly, Padilla et al. (2024) emphasized the need for political awareness among educators to dismantle deficit discourses and foster fairer learning environments, especially for students with disabilities and marginalized backgrounds (Varty, 2022). Research underscores the significance of inclusive and culturally responsive pedagogical strategies in achieving equitable mathematics education. Gardesten and Palmer (2023) found that integrating social relationships into mathematics instruction enhances student engagement and participation. Roos and Bagger (2024) examined the ethical challenges educators face when balancing equity and resource distribution, highlighting the necessity of ethical professional judgment in diverse classroom settings. Additionally, Abtahi and Planas (2024) stressed the importance of challenging discriminatory ideologies in mathematics education to create learning environments where students from diverse cultural and socio-economic backgrounds can thrive (Mahmud et al. 2020).

The role of students' lived experiences is also central to fostering an inclusive mathematics curriculum. Nieminen et al. (2024) revealed that ableist educational structures restrict the mathematical identities of students with disabilities, while Douglas et al. (2024) demonstrated that disparities in teaching effectiveness negatively affect the academic confidence of students from marginalized groups. Furthermore, innovative pedagogical strategies are essential for advancing inclusion in mathematics education. Katz et al. (2023) explored the use of Toulmin analysis to strengthen mathematical reasoning within broader intellectual contexts, while Ledezma et al. (2024) investigated mathematical modeling as a tool for inclusive learning. Blanco et al. (2022) emphasized the role of service-learning programs in developing teachers' abilities to support students at risk of social exclusion. Collectively, these studies highlight the necessity of responsive, innovative, and socially just pedagogical strategies to ensure equitable access, diverse representation, and inclusive learning opportunities in mathematics education.

6. Discussions

This study highlights the crucial role of Professional Development and Teacher Practices, Technological and Pedagogical Innovations, and Equity, Diversity, and Inclusion in Mathematics Education in fostering inclusive mathematics education. Teacher professional development has been shown to be a key factor in equipping educators with the necessary skills and strategies to address student diversity. Professional development programs that integrate theoretical knowledge with practical applications enhance teacher self-efficacy, allowing them to adapt their instructional strategies more effectively within inclusive classroom settings (Scherer & Bertram, 2024; Chirinda, 2021). By improving pedagogical skills and increasing awareness of diverse student needs, well-structured professional development fosters a more equitable and supportive learning environment for all students (Hermanto & Pamungkas 2023).

Moreover, technological and pedagogical innovations play a significant role in expanding accessibility in mathematics education. Research has demonstrated that digital tools such as Padlet and virtual simulations can increase student engagement, while innovations such as alternative text integration in LATEX and MathJax provide valuable support for students with special needs (Al Omoush et al., 2023; Cobian et al., 2024). The integration of technology-enhanced learning environments allows students to engage with mathematics at their own pace, making learning more inclusive and adaptive to individual needs. These technological advancements contribute to improving pedagogical effectiveness and promoting greater equity in mathematics education.

The study also underscores the importance of equity, diversity, and inclusion in mathematics education, emphasizing the need for systemic changes in policies and teaching practices (Sofwan Mahmud et al. 2018). Research indicates that inclusive mathematics education requires culturally responsive pedagogy, which considers students' lived experiences, social backgrounds, and diverse learning needs (Mahmud et al. 2022). Studies highlight those variations in curricula, availability of resources, and teacher training programs across different educational systems impact the effectiveness of inclusive strategies. Future research should focus on comparative analyses between different educational contexts to better understand the factors influencing the success of inclusive mathematics education. Additionally, empirical field studies are needed to capture real-world classroom dynamics and provide deeper insights into how inclusive practices translate into student learning outcomes (Johari et al. 2022). Despite the benefits of professional development, technology integration, and inclusive pedagogical practices, several challenges remain in implementing these approaches effectively. Prior studies have largely employed qualitative and subjective assessment methods, which may not fully measure the impact of inclusive strategies on students' academic performance and social development. Future research should incorporate quantitative and longitudinal methodologies to assess the long-term effects of inclusive mathematics education (Hermanto & Pamungkas 2023).

In conclusion, this study emphasizes that the success of inclusive mathematics education depends on a multi-faceted approach that integrates high-quality teacher training, effective technology use, and pedagogical strategies that accommodate diverse student needs (Kanandjebo 2024). By adopting a comprehensive, evidence-based, and equity-focused approach, mathematics education can become more inclusive, accessible, and responsive to contemporary educational demands, ensuring equal learning opportunities for all students (Dev et al. 2024).

7. Conclusion

Overall, this study underscores the critical role of inclusive mathematics education in ensuring that all students, regardless of background or ability, have equitable access to learning opportunities. The findings highlight that teacher professional development, technology integration, and culturally responsive pedagogical strategies are fundamental in enhancing inclusive mathematics instruction. While challenges persist in implementing inclusive education, this study emphasizes the necessity of a comprehensive approach that integrates teacher training, technological advancements, and systemic reforms to establish a more equitable and effective mathematics education framework. Future research should investigate how these strategies can be scaled and adapted across diverse educational contexts to maximize their impact. Thus, achieving equity in mathematics education requires collaborative efforts among policymakers, educational institutions, and educators to develop evidence-based best practices that support students from diverse backgrounds. Inclusive mathematics education extends beyond access; it is about empowering students to reach their full potential and actively engage in meaningful mathematical learning experiences.

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