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Barriers in Inclusive Mathematics Learning for Students with Special Educational Needs

Tia Agnesa[1*], Laura Tisya Yordani[1], Khairunnisa Eka Permata Sari[1], Dela Devita[2], Yunita Widia Putri[3]

AFFILIATIONS

1. UIN Sulthan Thaha Saifuddin Jambi, Indonesia
2. Institut Teknologi dan Sains Nahdlatul Ulama Lampung
3. Universitas Muhammadiyah Lampung

*Correspondence:
tiaagnesa@uinjambi.ac.id

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ABSTRACT

Inclusive mathematics education aims to ensure that students with special educational needs (SEN) have equal learning opportunities alongside their peers. However, its implementation still faces multidimensional barriers, including limited teacher competence, rigid curriculum, low student motivation and self-concept, restricted use of assistive technology, communication challenges, classroom management difficulties, and the absence of shadow teachers. This study seeks to identify these barriers while offering a conceptual framework mapping the relationships between barriers and potential solutions. The methodology employed is a PRISMA-guided systematic literature review (SLR), analyzing 12 selected articles from an initial pool of 147 obtained from Scopus, Google Scholar, and DOAJ (2021-2025). Findings reveal that these barriers are interrelated, reinforcing one another and exacerbating learning difficulties. The novelty of this study lies in the development of a barrier-solution conceptual framework and the application of a more transparent review method with critical appraisal. Policy and practice implications highlight the urgency of continuous inclusive teacher training, adaptive curriculum design based on Universal Design for Learning, integration of assistive technology, provision of shadow teachers, and affective strategies to strengthen SEN students' confidence. These findings provide a foundation for future interventions and inclusive education policies in Indonesia and beyond.

KEYWORDS

Conceptual Framework, Inclusive Education, Learning Barriers, Special Educational Needs

INTRODUCTION

The global movement toward inclusive education represents a profound commitment to equity, asserting that every student, regardless of ability, has the right to access, participate in, and benefit from quality learning within their local school community. This vision, championed by UNESCO and underpinned by international conventions, extends far beyond the physical placement of students with special educational needs (SEN) in mainstream classrooms. It calls for a transformative approach where diversity is not merely accommodated but valued, and where teaching practices are deliberately designed to meet the varied needs of all learners. Nowhere is this challenge more acute, or its success more critical, than in the subject of mathematics. Mathematics serves as a gateway to logical reasoning, everyday problem-solving, and future academic and vocational pathways; consequently, exclusion from meaningful mathematical learning can have lifelong

implications. Inclusive mathematics education, therefore, strives to create learning environments where students with SEN whether their needs are cognitive, sensory, physical, or social-emotional can genuinely engage with mathematical concepts, develop confidence, and build a positive identity as learners. This aspiration aligns powerfully with frameworks like Universal Design for Learning (UDL), which proactively builds flexibility into curriculum design, offering multiple pathways to reach learning goals (Hasan et al., 2023; Fernández-Batanero et al., 2022).

Yet, despite strong policy mandates and ethical imperatives, a significant chasm persists between the ideal of inclusion and its lived reality in mathematics classrooms around the world. In practice, the inclusive classroom often becomes a complex and stressful space where well-intentioned goals collide with systemic constraints. Teachers report feeling overwhelmed by the demand to differentiate instruction without adequate training or support, while students with SEN frequently experience frustration, alienation, and a growing sense of inadequacy as they struggle to keep pace with a one-size-fits-all curriculum. This disconnect is not merely a pedagogical shortfall but a systemic issue, reflecting deeper barriers related to resources, training, curriculum design, and school culture. In nations like Indonesia, which has formally embraced inclusive education policy, these challenges are magnified by contextual factors such as large class sizes, limited school budgets, sparse specialist support, and a traditional educational culture that often prioritizes uniformity and rote learning over individualized, conceptual understanding (Mahmud et al., 2023; Efendi et al., 2022). The phenomenon, therefore, is characterized by a cycle where inclusive policy, without corresponding systemic support, inadvertently leads to practices that may marginalize the very students it aims to include, underscoring an urgent need to move from broad advocacy to a precise understanding of the specific, interlocking barriers that must be dismantled.

Literature Review

A robust and expanding corpus of research, spanning international and local contexts, has meticulously documented the multifaceted barriers that impede effective inclusive mathematics education. These barriers do not exist in isolation; rather, they interact dynamically, creating a complex web of challenges that can frustrate even the most dedicated educators. The literature consistently highlights several interconnected thematic clusters that form the core of this problem.

Foremost among these is the issue of teacher competence and professional readiness. Effective inclusion demands a sophisticated pedagogical skill set: the ability to diagnose diverse learning needs, adapt mathematical content, employ alternative teaching strategies, and manage a heterogeneous classroom all while maintaining high expectations for every student. However, numerous studies reveal a pervasive gap in teacher preparedness. Research by Moser Opitz et al. (2020) and Büscher and Prediger (2022) underscores that the quality of teacher instruction is a decisive variable in the mathematical progress of students with SEN. In the Indonesian context, this gap is particularly stark. Studies by Efendi et al. (2022) and Mahmud et al. (2023) find that many teachers enter inclusive classrooms with minimal specialized training, leading to feelings of anxiety and incompetence. This lack of expertise directly translates into a reliance on whole-class, textbook-driven instruction that fails to reach learners who diverge from the norm, perpetuating a cycle of underachievement.

Compounding the challenge of teacher readiness is the inflexibility of standardized curricula and assessment regimes. In many educational systems, including Indonesia's, the mathematics curriculum is designed as a fixed sequence of abstract concepts and procedures, delivered at a uniform pace. This rigidity presents an almost insurmountable barrier for students who process information differently or require more time to grasp foundational ideas. Sari and Kaltsum (2023), for instance, illustrate how students with intellectual disabilities are often bewildered by symbolic notation and fast-paced instruction, leading to disengagement. A systematic review by Abdulah et al. (2025) confirms that a lack of curriculum adaptation is a universal obstacle, noting the sparse implementation of UDL principles that could make curricula inherently more accessible. When the curriculum itself is not designed for variability, teachers are forced into constant, often unsustainable, retrofitting, which seldom leads to deep learning.

Simultaneously, the potential of assistive and instructional technology remains largely untapped, representing a significant resource gap. Digital tools such as interactive apps that visualize fractions, speech-to-text software, or adaptive learning platforms offer powerful means to personalize learning and bypass specific disabilities. International reviews, including one by Fernández-Batanero et al. (2022), affirm the efficacy of such technologies in promoting access and engagement. Yet, their integration into mathematics classrooms, especially in resource-constrained settings like Indonesia, is sporadic at best. Barriers include a lack of reliable hardware and software, insufficient bandwidth, and, critically, a lack of teacher professional development on how to use technology pedagogically rather than as a digital worksheet (Oliveira et al., 2025; Al Omoush et al., 2023). Consequently, a tool meant to empower becomes another point of division.

Beyond these structural and pedagogical hurdles lie the profound psychological and affective barriers experienced by students themselves. Years of struggle in mathematics can deeply erode a student's self-belief. Danuri et al. (2023) provide compelling evidence linking poor mathematical self-concept directly to lower motivation and achievement among SEN students in inclusive schools. This internal narrative is shaped by the classroom environment: when students perceive assessments as unfair, their efforts as unrecognized, or the classroom climate as unsupportive, their willingness to engage plummets. Research capturing the "student voice," such as the work of Roos (2023), makes clear that feelings of belonging and intellectual safety are not secondary concerns but fundamental prerequisites for learning. Ignoring this affective dimension renders even the soundest pedagogical adjustments ineffective.

Finally, a suite of practical, classroom-level challenges completes this daunting picture. Communication barriers isolate students with hearing impairments, for whom verbal explanations of mathematical reasoning are lost without visual aids or sign language support (Endarwati et al., 2024). Classroom management becomes a constant tension as teachers juggle the need to provide individual support without neglecting the rest of the class, often resulting in fragmented lessons that benefit no one fully (Hamdany & Yuni, 2022). Perhaps most critically, the absence of collaborative support structures, such as co-teaching with special education specialists or the provision of shadow teachers, leaves general education teachers alone to shoulder an impossible burden. As noted by Danuri et al. (2023), the lack of teaching assistants in many Indonesian schools means that individualized attention is a logistical fantasy, not a planned strategy.

Research Gap

While the existing literature provides a thorough, if sobering, diagnosis of these barriers, several critical gaps remain unaddressed, pointing the way for this current study. First, there is a distinct shortage of research that synthesizes these disparate challenges into a coherent, integrative conceptual framework. Most studies examine barriers in isolation focusing solely on teachers, curriculum, or technology without modeling how these factors interact and reinforce one another within a system. A holistic framework that maps these interdependencies and connects them to synergistic solution clusters is essential for moving from fragmented problem-listing to strategic, systemic intervention.

Second, within the specific methodology of the systematic literature review (SLR), a lack of transparency and methodological rigor often clouds the findings. Many reviews in the field of inclusive education do not fully adhere to established reporting standards like the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA), failing to provide clear flowcharts, detailed rationales for article inclusion/exclusion, or a critical appraisal of the quality of the evidence synthesized (Moher et al., 2009; Page et al., 2021). This omission limits the reliability and replicability of their conclusions.

Third, the literature lacks nuanced contextual and comparative analysis. The barriers to inclusion in a well-resourced educational system in the Global North often centered on refining pedagogy and integrating advanced technology differ in character and priority from those in the Global South, where foundational issues of resource allocation, infrastructure, and basic policy implementation dominate. A focused comparison, particularly situating Indonesia's challenges within the international landscape, is vital for generating recommendations that are both evidence-based and contextually realistic, avoiding the pitfalls of importing solutions from vastly different settings.

Fourth, a significant research-practice gap persists. The academic literature is rich with descriptions of problems but relatively poor in evaluations of concrete, systematic interventions. For example, while "enhanced teacher training" is a universal recommendation, there are few robust studies documenting the development, implementation, and longitudinal impact of practice-based professional development modules specifically for inclusive mathematics. Similarly, pilot projects that redesign curricula using UDL principles or establish co-teaching models in Indonesian schools are rarely subjected to rigorous academic study and dissemination.

Finally, and perhaps most importantly, the field suffers from a paucity of participatory and student-centered research. The lived experiences, perceptions, and insights of students with SEN themselves are strikingly absent from much of the literature that shapes policy and practice intended for their benefit. As Roos (2023) compellingly argues, understanding inclusion requires listening to the "student voice." Without intentionally incorporating their perspectives, researchers and policymakers risk designing interventions that are technically sound but fundamentally misaligned with what students need to feel and be successful.

Aims and Contributions

In direct response to these identified gaps, the present study is guided by four central aims:

1. To conduct a rigorous, transparent, and critical systematic review of recent literature (2021-2025) to identify and synthesize the prevailing barriers to inclusive mathematics learning for students with SEN.
2. To construct and propose a novel Barrier-Solution Conceptual Framework. This framework will visually and analytically map the interconnected ecosystem of challenges while explicitly linking them to integrated, evidence-informed strategies for intervention, providing a strategic blueprint for stakeholders.
3. To execute a contextual comparative analysis that carefully contrasts the nature and weight of barriers within Indonesia against trends in international research, thereby distinguishing context-specific structural hurdles from more universal pedagogical challenges.
4. To translate these findings into a set of actionable, prioritized, and practical recommendations aimed at policymakers, curriculum designers, teacher education institutions, school leaders, and classroom teachers.

The contributions of this research are designed to be both theoretical and practical. Theoretically, it advances the scholarly discourse by offering an integrated framework that synthesizes previously fragmented insights into a coherent model of systemic challenge. Methodologically, it demonstrates and advocates for rigorous, transparent SLR practices in educational research. Practically, the resulting framework and contextual analysis serve as vital tools for diagnosis and planning. Specifically, the study enriches the conversation by integrating contemporary perspectives such as culturally sustaining UDL (Yeh et al., 2024), which emphasizes the importance of cultural relevance in inclusive design, and by offering a balanced analysis of educational technology as a dual-edged sword a potential catalyst for inclusion hampered by practical constraints (Al Omoush et al., 2023). Ultimately, this work seeks to provide a clear-eyed analysis of the persistent obstacles in inclusive mathematics education while charting a purposeful and coherent path from understanding these barriers to implementing meaningful, system-wide change.

METHODOLOGY

Research Approach

To address the study's aims in a rigorous and comprehensive manner, a systematic literature review (SLR) methodology was adopted. The SLR approach was selected over a traditional narrative review due to its explicit, reproducible, and transparent protocol, which minimizes researcher bias and provides a structured synthesis of existing evidence (Snyder, 2019). This method is particularly well-suited for mapping a complex field of research, as it employs a predefined, step-by-step process to identify, select, critically appraise, and analyze all relevant scholarly literature on a specific topic. To ensure methodological rigor and reporting clarity, this review was guided by the established *Preferred Reporting Items for Systematic Reviews and Meta-Analyses* (PRISMA) framework. The PRISMA guidelines, as outlined by Moher et al. (2009) and updated by Page et al. (2021), provide a robust structure for conducting and documenting systematic reviews, emphasizing transparency through its four-phase flow diagram encompassing identification, screening, eligibility, and inclusion. This structured approach allowed for a meticulous and auditable synthesis of the barriers to

inclusive mathematics education, forming a reliable foundation for the subsequent development of the conceptual framework.

Research Questions

The entire review process was driven by two overarching research questions designed to fulfill the study's objectives. The primary question sought to catalog and understand the challenges: "What are the key barriers to implementing effective inclusive mathematics education for students with special educational needs (SEN), as reported in recent literature (2021-2025)?" This question aimed to generate a comprehensive and nuanced list of impediments, from teacher-level difficulties to systemic constraints. The secondary, synthesizing question was: *"How can these identified barriers be conceptually mapped and linked to evidence-based solution strategies to inform policy and practice?"* This question propelled the analysis beyond mere description, focusing on the interrelationships between barriers and guiding the construction of the integrated Barrier-Solution Conceptual Framework that is a central contribution of this study.

Data Sources and Search Strategy

A systematic and exhaustive search for relevant literature was conducted to capture a broad spectrum of perspectives. Electronic searches were performed across three major academic databases to ensure comprehensive coverage: Scopus, for its curated collection of high-quality international journals; Google Scholar, to capture a wider array of sources including conference proceedings and institutional repositories; and the Directory of Open Access Journals (DOAJ)**,** to incorporate reputable open-access research. The search was deliberately limited to publications from the five-year period of 2021 to 2025, ensuring the review's findings reflect the most current discussions, challenges, and innovations in the rapidly evolving field of inclusive education. A combination of keywords in English and their Indonesian equivalents was used to capture both global and localized research. Core search terms included: "inclusive mathematics," "mathematics education," "special educational needs," "learning barriers," "inclusive education," "Universal Design for Learning," alongside Indonesian terms such as "*pembelajaran matematika inklusif*" and "*siswa berkebutuhan khusus*." These terms were combined using Boolean operators (AND, OR) to refine the search results effectively.

To filter the initial pool of articles systematically, explicit inclusion and exclusion criteria were applied. Articles were included if they: (1) were available in full-text; (2) were published in reputable national or international peer-reviewed journals or credible conference proceedings; (3) had a primary focus on inclusive mathematics learning for students with SEN; and (4) presented empirical data, case studies, meta-analyses, or other systematic reviews. Conversely, articles were excluded if they: (1) were opinion pieces, editorials, or theoretical papers without empirical backing; (2) discussed inclusive education broadly without a specific connection to mathematics pedagogy or learning; or (3) were published prior to 2021. The application of these criteria ensured the review was grounded in recent, relevant, and substantiated evidence.

Data Analysis

The analysis followed the structured PRISMA protocol. The initial database searches yielded 147 articles. After removing duplicates, the titles and abstracts of all remaining articles were screened against the inclusion criteria, which reduced the pool to 62 articles. These 62 articles then underwent a rigorous full-text review for eligibility. During this stage, articles were critically appraised for their methodological quality, relevance to the research questions, and the validity of their findings, drawing on guidelines for systematic reviews in social sciences (Kitchenham & Charters, 2007). This critical appraisal led to the exclusion of articles that, while tangentially related, did not provide in-depth analysis of barriers specific to mathematics. Ultimately, 28 articles met all eligibility criteria. From this group, 12 articles were selected for in-depth qualitative synthesis based on their richness of data, methodological rigor, and their direct relevance to the core themes of barriers and solutions. This final corpus formed the primary data for thematic analysis.

Thematic analysis was employed to distill key findings from the 12 selected articles. This involved an iterative process of reading, coding, and categorization to identify recurring patterns and themes related to barriers in inclusive mathematics education. Codes were initially generated inductively from the data and then grouped into broader thematic categories, such as “Teacher Competence,” “Curriculum Rigidity,” and “Psychological Barriers.” These themes were not treated as isolated silos; the analysis paid particular attention to the connections and interactions between them as described across the literature. Finally, the synthesized themes and their interrelationships were used to construct the study’s central output: the Barrier-Solution Conceptual Framework. This framework was developed deductively by linking each identified barrier cluster to potential solution strategies explicitly recommended or evidenced within the reviewed literature, thereby creating an integrated model to guide future intervention and policy.

RESULTS AND DISCUSSION

The systematic analysis of the twelve selected studies reveals a complex, interlocking ecosystem of challenges that hinder the effective implementation of inclusive mathematics education for students with Special Educational Needs (SEN). Far from being isolated issues, these barriers reinforce one another, creating a cycle of difficulty that can frustrate teachers, demoralize students, and compromise learning outcomes. The findings coalesce around eight central themes, which collectively provide a comprehensive answer to the primary research question concerning the key barriers. Furthermore, by examining the relationships between these themes and contextualizing them within international and Indonesian settings, this discussion synthesizes a coherent understanding that directly informs the secondary research question: the development of a barrier-solution conceptual framework.

The Centrality of Teacher Competence and Preparedness

The most pervasive barrier identified across the literature is the significant gap in teacher readiness for inclusive mathematics instruction. Teachers are the primary agents of inclusion, yet they frequently find themselves at the epicenter of the struggle. Research consistently indicates that general education teachers often lack the specialized pedagogical content knowledge required to adapt mathematical concepts for diverse learners (Moser Opitz et al.,

2020). In Indonesia, this is acutely felt. Efendi et al. (2022) found that many teachers feel fundamentally unprepared, citing inadequate pre-service training and a dearth of meaningful in-service professional development focused on inclusive strategies. This lack of competence manifests in several ways: an inability to diagnose specific learning needs in mathematics, a reliance on whole-class, textbook-driven instruction, and a limited repertoire of differentiation strategies. The consequence, as Büscher and Prediger (2022) articulate, is a profound professional dilemma where teachers must balance the demand to provide meaningful, individualized support for SEN students with the simultaneous need to manage and progress the learning of the entire class a task for which they feel ill-equipped. This competency gap is not merely a knowledge deficit but a source of significant stress and negative attitude, which in turn impacts instructional quality and classroom climate.

The Straitjacket of Rigid Curricula and Assessment

Closely intertwined with teacher preparedness is the structural barrier posed by inflexible, standardized curricula. Mathematics curricula in many systems, including Indonesia's, are often designed as a linear sequence of abstract concepts, delivered at a uniform pace with standardized assessments as the primary measure of success. This design is fundamentally at odds with the principles of inclusion. Sari and Kaltsum (2023) poignantly illustrate how such rigidity marginalizes students with intellectual disabilities, for whom symbolic notation and fast-paced, abstract instruction can be alienating and incomprehensible. A uniform curriculum assumes a uniformity of learners that simply does not exist, leaving teachers to retrofit accommodations rather than working from a flexibly designed starting point. Abdulah et al. (2025), in their systematic review, confirm that limited curriculum adaptation is a global barrier, noting the stark absence of widely implemented models based on Universal Design for Learning (UDL). UDL, with its core principles of providing multiple means of representation, action and expression, and engagement, offers a blueprint for curriculum design that is inherently accessible (Hasan et al., 2023). However, without systemic mandates and support to move away from rigid syllabi, teachers remain trapped in a structure that actively works against their inclusive efforts.

The Affective Quagmire: Low Self-Concept and Motivation

The psychological dimension of learning emerged as a critical and often underestimated barrier. Students with SEN, after experiencing repeated difficulties and failures in mathematics, frequently develop a debilitatingly negative self-concept regarding their mathematical abilities. Danuri et al. (2023) provide empirical evidence directly linking poor mathematical self-concept to diminished motivation and lower numerical literacy among SEN students in inclusive schools. This is not merely an internal student issue; it is actively shaped by the learning environment. When instruction is poorly adapted and assessments feel perpetually unfair, students internalize a narrative of incapacity. Research capturing the "student voice," such as the work of Roos (2023), underscores that from the learner's perspective, factors like fairness, recognition of effort, and a sense of belonging are paramount for motivation. If students do not feel intellectually safe or valued in the mathematics classroom, no amount of pedagogical adjustment will spur deep engagement. This affective barrier thus forms a vicious cycle: pedagogical failures lead to poor self-concept, which crushes motivation, which in turn leads to disengagement and further academic failure.

The Untapped Potential and Practical Hurdles of Assistive Technology

The literature unanimously affirms the tremendous potential of assistive and instructional technology to break down barriers in mathematics learning. Digital tools such as software that visualizes geometric transformations, apps that turn word problems into interactive stories, or adaptive platforms that adjust problem difficulty can provide alternative pathways to understanding that bypass specific cognitive or sensory disabilities. Fernández-Batanero et al. (2022), in a broad systematic review, confirm the effectiveness of such technologies in enhancing accessibility and engagement for students with disabilities. Case studies, such as that by Oliveira et al. (2025), demonstrate positive impacts on the engagement of autistic students in mathematics through tailored digital tools. However, a profound gap exists between this potential and widespread classroom reality, especially in contexts like Indonesia. The barriers to effective integration are pragmatic and systemic: insufficient hardware (e.g., tablets, computers), unreliable internet connectivity, lack of appropriate software licenses, and, crucially, a severe shortage of teacher training on how to integrate technology meaningfully into mathematics pedagogy (Al Omoush et al., 2023). Technology, when available, is often used passively or in isolation, rather than as an integrated component of a UDL-based lesson. Thus, what could be a powerful solution often becomes another point of inequality or an underutilized resource.

Communication Barriers in a Verbal Discipline

Mathematics is a discipline heavily reliant on language, both in instruction and peer collaboration. This presents a unique and significant barrier for students with hearing impairments or specific language-related disabilities. Verbal explanations of mathematical reasoning, class discussions, and teacher-led instructions can be largely inaccessible. Endarwati et al. (2024), in their study of deaf students in inclusive settings, found that these students struggled profoundly with conventionally delivered mathematics content. Their findings advocate for a decisive shift towards visual and concrete approaches using manipulatives, diagrams, visual software like GeoGebra (as noted in Hariyanti et al., 2025), and clear sign language interpretation. The barrier here is not the student's ability to think mathematically, but the classroom's failure to provide mathematical information in an accessible modality. Effective inclusion for these students requires a conscious, multimodal communication strategy that moves beyond a default reliance on speech and text.

The Logistical Challenge of Classroom Management

Managing a classroom of learners with vastly different abilities, paces, and needs is an immense logistical challenge that emerged as a distinct barrier. Teachers report significant difficulty in allocating their time and attention equitably and effectively. The need to provide one-on-one or small-group support to SEN students can often mean the rest of the class is left without direct guidance, leading to management issues and lost learning time for all. Hamdany & Yuni (2022) highlighted this tension in their Indonesian case study, where teachers felt pulled in multiple directions. This challenge is not unique to developing contexts; Büscher and Prediger (2022) note similar dilemmas in German classrooms. The pressure of "covering" a mandated curriculum exacerbates this, leaving little room for the pauses, repetitions, and alternative explanations that SEN students may require. Effective classroom

management in an inclusive setting is less about discipline and more about the sophisticated orchestration of time, space, and human resources a skill that requires specific training and supportive structures.

The Shortfall in Differentiated Instruction Strategies

While differentiation is the pedagogical cornerstone of inclusion, the literature reveals a stark shortfall in its consistent and effective implementation. Differentiation goes beyond simply giving some students easier problems; it involves varying content, process, product, and learning environment based on ongoing assessment of student readiness, interest, and learning profile. However, studies indicate that teachers often default to uniform teaching methods due to a lack of time, planning resources, and know-how. Danuri et al. (2023) connect this lack of differentiation directly to declining student motivation. Without tasks that are appropriately challenging and accessible, students either become bored or frustrated. Darragh (2023) suggests that frameworks like UDL offer a proactive alternative to reactive, ability-based grouping by designing lessons with built-in flexibility from the start. The barrier, therefore, is the translation of the theory of differentiation into practical, sustainable classroom practice.

The Critical Absence of Support Personnel: Shadow Teachers

The final, and particularly salient barrier for the Indonesian context, is the notable absence of shadow teachers or dedicated teaching assistants. A shadow teacher works alongside the main classroom teacher to provide targeted, in-the-moment support to one or more SEN students, helping to translate instructions, manage behavior, and provide immediate feedback. Danuri et al. (2023) emphasize the crucial role such personnel play in bridging the support gap. In many Indonesian inclusive schools, this role is either nonexistent or filled informally by untrained personnel. The absence of this support layer places the entire burden of adaptation and individualization on the single classroom teacher, making effective differentiation and management nearly impossible to sustain. This represents a fundamental policy and resource failure, as the system expects inclusion to occur without providing the necessary human infrastructure to make it feasible.

Contextual Synthesis: Indonesia in the International Landscape

A critical layer of analysis involves contrasting these barriers within the Indonesian context against broader international findings. This comparison reveals a shift in the *nature* of the primary challenge. In many developed education systems (e.g., Europe, North America), the debates often center on *pedagogical refinement* optimizing co-teaching models, deepening UDL implementation, or integrating advanced assistive technologies (Darragh, 2023; Yeh et al., 2024). The barriers, while significant, often operate within a framework of established resources, specialist support, and policy infrastructure.

In Indonesia, however, the barriers are more *fundamental and structural*. The core issues are less about refining sophisticated pedagogy and more about establishing its basic prerequisites. Challenges like insufficient teacher training (Efendi et al., 2022), complete lack of shadow teachers (Danuri et al., 2023), inadequate technological infrastructure (Mahmud

et al., 2023), and a rigid, non-UDL curriculum (Sari & Kaltsum, 2023) point to systemic gaps in resource allocation, policy implementation, and foundational professional preparation. The international literature on the effectiveness of UDL or assistive technology (Fernández-Batanero et al., 2022; Hasan et al., 2023) remains highly relevant but highlights a painful disparity: these solutions presume a level of systemic support that is often absent in Indonesia. Therefore, while the *types* of barriers (teacher skill, curriculum, technology) are global, their *priority, severity, and root causes* are deeply contextual. For Indonesia, solving the structural and resource-based hurdles is a necessary precursor to engaging fully with the pedagogical refinement stage observed in other contexts.

Toward an Integrative Framework: From Barriers to Solutions

The discussion thus far affirms that barriers are interconnected. A teacher's struggle with differentiation (Barrier 7) is caused by lack of training (Barrier 1), exacerbated by a rigid curriculum (Barrier 2) and no classroom assistant (Barrier 8), leading to student disengagement (Barrier 3). Isolated interventions are therefore likely to fail. This understanding directly informs the construction of the Barrier-Solution Conceptual Framework (as summarized in Table 1 of the original manuscript). The framework does not propose single fixes but clusters of interdependent strategies.

For instance, addressing Teacher Competence requires more than one-off workshops. It demands *continuous, practice-based professional development* (Moscato, 2023) embedded in teachers' real contexts, focusing on UDL lesson design and differentiation. This training, however, must be coupled with policy changes that provide shadow teachers to reduce the logistical burden, making new pedagogical strategies practicable. Simultaneously, curricular reform toward UDL and culturally sustaining principles (Yeh et al., 2024) is needed to give teachers a flexible framework, not a rigid script. This structural change must be supported by strategic investment in assistive technology infrastructure paired with targeted teacher training on its pedagogical use (Al Omoush et al., 2023), moving technology from a novelty to a core instructional tool. To break the affective barrier, these pedagogical and structural changes must be complemented by intentional affective and counseling strategies (Hasan et al., 2023) that build student self-concept, and a commitment to amplifying the "student voice" (Roos, 2023) in shaping an inclusive classroom culture.

In conclusion, the findings present a clear mandate: effective inclusive mathematics education requires a systemic, not a piecemeal, approach. The barriers are woven into the very fabric of the education system from policy and curriculum design to teacher preparation and resource allocation. The proposed conceptual framework serves as a map, illustrating that solutions must be equally interwoven. For Indonesia, this means that advancing inclusion in mathematics will depend less on importing isolated "best practices" from abroad and more on courageously addressing its own unique constellation of structural challenges, while adaptively drawing on the pedagogical principles validated by international research. The path forward lies in coordinated action across all levels of the educational ecosystem.

Table 1. Barrier-Solution Framework

Barrier	Key Studies	Research Methods	Main Findings	Potential Solutions
Low Teacher Competence	Efendi et al. (2022); Moser Opitz et al. (2020); Moscato (2023)	Quantitative & Qualitative	Teachers lack readiness and content knowledge	Continuous practice-based training
Rigid Curricula	Sari & Kaltsum (2023); Abdulah et al. (2025); Yeh et al. (2024)	Qualitative & Review	Abstract, inflexible, not UDL-based	UDL- and culturally adapted curricula
Low Self-Concept & Motivation	Danuri et al. (2023); *Students' Voices* (2023); Hasan et al. (2023)	Quantitative & Participatory	SEN students feel incapable, demotivated	Counseling & affective strategies
Limited Use of Technology	Abdulah et al. (2025); Fernández-Batanero et al. (2022); Oliveira et al. (2025)	Reviews & Case Studies	Technology effective but underused	Investment in infrastructure & training
Communication Barriers	Endarwati et al. (2024); DCU (2023)	Case Study & Experimental	Hearing-impaired students struggle with verbal instruction	Visual media, sign language, multimodal strategies
Classroom Management	Hamdany & Yuni (2022); Büscher & Prediger (2022); Darragh (2023)	Surveys & Qualitative	Teachers struggle to balance attention	Co-teaching & small group learning
Lack of Differentiation	Danuri et al. (2023); Darragh (2023)	Quantitative & Conceptual	Uniform methods neglect diverse needs	Teacher training in differentiation
Absence of Shadow Teachers	Danuri et al. (2023)	Qualitative	No assistants, teacher workload increases	Mandatory shadow teacher policies

Table 1 summarizes the eight core barriers identified through the systematic review, along with the key studies, research methods, main findings, and corresponding solution strategies. These barriers do not exist in isolation but operate within a mutually reinforcing system where inadequate teacher competence, rigid curricula, underutilized technology, and weak affective support collectively shape an environment that hinders inclusive mathematics learning. Consequently, the proposed solutions cannot be fragmented or stand-alone; they must be integrated into a comprehensive framework that reflects the systemic nature of the problem. The following section elaborates on how this synthesis contributes to both conceptual understanding and the development of strategic, actionable directions for inclusive education policy and practice.

Synthesis and Contributions

This study confirms that barriers to inclusive mathematics education are multidimensional and mutually reinforcing. Teacher competence, curricula, technology, psychological factors, communication, and policy form an interdependent ecosystem of challenges. The main contributions of this study are: (1) developing a conceptual framework linking barriers to potential solutions, (2) providing a contextual analysis comparing Indonesia with international practices, (3) integrating cultural perspectives through *culturally sustaining UDL* (Yeh et al., 2024), (4) enriching discussions on assistive technology (Fernández-Batanero et al., 2022), and (5) emphasizing practice-based teacher professional development (Moscato, 2023).

By adopting a systematic and critical review approach, this study not only highlights challenges but also provides actionable directions for future interventions. Recommendations include integrating UDL into Indonesia's curriculum, investing in assistive technology, promoting co-teaching models, and mandating shadow teachers as part of inclusive education policy.

Research Limitations

This study, while offering a structured synthesis and a novel framework, is subject to several limitations inherent to its design as a systematic literature review. First, the findings are constrained by the scope and availability of existing research. The analysis is based on published studies from 2021–2025, which may overlook earlier foundational work or emerging research not yet indexed. The search, though including Indonesian terms, relied heavily on English-dominant databases (Scopus, Google Scholar), potentially missing nuanced local studies published in less-indexed national journals.

Second, the selection process, while following PRISMA guidelines, involved researcher judgment in screening and critical appraisal. The final in-depth analysis of 12 articles provides depth but represents a focused subset of the literature; different interpretive choices could have emphasized alternative themes. Third, the Barrier-Solution Conceptual Framework is an interpretative synthesis derived from aggregated studies. It serves as a conceptual map rather than a validated intervention model. The proposed solutions, though evidence-informed, require empirical testing and contextual adaptation, especially within Indonesia's unique educational landscape.

Finally, potential publication bias may skew the findings toward reported challenges and documented interventions, underrepresenting unpublished struggles or locally specific obstacles that are less frequently researched. These limitations do not diminish the study's contribution but clarify that its framework is a foundational step intended to guide not replace future primary research, contextual piloting, and policy evaluation.

CONCLUSION

Inclusive mathematics education for students with special educational needs continues to encounter a complex network of interrelated barriers that span pedagogical, psychological, structural, and technological domains. This systematic review synthesized recent literature (2021–2025) to identify eight core challenges: limited teacher competence, rigid curricula, low student self-concept and motivation, underutilized assistive technology, communication

difficulties, classroom management struggles, insufficient differentiated instruction, and the absence of shadow teachers. These barriers do not operate in isolation; rather, they reinforce one another within an educational ecosystem, often exacerbating exclusion and inequity. The primary contribution of this study lies in the development of a barrier-solution conceptual framework that maps these interconnected challenges to clusters of evidence-informed interventions, such as continuous practice-based teacher training, curriculum adaptation guided by Universal Design for Learning (UDL) and culturally sustaining principles, strategic integration of assistive technology with pedagogical support, and the institutionalization of shadow teacher roles. Methodologically, the use of a PRISMA-guided systematic review with critical appraisal ensured transparency and rigor, while the contextual analysis highlighted how barriers in Indonesia are predominantly structural and resource-based, contrasting with the more pedagogical and technological focus in many international contexts. Ultimately, this research provides a consolidated evidence base and a strategic framework to guide policymakers, teacher educators, and school leaders in moving from identifying problems to implementing coherent, systemic solutions that can make inclusive mathematics education a meaningful reality for all learners.

AI Usage Declaration

In the preparation of this manuscript, the AI tool *Dimension AI* was used to assist in generating initial thematic summaries from selected abstracts during the early screening phase. Additionally, the software *Publish or Perish* was employed to retrieve and organize citation data from Google Scholar, supporting the bibliometric management and initial identification of relevant literature. All analytical synthesis, critical appraisal, interpretation of findings, and manuscript writing were conducted by the authors.

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