Mathematical exclusion as social injustice: A critical analysis of inclusive education discourse and practice in grades 5-6

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Abstract

The promise of inclusive education to provide equitable learning opportunities for all students faces significant challenges when confronted with the abstract nature of mathematics and the deeply embedded power structures within educational systems. This critical systematic review examines how inclusive mathematics education for grades 5-6 students learning squares, cubes, areas, and volumes operates as a site of both possibility and contradiction in achieving educational

equity. Drawing on 87 studies and employing an intersectional lens that integrates disability studies, critical race theory, and feminist pedagogy, we reveal how current inclusive practices often reproduce rather than disrupt educational inequities. Our analysis uncovers three critical tensions: the paradox of inclusion where physical integration masks continued marginalization; the hidden curriculum that privileges certain ways of mathematical thinking while devaluing others; and the neoliberal co-optation of inclusive discourse that emphasizes individual accommodation over systemic transformation. We find that while technological innovations and differentiated instruction show promise, their implementation frequently fails to address underlying power dynamics and ableist assumptions. Most significantly, we identify how the discourse of mathematical rigor serves to maintain exclusionary practices under the guise of maintaining standards. This research is crucial for understanding how mathematical exclusion perpetuates broader social inequalities, limiting opportunities for marginalized students in STEM fields and affecting their economic mobility, civic participation, and life trajectories. This review contributes a new critical framework for understanding inclusive mathematics education that moves beyond technical solutions to address the fundamental questions of whose knowledge counts, who belongs in mathematics, and how current practices perpetuate educational injustice. We argue for a radical reimagining of inclusive mathematics education that centers social justice, recognizes multiple ways of knowing, and actively works to dismantle oppressive structures within mathematics classrooms.*

Keywords: ableism, critical mathematics education, educational equity, inclusive education, intersectionality, mathematical exclusion, social justice, Sustainable Development Goals

Introduction

Despite decades of inclusive education policies and the global commitment to Sustainable Development Goal 4 (SDG 4) ensuring inclusive and equitable quality education for all, mathematics education continues to function as a gatekeeper, systematically excluding students whose ways of knowing and being do not align with dominant educational norms (Davis, 2022; Tan, Padilla, & Lambert, 2022). This exclusion has profound implications for social mobility, economic opportunity, and participation in an increasingly quantitative and technological society. Mathematics education serves as a critical gateway to STEM fields, and when educational systems fail to provide truly inclusive mathematics education, they perpetuate cycles of marginalization that extend far beyond the classroom, affecting career trajectories, civic participation, and life outcomes (Martin, 2019).

The persistence of mathematical exclusion despite decades of inclusive education reforms reveals what Louie (2017) terms a "culture of exclusion" that structures everyday instruction even among equity-committed teachers. This culture operates through multiple mechanisms: from the "auto-exclusion" processes where students internalize and enact their own marginalization (Kollosche, 2019), to the shift from overt to covert forms of exclusion that maintain hierarchies while appearing progressive (Mhlolo & Ntoatsabone, 2023). Recent work by Xenofontos (2025) conceptualizes these dynamics as "affective atmospheres" – shared feelings of displacement and marginalization that circulate through classroom spaces, revealing how exclusion is collectively experienced rather than individually suffered.

The teaching of spatial concepts such as squares, cubes, areas, and volumes in grades 5-6 represents a critical juncture where abstract mathematical thinking intersects with deeply embedded assumptions about who can do mathematics and whose mathematical knowledge is valued (Parekh, 2023). The transition from arithmetic to more abstract mathematical concepts during these middle years of schooling is not merely a cognitive challenge but a profoundly social and political process. Padilla and Tan (2019) argue that mathematics education standards and curricula are not neutral tools but rather instruments that can enable or disable students, depending on how they align with students' diverse ways of understanding and expressing mathematical ideas. For students navigating multiple forms of marginalization, including those related to disability, race, language, and class, this transition often marks the beginning of their systematic exclusion from advanced mathematics and, consequently, from STEM fields (Harper, 2019).

Recent events have further exposed and exacerbated these inequities. The COVID-19 pandemic laid bare the digital divide and its disproportionate impact on students with disabilities and those from marginalized communities (Naidoo & Singh-Pillay, 2025). While some students seamlessly transitioned to online learning with high-speed internet and individual devices, others struggled without basic connectivity or accessible digital materials. The pandemic's aftermath has intensified debates about what constitutes quality education and for whom educational systems are designed (Ramachandran, 2023).

This systematic review addresses a critical gap at the intersection of inclusive education, mathematics teaching, and social justice. While previous reviews have examined inclusive mathematics education broadly or focused on specific disabilities, none have critically analyzed how the teaching of particular mathematical concepts functions to include or exclude diverse learners within broader systems of power and oppression. For example, the recent study by Corral-Granados, Smeplass, Cecilia Rapp, and Eide Isaksen (2023) examining Norwegian elementary schools reveals how even in contexts with strong inclusive education policies, children experience systematic exclusion through school culture, rules, and pedagogical practices that fail to recognize diverse ways of mathematical thinking. By focusing specifically on squares, cubes, areas, and volumes in grades 5-6, we examine how abstract spatial concepts become sites where educational equity is either advanced or undermined.

Our analysis is guided by a critical framework that views inclusive education not as a technical problem to be solved through better strategies or tools, but as a fundamental question of justice that requires examining and transforming the power relations embedded in mathematics education (Gonzalez, Chapman, & Battle, 2020). We employ intersectionality as a lens to understand how multiple systems of oppression, including ableism, racism, linguicism, and classism, interact to shape students' experiences in mathematics classrooms (Leyva & Joseph, 2023).

The significance of this review extends beyond academic discourse. As Akmal and Pritchett (2021) demonstrate, the gap between policy promises of equity and the lived realities of educational inequality has profound implications for social mobility and economic opportunity. Mathematics education, particularly in areas requiring spatial reasoning, serves as a gateway to fields such as engineering, architecture, and technology. When educational systems fail to provide truly inclusive mathematics education, they perpetuate cycles of marginalization that extend far beyond the classroom.

Understanding why this research matters requires recognizing that mathematical exclusion operates as a form of social exclusion with consequences that extend across the life course. As Hirpa (2021) demonstrates in research on early childhood education in Ethiopia, exclusion from educational settings begins early and involves multiple agents – parents, educational institutions, and government bodies – whose decisions compound to create systematic barriers. This research establishes that exclusion is not merely an educational phenomenon but a social justice issue with implications for economic participation, civic engagement, and human development. Our review builds on this foundation by examining how mathematical exclusion specifically perpetuates these broader patterns of social marginalization, making visible the mechanisms through which abstract mathematical content becomes a tool for social stratification.

The questions guiding this critical systematic review reflect our commitment to uncovering both the possibilities and contradictions within inclusive mathematics education:

1. How do current theoretical frameworks for inclusive mathematics education address or obscure issues of power, privilege, and marginalization in teaching spatial concepts?
2. What do empirical studies reveal about the gap between inclusive education policies and the lived experiences of diverse learners in mathematics classrooms?
3. How do intersecting forms of oppression shape students' access to and success in learning mathematical concepts related to space and measurement?
4. What alternative visions and practices emerge when inclusive mathematics education is reimagined through a social justice lens?

Through this critical examination, we aim to move beyond cataloging best practices to fundamentally questioning whose interests are served by current approaches to inclusive mathematics education and imagining more just alternatives.

Theoretical framework: Toward a critical understanding of inclusive mathematics education

This section develops a critical theoretical framework that interrogates the limitations of traditional approaches to inclusive mathematics education and offers alternative lenses grounded in critical theory, disability studies, and intersectionality. Our framework challenges the dominant paradigms that treat inclusion as a technical problem while maintaining underlying power structures intact.

The limits of traditional frameworks

Mainstream approaches to inclusive mathematics education have largely operated within what Skovsmose (2014) terms the formatting power of mathematics, accepting without question the discipline's role in sorting and stratifying students. The dominant frameworks, while appearing progressive, often serve to maintain rather than challenge existing hierarchies.

Constructivist learning theory, despite its emphasis on active learning and prior knowledge, tends to individualize both success and failure in mathematics. When students struggle with spatial concepts like volume or area, constructivist interpretations often locate the problem in the individual's cognitive structures rather than interrogating how mathematical knowledge itself is constructed to privilege certain ways of thinking (Gutiérrez-Saldivia, Barría, & Tapia, 2020). This individualization obscures the collective and cultural dimensions of mathematical knowing, particularly for Indigenous students whose spatial reasoning may be grounded in fundamentally different epistemologies (Owens, 2023).

Similarly, while Vygotskian sociocultural theory acknowledges the social nature of learning, its application in inclusive mathematics education frequently reduces to technical questions about scaffolding without examining whose cultural tools are valued and whose are marginalized. Abtahi and Planas (2024) argue that the Zone of Proximal Development, when applied uncritically, can reinforce deficit perspectives by positioning some students as perpetually needing more support to reach normative standards rather than questioning the standards themselves.

Universal Design for Learning (UDL), despite its promise of creating accessible learning environments (Barna, Kuzminska, & Semerikov, 2025), often operates within what Cantley, Prendergast, and Schlindwein (2017) call a liberal multicultural framework that celebrates diversity without addressing structural inequities. The emphasis on multiple means of representation, engagement, and expression, while valuable, can become a form of what Martin (2019) terms inclusion without justice when it fails to challenge the fundamental assumptions about what counts as mathematical knowledge. As documented in recent research on ethnic and religious minorities in Nordic educational contexts (Midtbøen, Orupabo, & Røthing, 2014), even well-intentioned inclusive frameworks can perpetuate exclusion when they fail to interrogate the cultural assumptions embedded in mathematical curricula.

Critical theoretical perspectives

To develop a more robust understanding of inclusive mathematics education, we draw on critical theories that center questions of power, oppression, and resistance. These perspectives reveal how mathematics education functions not as a neutral terrain but as a site where social hierarchies are both reproduced and potentially disrupted.

Critical Disability Studies in Education (CDSE) offers a fundamental reframing of how we understand disability in mathematics classrooms. Rather than viewing disability as an individual characteristic requiring accommodation, this perspective examines how educational systems disable students through narrow definitions of mathematical competence (Parekh, 2023). Tan et al. (2022) demonstrate how the very structure of mathematics education, with its emphasis on speed, abstraction, and individual performance, creates disabilities by excluding alternative ways of engaging with mathematical concepts. This lens reveals how teaching volume through purely visual representations disables students who might understand three-dimensional relationships through tactile or kinesthetic exploration.

The integration of Critical Race Theory (CRT) illuminates how racial oppression intersects with ableism in mathematics education. Davis (2022) argues that the over-representation of Black and Latino students in special education mathematics classes cannot be understood without examining how racist assumptions about intellectual capacity shape identification and placement decisions. The teaching of geometric concepts often embodies what Martin (2009) calls a racial hierarchy of mathematical ability, where certain cultural approaches to spatial reasoning are devalued or rendered invisible.

Feminist and decolonial pedagogies provide additional critical lenses for examining inclusive mathematics education. Gonzalez, Lucas, and Battle (2023) demonstrate how gendered assumptions about spatial ability intersect with ableist notions of mathematical competence, creating multiple barriers for girls with disabilities in mathematics. Decolonial perspectives, as articulated by Nxumalo (2021), challenge the Eurocentric foundations of school mathematics, revealing how concepts like area and volume emerged from specific cultural contexts yet are presented as universal truths.

From individual deficits to structural violence

Building on Bourdieu's sociological framework, Jorgensen, Gates, and Roper (2014) demonstrate how school mathematics functions as a mechanism of structural exclusion, where success depends on possession of specific forms of cultural capital typically associated with middle-class backgrounds. This structural lens is further developed by Soto and Cantoral (2014), who employ the concept of "symbolic violence" to explain how academic mathematical discourse excludes students by imposing meanings and procedures that render their own mathematical knowledge invisible. Similarly, Vurayai (2020) reveals how mathematics problems in textbooks and examinations embed cultural assumptions that systematically disadvantage rural learners in Zimbabwe, illustrating how exclusion operates through seemingly neutral curricular materials.

The concept of "auto-exclusion" introduced by Kollosche (2019) provides crucial insight into how structural exclusion becomes internalized. Through analysis

of student interviews, Kollosche (2019) identifies six primary reasons why students reject mathematics: teacher personality, teaching styles, incomprehension, lack of self-discipline, perceived irrelevance, and epistemological objections. This self-exclusion represents not individual failure but a rational response to systemic barriers – what Rodrigues, da Rosa, and Manoel (2022) describe as the consequence of mathematics education that "disregards the concept of teaching all".

The social exclusion framework provides a particularly powerful lens for understanding mathematical exclusion. Hirpa (2021) conceptualizes educational exclusion through the lens of social exclusion theory, identifying three key elements: geographic residence (belonging to a community), denial of participation in normal activities, and factors beyond individual control that prevent participation. Applied to mathematics education, this framework reveals how students with disabilities are "geographically resident" in inclusive classrooms yet systematically denied meaningful participation in mathematical learning. Crucially, Hirpa (2021) identifies multiple agents of exclusion – parents, educational institutions, and government bodies – whose actions compound to create barriers. This multi-agent perspective enriches our understanding of how mathematical exclusion operates not through any single cause but through the interaction of sociocultural barriers, absence of early identification, resource scarcity, and governmental reluctance to enforce inclusive policies.

An integrated critical framework

Building on these critical perspectives, we propose an integrated framework for analyzing inclusive mathematics education that centers power relations and social justice (Fig. 1). This framework examines how multiple systems of oppression intersect to shape mathematical learning experiences and identifies spaces for resistance and transformation.

This framework illuminates several key insights that guide our analysis. First, it reveals how multiple systems of oppression operate simultaneously and intersectionally to shape students' mathematical experiences. A student who is labeled as having a learning disability, speaks a language other than English at home, and comes from a working-class background faces not simply additive challenges but qualitatively different barriers created by the interaction of ableism, linguicism, and classism (Cho, Lee, & Hernan-Patnode, 2022).

Second, the framework highlights how seemingly neutral educational practices serve as mechanisms through which oppression operates. The standard sequence for teaching area (rectangle $\rightarrow$ square $\rightarrow$ complex shapes) appears pedagogically sound but embodies cultural assumptions about linear progression and abstract thinking that may conflict with more holistic or contextual approaches to spatial understanding (Stavrou & Miller, 2017).

Third, it identifies the dialectical relationship between exclusion and stratification. Mathematical exclusion does not simply mean some students fail while others succeed; rather, the system requires failure to justify its sorting function. As Au (2016) argues, inclusive education under neoliberalism often means including more students in a system designed to rank and stratify rather than transforming the system itself.

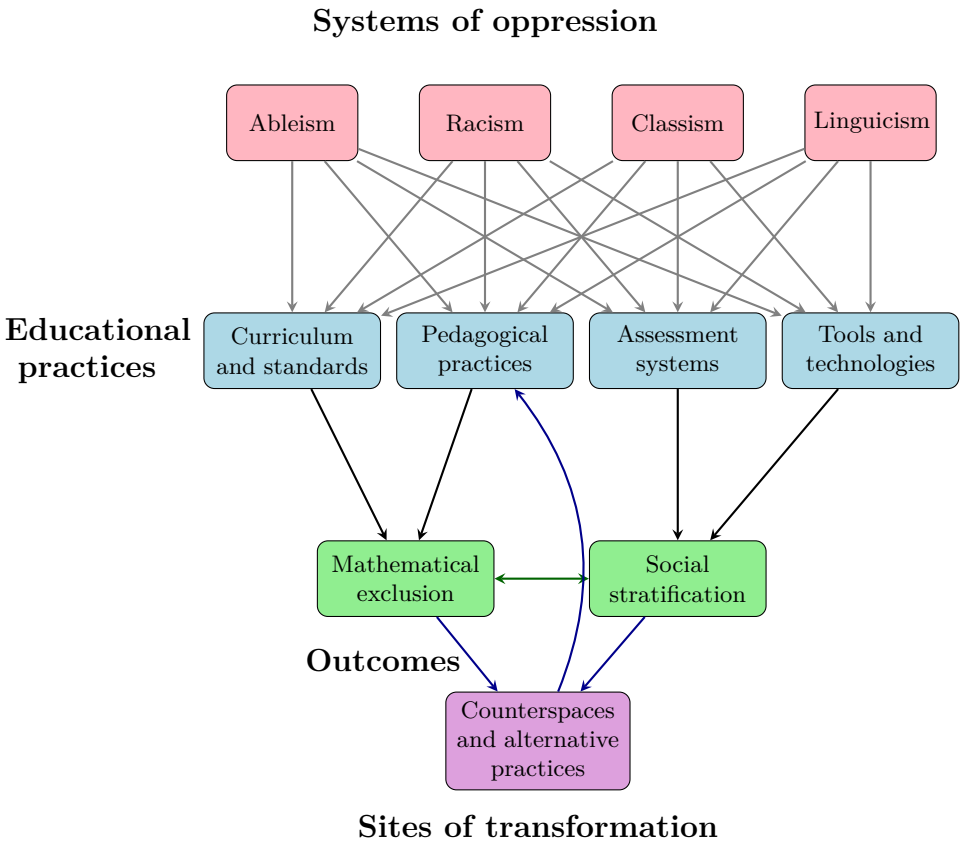

Figure 1 A critical framework for analyzing inclusive mathematics education: intersecting systems of oppression, educational practices, and possibilities for transformation.

Finally, and crucially, the framework recognizes spaces of resistance and transformation. Despite systemic oppression, students, teachers, and communities create counterspaces where alternative mathematical practices flourish (Ong, Smith, & Ko, 2018). These might include culturally sustaining mathematics programs that center Indigenous ways of knowing space and quantity, or student-led math circles where collaborative problem-solving replaces individual competition.

As we turn to examining the empirical literature on inclusive mathematics education, this critical framework serves as both a lens for analysis and a tool for imagining alternatives. It reminds us that every pedagogical choice, every curricular decision, and every assessment practice occurs within and potentially challenges or reinforces systems of oppression. Most importantly, it insists that truly inclusive mathematics education requires not just better methods but a fundamental reimagining of what mathematics education could be when oriented toward justice rather than selection.

Implications for analyzing inclusive mathematics education

This critical framework fundamentally shifts how we approach the analysis of inclusive mathematics education. Rather than asking whether certain strategies effectively help students with disabilities learn standard mathematics content, we interrogate how the content itself and the ways it is taught create or challenge disabilities. Instead of seeking best practices for inclusion, we examine how inclusive and exclusive practices are co-constructed through relations of power.

When examining research on teaching volume to diverse learners, for instance, our framework directs attention not only to the effectiveness of manipulatives or visual aids but to deeper questions. Whose spatial reasoning is privileged when volume is introduced through cubic units? How do assessment practices that emphasize quick calculation of volume formulas exclude students who understand three-dimensional relationships in other ways? What happens to students whose cultural backgrounds include rich traditions of spatial thinking that do not map onto school mathematics?

This theoretical orientation also shapes how we understand the relationship between policy and practice. Following Ball, Maguire, and Braun (2011), we view inclusive education policies not as neutral attempts to promote equity but as discursive practices that shape what can be said and done in mathematics classrooms. The gap between policy rhetoric of inclusion and classroom realities of exclusion is not simply a matter of implementation failure but reflects deeper contradictions in educational systems tasked with both promoting equity and maintaining social hierarchies.

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Methodology

Our methodological approach reflects a critical stance toward knowledge production in educational research. Rather than positioning ourselves as neutral observers cataloging effective practices, we acknowledge that the very act of conducting a systematic review involves choices about whose knowledge counts, which voices are heard, and what constitutes legitimate evidence (Lather, 2017). This section details our systematic approach while maintaining transparency about the inherent limitations and biases in academic knowledge production.

Search strategy and the politics of academic databases

The initial challenge in conducting this review involved recognizing that academic databases themselves embody particular worldviews about what constitutes valid knowledge. Our search strategy began with mainstream databases (Scopus, Web of

Science, ERIC) but quickly revealed their limitations. These databases privilege peer-reviewed articles from English-language journals, effectively excluding significant work published in other languages, in non-Western contexts, or through alternative venues such as community reports or practitioner publications (Connell, 2007).

To address these limitations while working within practical constraints, we employed a multi-pronged search strategy. Primary searches used combinations of terms related to mathematical content ("square*", "cube*", "area*", "volume*", "spatial reasoning"), educational level ("grade 5", "grade 6", "middle school", "elementary"), inclusion ("inclusive", "disabilit*", "special need*", "divers*", "marginali*"), and mathematics education ("teach*", "learn*", "instruction", "pedagog*"). However, recognizing that critical perspectives often use different vocabularies, we also searched for terms like "critical mathematics", "ethnomathematics", "disability studies", "social justice", and "equity" in combination with our mathematical concepts.

Beyond database searches, we employed what Demeter (2019) term "studying up and down" by examining citations in both directions – not only following references forward through citation tracking but also investigating whose work was being cited and whose was absent. This revealed patterns of citation politics where certain scholars, particularly those from the Global North writing in English, dominated reference lists while work by scholars from the Global South or those writing from explicitly critical perspectives appeared marginally if at all.

Inclusion criteria and the boundaries of legitimacy

Establishing inclusion criteria required grappling with fundamental questions about what counts as knowledge about inclusive mathematics education. Traditional systematic reviews often exclude non-empirical work, but doing so would eliminate crucial theoretical pieces that challenge the very foundations of inclusive mathematics education. Our criteria therefore evolved through an iterative process that balanced breadth with focus.

We included studies that met the following criteria:

1. Addressed teaching or learning of spatial/geometric concepts including but not limited to squares, cubes, areas, and volumes.
2. Involved students in grades 4-7 or ages 9-13 (expanded from 5-6 to capture transitional years).
3. Engaged with issues of inclusion, disability, diversity, or marginalization.
4. Were published between 2010 and 2025 in English (while acknowledging this as a limitation).
5. Offered either empirical data or theoretical frameworks relevant to inclusive mathematics education.

Importantly, we did not exclude studies based on methodological approach, recognizing that privileging certain methodologies (such as randomized controlled trials) often excludes research conducted with and by marginalized communities (Tuck & Yang, 2012). This decision meant including teacher narratives, participatory action research, and theoretical essays alongside experimental studies.

The screening process involved multiple rounds of review with attention to borderline cases that revealed our own assumptions. For instance, a study on culturally responsive geometry teaching that did not explicitly mention disability initially seemed outside our scope until we recognized how narrow definitions of inclusion perpetuate the false separation of disability from other forms of marginalization (Annamma, Connor, & Ferri, 2013).

Data extraction as interpretive practice

Rather than treating data extraction as a mechanical process of recording objective facts, we approached it as an interpretive practice requiring critical reflexivity. We developed a data extraction framework that captured not only surface features (authors, year, country, methods, findings) but also examined:

- Whose perspectives were centered (researchers, teachers, students, families, communities)?
- How disability and difference were conceptualized (deficit, difference, social construction)?
- What theoretical frameworks were explicit or implicit?
- Which students were rendered visible or invisible?
- How success was defined and measured?
- What alternatives to dominant practices were imagined?

This process revealed patterns in how inclusive mathematics education research constructs its subjects. Studies frequently described students through deficit language ("struggling", "at-risk", "low-achieving") even when purporting to take inclusive approaches. The passive voice often obscured who made decisions about students' placements or accommodations. Success was typically defined in terms of approximating "normal" performance rather than recognizing diverse ways of engaging with mathematics.

Quality appraisal beyond methodological hierarchies

Traditional quality appraisal tools embed assumptions about what constitutes rigorous research, often privileging experimental designs and large sample sizes while devaluing contextual, narrative, or participatory approaches. Rather than applying a single quality framework, we developed a multidimensional approach to quality that considered:

1. *Methodological coherence*: Did the methods align with the research questions and theoretical framework? A small phenomenological study exploring disabled students' experiences of learning volume concepts might offer crucial insights despite not meeting traditional standards for generalizability.
2. *Theoretical sophistication*: Did the study engage with theories of power, oppression, and resistance, or did it remain at the level of technical solutions? We valued studies that complicated rather than simplified the challenges of inclusive mathematics education.

3. *Ethical reflexivity*: How did researchers position themselves in relation to their participants? Studies where researchers acknowledged their own positionality and power received higher ratings than those presenting a view from nowhere.
4. *"Practical wisdom"*: Did the study offer insights that resonated with the complex realities of classrooms? We valued research that grappled with contradictions and constraints rather than presenting idealized scenarios.
5. *Transformative potential*: Did the study challenge existing systems or merely help them function more smoothly? Research that imagined alternative possibilities scored higher than that which accepted current structures as given.

This multidimensional approach revealed quality in unexpected places. A collaborative self-study by teachers working with recently arrived immigrant students offered profound insights into the intersection of language, disability labels, and mathematical learning despite its small scale and lack of control groups.

Analysis through a critical lens

Our analytical approach drew on techniques from critical discourse analysis and thematic synthesis while maintaining awareness of how these methods can reproduce the very patterns we sought to critique. Initial coding identified surface themes familiar from previous reviews: instructional strategies, assessment approaches, teacher preparation, technology use. However, deeper analysis revealed how these categories obscured more fundamental issues.

We therefore developed a two-level analytical framework. The first level engaged with the explicit content of studies – what they claimed to find about inclusive mathematics education. The second level examined the discursive work these studies performed – how they constructed problems and solutions, whom they positioned as agents or objects, and what possibilities they opened or foreclosed.

This dual analysis revealed striking patterns. Studies of technology in inclusive mathematics education, for instance, often presented tools as neutral solutions while obscuring how their design embodied particular assumptions about mathematical thinking. Research on differentiated instruction frequently individualized both problems and solutions, deflecting attention from systemic issues. Even studies employing social justice language sometimes reinforced deficit perspectives by positioning certain students as perpetually in need of help rather than as holders of valuable mathematical knowledge.

Synthesis as critical reconstruction

The final stage of synthesis involved more than summarizing findings; it required what Apple (2018) calls "critical reconstruction" – identifying not only what is but imagining what could be. We looked for patterns across studies but also attended to outliers and contradictions that revealed fissures in dominant narratives.

Our synthesis strategy involved three interconnected approaches:

1. *Mapping the terrain* – we identified dominant themes and approaches in the literature, examining how they related to broader educational and social trends.

This revealed, for instance, how the rise of neuroscience explanations for learning differences coincided with decreased attention to social and cultural factors.

2. *Excavating subjugated knowledges* – following Collins (2019), we searched for perspectives and practices that existed at the margins of the literature. This included attending to brief mentions of alternative approaches, footnoted critiques, and roads not taken in discussion sections.
3. *Imagining otherwise* – we used contradictions and tensions in the literature as productive sites for imagining alternatives. When studies reported that students with learning disabilities performed better in special schools than inclusive settings (Nikolić, Cvijetić, Branković, Đorđić, & Johnstone, 2020), rather than accepting this as evidence against inclusion, we asked what it revealed about current inclusive practices and how they might be transformed.

Limitations and reflexivity

Every methodological choice involves trade-offs and exclusions. As a systematic review analyzing 87 diverse studies, we faced particular challenges in synthesizing findings across different methodological approaches, cultural contexts, and theoretical frameworks. The heterogeneity of the included studies – ranging from large-scale quantitative assessments to small ethnographic case studies – made it impossible to provide standardized demographic information about all participants involved. Studies employed varying definitions of disability, different categorization systems for socioeconomic status, and inconsistent reporting of participant characteristics. This limitation reflects broader issues in educational research about how difference is categorized and reported.

By limiting our search to English-language publications, we undoubtedly missed important work from non-Anglophone contexts. Our focus on academic literature excluded the knowledge of practitioners and communities developing inclusive approaches outside formal research channels. The time constraints of a systematic review prevented the deep engagement with individual studies that their complexity warranted.

More fundamentally, even our critical approach operates within academic conventions that may inadvertently reproduce the very hierarchies we seek to challenge. The linear structure of a review article implies a coherence and progression that belies the messy, contested nature of inclusive mathematics education. Our position as university-based researchers shapes what we can see and say despite our efforts at reflexivity.

We offer these limitations not as disclaimers but as invitations for readers to engage critically with our analysis, to identify what we have missed or misrepresented, and to imagine beyond what we have been able to envision. The methodology of a critical systematic review, like inclusive mathematics education itself, must remain open to challenge and transformation.

Researcher positionality

As critical education researchers analyzing 87 studies from diverse contexts, we bring particular perspectives that shape our interpretation of the literature. Our research team consists of four scholars from Eastern European contexts, each bringing distinct but interconnected expertise to this analysis.

The first author (S.S.) specializes in educational technology and digital transformation, with experience examining how technological changes create both opportunities and barriers for inclusive education. Having worked across multiple post-Soviet educational systems, he brings awareness of how political and economic transitions shape educational inequality. The second author (P.N.) contributes expertise in chemistry education and has observed firsthand how mathematical prerequisites can become gatekeeping mechanisms in science education, particularly for students from linguistically diverse backgrounds.

The third author (T.V.) focuses on digital pedagogies and teacher education, bringing insights from working with pre-service teachers struggling to implement inclusive practices within standardized curricula. Her research on technology-mediated learning environments informs our analysis of how digital tools can both facilitate and hinder mathematical inclusion. The fourth author (I.M.) offers an international comparative perspective, having studied educational systems across Poland, Ukraine, and other European contexts, illuminating how different policy frameworks shape inclusive possibilities.

Collectively, we acknowledge our positions within academic institutions grant us certain privileges while potentially distancing us from classroom realities. None of us has direct lived experience of disability, which limits our understanding of ableist exclusion. Our Eastern European perspectives may also shape how we interpret Western-dominated literature on inclusive education. We address these limitations through careful attention to studies that center marginalized voices and through critical examination of our own interpretive assumptions throughout the analysis process.

Results: Mapping the landscape of inclusive mathematics education

The 87 studies that met our inclusion criteria reveal a complex landscape of inclusive mathematics education characterized by tensions, contradictions, and glimpses of transformative possibility. Rather than presenting a unified picture, these studies expose deep fractures in how inclusive mathematics education is conceptualized and enacted across different contexts. Our analysis organizes these findings through themes that illuminate how inclusive mathematics education operates as a site of both oppression and resistance.

Theme 1: The paradox of physical inclusion without epistemological access

This theme, appearing in 42 of the reviewed studies, reveals how students with disabilities are increasingly present in mainstream mathematics classrooms while remaining excluded from meaningful mathematical learning. The paradox manifests particularly acutely in the teaching of spatial concepts, where abstract representations create additional barriers beyond computational mathematics.

A dominant pattern across studies involves what Slee (2011) terms "the paradox of inclusion" – students with disabilities are increasingly present in mainstream mathematics classrooms while remaining excluded from meaningful mathematical learning. This paradox manifests particularly acutely in the teaching of spatial concepts, where the abstract nature of squares, cubes, areas, and volumes creates additional barriers.

Multiple studies document this pattern through different lenses. Cole, Murphy, Frisby, and Robinson (2023) found that students with disabilities in inclusive settings showed improved test scores compared to those in separate special education classrooms, yet classroom observations revealed these students were often engaged in parallel activities rather than participating in grade-level mathematics. During a unit on volume, for instance, while their peers explored the relationship between dimensions and cubic units, students with identified learning disabilities completed worksheets on basic multiplication facts – technically in the same room but accessing entirely different mathematics.

The research of Barr and Mavropoulou (2021) with adolescents with intellectual disabilities provides a particularly poignant illustration. Despite physical presence in inclusive classrooms, these students reported feeling like "visitors" rather than full participants in mathematics learning. One student's comment captures this experience: "I sit in math class, but it's not really for me. When they do the hard stuff about shapes and measuring, I do something else." Teachers in the study confirmed this pattern, acknowledging that they lacked strategies for making geometric concepts accessible while maintaining what they perceived as necessary academic rigor.

The Norwegian context provides particularly revealing examples of this paradox. Corral-Granados et al. (2023) document how even in schools with explicit inclusive policies and substantial resources, children from minoritized backgrounds experience systematic exclusion through pedagogical practices that fail to recognize their mathematical knowledge. Their study reveals how the Norwegian emphasis on "equality as sameness" creates a particular form of exclusion where difference is neither acknowledged nor accommodated, leaving students physically present but epistemologically absent from mathematical learning.

This surface-level inclusion extends to technological solutions marketed as promoting accessibility. Duncan, Holt, and Keenan (2023) analysis of mathematics education technology reveals how tools designed for inclusion often perpetuate exclusion by embedding narrow assumptions about mathematical thinking. Software for teaching area concepts, for example, typically relies on visual processing and fine motor skills for manipulating shapes, inadvertently excluding students with visual impairments or motor disabilities who might understand spatial relationships through other modalities.

This paradox of inclusion resonates with Mhlolo and Ntoatsabone's (2023) distinction between overt and covert exclusion in South African mathematics education. While policies embrace broad definitions of inclusion, practice reveals what they term a "narrow view" focused solely on disability, neglecting gifted learners and other forms of diversity. The shift from overt to covert exclusion means that while explicit tracking may disappear, subtle forms of marginalization persist through differentiated expectations and parallel curricula that maintain hierarchies while appearing inclusive.

Theme 2: The hidden curriculum of mathematical worth

Beyond explicit curricular content, 38 studies in our review reveal how hidden curricula operate to construct hierarchies of mathematical worth. These implicit messages about who belongs in mathematics intersect with existing social hierarchies of race, class, language, and ability.

Reinholz and Shah (2018) developed an innovative methodology called "equity analytics" to quantify participation patterns in mathematics discussions. Their analysis of classroom discourse about geometric concepts revealed that even in classrooms with experienced, equity-minded teachers, students with disabilities spoke 60% less frequently than their peers and were more likely to be asked procedural rather than conceptual questions. When discussing strategies for finding the area of irregular shapes, for instance, students without identified disabilities were asked to explain their reasoning while students with disabilities were asked whether they had "the right answer".

The hidden curriculum also operates through the organization of mathematical knowledge itself. Lambert, Hernández-Saca, and Mireles-Rios (2020) ethnographic work documents how the standard progression from two-dimensional to three-dimensional geometry privileges certain cognitive styles. Students who think holistically about spatial relationships – often including Indigenous students and those with autism – find their insights devalued when curriculum demands they first master area before approaching volume.

Theme 3: Technologies of normalization and resistance

Technology emerges as a contested terrain in 31 of the reviewed studies. While often presented as neutral tools for accessibility, our analysis reveals how educational technologies function as complex sites where normalization and resistance coexist.

The literature reveals how various technologies – both material and conceptual – function to normalize certain ways of being mathematical while marginalizing others. Yet within these same technologies lie possibilities for resistance and transformation.

Assessment technologies emerge as particularly powerful tools of normalization. Dahlstrom-Hakki and Alstad (2019) found that standardized assessments of geometric understanding systematically disadvantage students with disabilities through seemingly neutral design choices. Timed tests of area calculation, for instance, measure processing speed as much as mathematical understanding. Students who develop innovative strategies for finding area – such as decomposing shapes in unconventional

ways – often cannot complete enough problems to demonstrate their knowledge within time constraints.

Digital technologies present similar contradictions. While many studies critique educational technology for reproducing exclusion, others identify transformative possibilities. Keller, Hebeisen, and Brucker-Kley (2018) work with virtual reality for teaching three-dimensional geometry showed that when students with disabilities were involved in co-designing VR experiences, the resulting tools challenged conventional approaches to spatial thinking. Students with ADHD created "movement-based" explorations of volume where users physically walked through cubic units, while students with visual impairments designed haptic feedback systems for experiencing three-dimensional relationships.

Theme 4: Intersectional exclusions and the myth of single-axis inclusion

A critical finding emerging from 45 studies involves the failure of single-axis approaches to inclusion. When inclusive mathematics education addresses disability without considering race, class, gender, language, and other dimensions of difference, it fails to serve students navigating multiple forms of marginalization.

Tan et al. (2022) comprehensive analysis reveals how the overrepresentation of Black and Latino students in special education mathematics classes cannot be addressed through disability-focused interventions alone. Their study of 200 students labeled with learning disabilities in mathematics found that race was a stronger predictor of placement in restrictive settings than severity of mathematical difficulties. Black students with mild difficulties in understanding area concepts were more likely to be removed from general education mathematics than white students with more significant challenges.

The intersection of gender and disability creates particular barriers in spatial reasoning tasks. Gonzalez et al. (2023) found that girls with ADHD were systematically overlooked for both advanced mathematics opportunities and support services. Teachers perceived their difficulties with traditional instruction on geometric concepts as "lack of interest" rather than as a need for different approaches.

Socioeconomic status compounds these intersectional exclusions. Wei (2025) documented how students with disabilities from low-income families had significantly less access to the material resources that support spatial concept development – manipulatives, technology, and physical space for mathematical exploration. In one striking example, a school serving predominantly low-income students relegated special education mathematics to a converted storage room where there was literally no space for students to build three-dimensional models or use floor-sized area demonstrations.

Theme 5: Spaces of possibility: Counter-narratives and alternative practices

Despite overwhelming evidence of systemic exclusion documented across the reviewed studies, 23 papers also contain what Solorzano and Yosso (2001) terms "counter-stories" – narratives and practices that challenge dominant approaches to

inclusive mathematics education. These alternatives, though often marginal and under-resourced, point toward radically different possibilities.

Several studies document culturally sustaining approaches to mathematics that center ways of knowing typically excluded from school mathematics. Nxumalo (2021) describes an Indigenous mathematics program where students learn about area and volume through traditional practices of sustainable land management. Rather than abstract calculations, students engage with questions like "How do we measure the space needed for ceremony?" and "What does it mean for land to be 'full'?" This approach revealed sophisticated mathematical thinking among students who had been labeled as having mathematics learning disabilities in conventional classrooms.

Rubel, Lim, Hall-Wieckert, and Sullivan (2016) participatory action research with youth in New York City demonstrates how critical mathematics education can transform understanding of spatial concepts. Students investigated the unequal distribution of green space in their city, calculating areas of parks in different neighborhoods and volumes of shade provided by trees. This project positioned students with disabilities as researchers and activists rather than objects of intervention.

Community-based math circles provide another model of inclusive practice that challenges school-based hierarchies. Winful (2009) examines how math circles focused on "the process of discovery and open-ended exploration" create "cooperative (rather than competitive) environment[s]" where students "had the opportunity to interact with professional mathematicians and educators in an informal setting," providing alternatives to traditional classroom hierarchies for underserved students of color.

The persistence of exclusionary cultures despite equity-oriented reforms is documented by Louie (2017), who found that even teachers participating in ongoing professional development for equity unconsciously framed mathematics as fixed knowledge and positioned students as deficient. This finding challenges assumptions that inclusive education failures result from lack of teacher commitment or training, revealing instead how deeply embedded cultural patterns structure classroom interactions. As Fernandez-Blanco, Gorgal-Romaris, Núñez, and Conde–Lago (2024) demonstrate through their STEAM intervention with at-risk students, meaningful inclusion requires not just pedagogical adjustments but fundamental shifts in how mathematical knowledge itself is conceptualized – from abstract procedures to embodied, creative exploration.

Theme 6: Teacher agency and the politics of implementation

The role of teachers emerges as complex and contradictory across 52 studies. Teachers simultaneously function as agents of exclusion and potential allies in transformation, with their practices shaped by structural constraints, professional preparation, and personal beliefs about mathematics and ability.

Scherer and Bertram (2024) longitudinal study of pre-service teachers found that exposure to disability studies perspectives significantly shifted their approaches to teaching geometric concepts. Teachers who initially saw inclusion as "helping disabled students access normal mathematics" came to question normalcy itself.

However, structural constraints severely limit teacher agency. Büscher and Prediger (2024) found that even teachers committed to inclusive practices struggled with

contradictory demands. Pressure to cover curriculum standards, prepare for standardized tests, and maintain "rigor" forced compromises that undermined inclusion. Teachers reported particular stress around geometric units where the abstract nature of content combined with time pressure made meaningful inclusion nearly impossible.

Professional development emerges as a contested space where these tensions play out. Traditional approaches that train teachers in "strategies for including students with disabilities" often reinforce the notion that some students are problems to be managed. However, Nührenbörger et al. (2025) documents an alternative professional development model where teachers engage in collaborative inquiry about mathematics and disability. Rather than learning techniques, teachers examined their own mathematical autobiographies and investigated how concepts like area carry cultural assumptions. This approach led to fundamental shifts in practice, with teachers co-creating lessons with disabled students and families rather than simply adapting existing curriculum.

Theme 7: The neoliberal co-optation of inclusive discourse

A disturbing pattern identified in 28 recent studies (published 2015-2023) involves what Mitchell and Snyder (2015) terms the "neoliberal hijacking of inclusion." The language of inclusive education increasingly appears in policies and practices that maintain or intensify exclusion while appearing progressive. This co-optation manifests in the rise of "personalized learning" technologies that promise to meet every student's individual needs (Semerikov, Nechypurenko, Vakaliuk, Mintii, & Fadieieva, 2025).

Market-based reforms in education intensify these contradictions. Waitoller, Nguyen, and Super (2019) documents how school choice policies, promoted as increasing options for students with disabilities, actually concentrate these students in under-resourced schools. Charter schools advertising inclusive approaches often counsel out students whose mathematical difficulties might lower test scores.

The commodification of inclusion extends to professional development and curriculum materials. Roos (2019) ritically examines the concept of inclusion in mathematics education, focusing on how it is implemented and its limitations. She finds that many so-called inclusive solutions, such as surface-level adaptations (e.g., larger fonts or simplified language), fail to address deeper issues of mathematical knowledge and power. Teachers invest scarce resources in materials that promise inclusion while maintaining the same hierarchical structures that create exclusion.

Discussion: Toward a critical reconceptualization of inclusive mathematics education

The findings of this systematic review reveal that inclusive mathematics education, as currently conceived and practiced, operates within a fundamental contradiction. While purporting to provide equitable access to mathematical learning for all students, it simultaneously functions as a mechanism for sorting, stratifying, and excluding those whose ways of being and knowing do not align with dominant norms. This contradiction has far-reaching implications: when mathematics education fails to be truly

inclusive, it not only limits individual opportunities but also perpetuates broader patterns of social inequality, restricting access to STEM fields, economic mobility, and full participation in an increasingly quantitative society. This discussion synthesizes key insights from our analysis and proposes alternative frameworks for understanding and practicing inclusive mathematics education that center justice rather than assimilation.

Our findings align with and extend Louie's (2017) documentation of how a "culture of exclusion" persists even in equity-oriented settings. This culture operates not through explicit discrimination but through what Soto and Cantoral (2014) term "symbolic violence" – the imposition of mathematical meanings and procedures that render students' own knowledge invisible and invalid. The persistence of such violence despite inclusive policies reveals what Mhlolo and Ntoatsabone (2023) identify as the gap between policy formulations and realizations, where broad visions of inclusion narrow to deficit views focused solely on disability accommodation.

The phenomenology of mathematical exclusion

Understanding how exclusion is experienced requires attending to student perspectives and the affective dimensions of mathematical learning. Kollosche (2019) identifies a critical phenomenon of "auto-exclusion" where students actively reject mathematics as a form of self-protection. This withdrawal represents not inability but rather a response to humiliation, irrelevance, and epistemological conflicts with how mathematics was presented. The common statement "I'm just not a maths person" argues represents internalized exclusion rather than natural inclination (Kollosche, 2019).

This auto-exclusion must be understood within what Xenofontos (2025) theorizes as "affective atmospheres" of mathematics classrooms. Drawing on allegorical analysis through Dante's Inferno, Xenofontos identifies nine atmospheric conditions that generate exclusion: displacement (Limbo), disorientation (Lust), mechanical drill (Gluttony), grade-chasing (Greed), resistance (Wrath), doubt (Heresy), internalized failure (Violence), performance without understanding (Fraud), and withdrawal (Treachery). These atmospheres are not individual emotional states but collective conditions generated through institutional practices like timed testing, public performance, and linguistic policing.

The technology dimension adds another layer to exclusionary atmospheres. While Silva-Díaz, Carrillo-Rosúa, and Fernández-Plaza (2021) found that immersive virtual reality could positively impact scientific-mathematical attitudes among students in contexts of severe social exclusion, such interventions remain exceptions. More commonly, as our review reveals, technology functions to intensify surveillance and standardization rather than opening alternative pathways to mathematical understanding.

Beyond accommodation: Questioning the foundations of school mathematics

The dominant paradigm in inclusive mathematics education focuses on accommodating students with disabilities within existing structures – providing extra time,

simplified materials, or alternative formats while leaving the fundamental nature of school mathematics unquestioned. Our analysis reveals the limitations of this accommodation model, particularly in teaching abstract concepts like squares, cubes, areas, and volumes.

The work of Gutiérrez (2013) on "Rochelle's Rule" provides a framework for moving beyond accommodation. She argues that we cannot talk about equity in mathematics education without interrogating mathematics itself – its origins, purposes, and effects. When applied to inclusive education, this principle demands that we ask not "How can we help disabled students access the standard curriculum?" but rather "Whose interests does this curriculum serve, and what alternatives might better serve all students?"

Consider the teaching of volume, typically introduced through cubic units and formulas. This approach embodies particular cultural assumptions about space as empty, measurable, and subdividable – assumptions that may conflict with Indigenous understandings of space as relational and inhabited (Olawale, 2025). Students whose spatial reasoning develops through movement, touch, or relational thinking find their knowledge devalued not because it is less sophisticated but because it does not match the narrow band of thinking privileged in school mathematics.

The findings suggest that truly inclusive mathematics education requires what Gutstein (2006) calls "reading and writing the world with mathematics" – using mathematical tools to understand and challenge injustice while simultaneously critiquing those tools themselves. When students investigate the volume of accessible spaces in their school or the area of playground allocated to different activities, they engage with geometric concepts while questioning how space is distributed and controlled.

From individual deficits to systemic analysis

The medical model of disability, which locates problems within individual students, continues to dominate inclusive mathematics education despite decades of critique from disability studies scholars. Our findings reveal how this individual focus obscures systemic barriers and perpetuates exclusion even within ostensibly inclusive settings.

The overrepresentation of students of color in special education mathematics, documented across multiple studies in our review, cannot be understood through individual assessment but requires analyzing the interaction of racism and ableism in educational systems (Artiles, 2019). When Black and Latino students are disproportionately identified as having mathematical learning disabilities, the problem lies not in their brains but in assessment tools and pedagogical approaches that privilege white, middle-class ways of demonstrating mathematical knowledge.

Kim and Aquino (2017) concept of "disability as diversity" offers an alternative framework that positions variation in learning as natural and valuable rather than pathological. From this perspective, a student who understands area through movement and gesture rather than symbolic manipulation is not disabled by their neurology but by a system that recognizes only narrow forms of mathematical expression. This shift from individual remediation to systemic transformation has profound implications for practice.

Mathematical exclusion as social exclusion: Agents and mechanisms

Our analysis, informed by the social exclusion framework developed by Hirpa (2021), reveals that mathematical exclusion operates through identifiable agents and mechanisms that mirror broader patterns of social exclusion. Just as Hirpa (2021) identifies parents, educational institutions, and government bodies as agents of exclusion from early childhood education, our review demonstrates that mathematical exclusion similarly involves multiple actors whose decisions compound to create systematic barriers.

The socio-cultural barriers identified by Hirpa (2021) – including lack of awareness about the importance of education, misconceptions about the educability of children with disabilities, and fear of stigma – operate with particular force in mathematics education, where cultural narratives about "mathematical minds" and "natural ability" reinforce exclusionary beliefs. Teachers may unconsciously communicate that mathematics is "not for" certain students, parents may internalize messages that their children cannot succeed in mathematics, and educational systems may fail to provide the resources and training necessary for inclusive practice.

The absence of early identification mechanisms noted by Hirpa (2021) has particular relevance for mathematics education, where difficulties with foundational concepts in early grades compound over time. Students who struggle with spatial reasoning in grades 5-6 often carry forward unaddressed difficulties from earlier years, creating what appears to be intractable mathematical disability but is actually the cumulative effect of systemic failures to identify and support diverse learners.

Resource scarcity – another dimension of exclusion identified by Hirpa (2021) – manifests in mathematics education through inadequate materials for hands-on learning, insufficient professional development for teachers, and overcrowded classrooms that make differentiated instruction impossible. The governmental reluctance to enforce inclusive policies that Hirpa (2021) documents in Ethiopia finds parallels across educational contexts, where policies promising inclusion are undermined by inadequate funding, weak accountability mechanisms, and competing priorities that subordinate equity to efficiency.

Intersectionality as foundational rather than additive

Our analysis reveals the failure of single-axis approaches to inclusion that treat disability as separate from race, class, gender, language, and other dimensions of difference. Students navigate multiple, intersecting systems of oppression that create qualitatively different experiences than those predicted by examining any single identity category.

Hernández-Saca, Kahn, and Cannon (2018) provides a framework for understanding these intersections through the concept of "disability intersectionality". Rather than adding considerations of race or language to disability-focused interventions, this approach recognizes that disability itself is constituted differently across racial and cultural contexts. A Mexican-American student labeled with a mathematics learning

disability experiences not generic disability plus culture but a specific form of racialized disability shaped by linguistic discrimination, immigration status, and cultural distance from school mathematics.

The implications for teaching spatial concepts are significant. When curriculum assumes that all students share similar visual-spatial experiences and cultural references, it excludes not only students with visual impairments but also those whose spatial understanding is grounded in different cultural practices. A student who navigates space through sound, touch, or relational landmarks may struggle with area problems that assume visual grid-based thinking, experiencing a manufactured disability that intersects with cultural marginalization.

Technology as contested terrain

The role of technology in inclusive mathematics education emerges from our analysis as deeply contradictory – simultaneously holding potential for transformation and serving as a mechanism for more sophisticated forms of exclusion. This finding challenges both techno-optimist narratives of digital solutions and wholesale rejections of educational technology.

Critical examination of mathematics education technologies reveals how they embed particular assumptions about ability, normalcy, and mathematical thinking. Adaptive learning systems that track students into different pathways based on initial assessments often perpetuate low expectations for students with disabilities, denying them access to rich mathematical experiences (Philip, 2011). The promise of "personalization" masks algorithmic discrimination that would be illegal if performed by human teachers.

Yet our review also identified examples where technology, developed with and by disabled people, created new possibilities for mathematical engagement. The key difference lies in who controls the design and implementation of these tools. When students with disabilities co-create virtual reality experiences for exploring three-dimensional shapes, they challenge conventional assumptions about how spatial concepts should be represented and manipulated.

Hamraie and Fritsch (2019) framework of "crip technoscience" offers guidance for evaluating and developing mathematical technologies. Rather than asking whether a tool improves disabled students' performance on standard measures, this approach interrogates how technologies construct ability and disability, whose ways of knowing they privilege, and what possibilities they open or foreclose.

Economic dimensions of mathematical exclusion

The consequences of mathematical exclusion extend beyond educational settings to shape economic trajectories across the life course. While our review focuses on educational processes, understanding the full significance of mathematical exclusion requires acknowledging its economic dimensions. Research in financial mathematics demonstrates how uncertainty and risk accumulate over time in ways relevant to understanding educational exclusion. del Carmen Valls Martínez, Rambaud, and Segura (2018), in their analysis of savings operations subject to random termination, develop

mathematical models showing how the risk of early termination must be compensated through systematic adjustments – a framework with provocative parallels to educational trajectories.

Just as del Carmen Valls Martínez et al. (2018) demonstrate that savers facing uncertain completion of savings operations require a "risk quota" to compensate for the possibility that their investment period will be prematurely terminated, students facing the risk of exclusion from mathematical learning trajectories accumulate educational deficits that compound over time. The "random periods" in educational contexts are determined not by mortality tables but by the unpredictable points at which students are excluded from mathematical learning through tracking decisions, disciplinary actions, or the accumulated effects of inadequate support.

This economic lens reveals mathematical exclusion as an investment problem: educational systems that fail to provide inclusive mathematics education are, in effect, terminating students' educational "savings operations" prematurely, denying them the compound returns that accrue from continued mathematical learning. The implications for economic mobility are profound, as mathematical competence increasingly determines access to well-compensated employment, particularly in STEM fields. Understanding mathematical exclusion through this economic frame underscores the urgency of transformation: every year of exclusion represents not just lost learning but lost future returns that compound across the life course.

Teacher education as political practice

The preparation and professional development of teachers emerges as a crucial site for either reproducing or challenging exclusive practices in mathematics education. Our findings reveal that technical training in accommodation strategies, while necessary, is insufficient for creating truly inclusive mathematics classrooms.

Cochran-Smith, Gleeson, and Mitchell (2010) framework of teacher education for social justice provides direction for reconceptualizing teacher preparation. Rather than training teachers to implement inclusive strategies within existing systems, this approach prepares teachers as critical intellectuals who question those systems. In mathematics education, this means developing teachers who can interrogate why certain forms of mathematical knowledge are valued, how assessment practices create disabilities, and what alternatives might better serve all students.

The studies in our review that documented transformative teacher practices shared common elements. Teachers engaged with disability studies and critical mathematics education perspectives, examined their own mathematical autobiographies and assumptions, and collaborated with disabled students and communities as partners rather than objects of intervention. These teachers moved beyond asking "How can I help this student access the curriculum?" to "How can we co-create mathematical experiences that value diverse ways of knowing?"

Imagining otherwise: Principles for justice-oriented inclusive mathematics education

Drawing on findings from across our review and informed by critical theoretical perspectives, we propose principles for reimagining inclusive mathematics education oriented toward justice rather than assimilation:

1. *Mathematical pluralism* – rather than treating school mathematics as universal truth to which all students must gain access, recognize multiple mathematical systems and ways of knowing. When teaching area, this might mean exploring Indigenous practices of land measurement alongside Euclidean approaches, examining how different systems serve different purposes and embody different worldviews.
2. *Collective access* – move beyond individual accommodations to create learning environments where interdependence is valued. In exploring volume concepts, students might work in groups where different sensory modalities and cognitive approaches are necessary for collective success, challenging the myth of individual mathematical achievement.
3. *Critical mathematical literacy* – develop students' ability to use mathematics to read and challenge their world while simultaneously critiquing mathematical tools themselves. Students might investigate how standardized testing in geometry serves to sort and stratify while developing alternative assessment approaches that value diverse forms of spatial reasoning.
4. *Disability expertise* – position disabled students and communities as holders of valuable knowledge about mathematics and learning rather than as problems to be solved. Their insights about navigating space, understanding patterns, and creating meaning should inform curriculum and pedagogy for all students.
5. *Intersectional analysis* – address how multiple systems of oppression interact to shape mathematical experiences. This requires examining not generic inclusion but specific questions like how Black disabled girls experience geometry instruction or how Indigenous multilingual students navigate standardized mathematics assessments.
6. *Systemic transformation* – focus on changing structures, policies, and practices rather than remediating individuals. This might involve challenging tracking systems that separate students by perceived ability, questioning assessment practices that manufacture disability, and creating alternative spaces for mathematical engagement outside traditional classroom hierarchies.

These principles do not provide a new set of "best practices" to be implemented uniformly but rather offer guidance for locally developed approaches that respond to specific contexts and communities. They require ongoing struggle and negotiation, acknowledging that creating just mathematical spaces involves confronting powerful interests that benefit from current systems of exclusion.

The path forward: Contradictions and possibilities

This critical analysis reveals inclusive mathematics education as a site of intense contradiction – between rhetoric of equity and practices of stratification, between

celebrations of diversity and enforcement of conformity, between individual accommodation and systemic transformation. These contradictions are not merely problems to be solved but productive tensions that can generate new possibilities.

The teaching of spatial concepts in grades 5-6 represents a microcosm of these broader tensions. Abstract ideas about squares, cubes, areas, and volumes become concrete sites where decisions about curriculum, pedagogy, and assessment either reproduce or challenge existing hierarchies. Every choice about how to introduce volume, which representations to privilege, or how to assess understanding carries political implications for who belongs in mathematics.

Our review suggests that meaningful progress requires abandoning the fantasy of win-win solutions that benefit everyone without challenging anyone. Creating mathematical spaces where students with disabilities can thrive as full participants rather than tolerated guests requires confronting the interests served by current systems – the testing industry that profits from standardized assessments, the tracked curriculum that maintains social hierarchies, and the conception of mathematical ability that justifies unequal outcomes.

Yet within these constraints, students, teachers, and communities create spaces of possibility. The math circles where collaborative problem-solving replaces competition, the classrooms where students investigate spatial injustice in their communities, and the assessment practices that value diverse ways of demonstrating understanding all point toward what inclusive mathematics education could become when oriented toward justice.

The path forward requires both immediate actions within existing systems and long-term visions of transformation. Teachers can begin incorporating multiple ways of exploring geometric concepts while organizing with others to challenge standardized assessments. Researchers can document and amplify marginalized approaches to mathematical thinking while critiquing the systems that marginalize them. Communities can create alternative mathematical spaces while demanding that schools serve all students justly.

Most fundamentally, this analysis calls for a shift in how we understand the project of inclusive mathematics education – from a technical challenge of accommodation to a political struggle for justice, from helping disabled students succeed in mathematics as currently constituted to transforming mathematics education to serve human flourishing rather than social sorting. This transformation will not come easily or without conflict, but the experiences and insights of those currently excluded from mathematical communities point the way toward more just alternatives.

Implications for practice, policy, and research

The critical insights emerging from this systematic review demand more than minor adjustments to existing approaches; they call for fundamental reimagining of how mathematics education systems understand and enact inclusion. This section articulates specific, actionable implications for various stakeholders while acknowledging the political and practical challenges of implementing transformative change within current educational structures.

Transforming classroom practice

The findings reveal that inclusive mathematics teaching requires more than technical strategies – it demands a fundamental shift in how teachers understand mathematics, disability, and justice. Moving beyond surface-level accommodations toward transformative practice involves several interconnected dimensions.

Teachers must first interrogate their own mathematical autobiographies and the ways current systems have shaped their understanding of who belongs in mathematics. Professional development should create spaces for teachers to examine how their experiences of learning geometry, for instance, privileged certain ways of thinking while marginalizing others. This critical self-reflection forms the foundation for recognizing and valuing the diverse mathematical knowledge students bring to classrooms.

Curriculum design must shift from universal approaches that assume homogeneous learners to pluralistic frameworks that recognize multiple mathematical traditions and ways of knowing. When teaching area concepts, this means moving beyond the standard rectangle-to-complex-shapes progression to explore how different cultures understand and measure space. Indigenous approaches that see area as relational rather than absolute, embodied methods that understand space through movement, and artistic perspectives that connect area to design and aesthetics all offer valid mathematical insights that enrich understanding for all students.

Assessment practices require the most radical transformation. Current systems that measure individual performance against narrow standards manufacture disability by defining mathematical competence in exclusionary ways. Alternative assessment approaches might include collaborative problem-solving where groups demonstrate collective understanding of volume through multiple modalities, portfolio systems where students document their mathematical thinking over time using their preferred forms of expression, or community-based projects where spatial concepts are applied to address local concerns.

The organization of learning spaces and time must also change. The traditional classroom setup with individual desks facing forward embodies assumptions about how mathematical learning occurs – through individual reception of transmitted knowledge. Inclusive mathematics spaces might feature flexible arrangements that support movement and collaboration, stations where different ways of exploring concepts are simultaneously available, and extended time blocks that allow for deep investigation rather than rushed coverage of topics.

Policy transformation at multiple scales

Creating conditions for inclusive mathematics education requires coordinated policy changes from classroom to international levels. These changes must address both immediate needs and long-term structural transformation.

At the school and district level, policies must move beyond compliance-oriented inclusion toward justice-oriented transformation. This includes eliminating tracking systems that segregate students by perceived mathematical ability, as these systems consistently disadvantage students with disabilities, particularly those who are also marginalized by race, class, or language. Instead of separate tracks, schools might

implement heterogeneous grouping with rich tasks that allow multiple entry points and solution paths.

Resource allocation policies must be critically examined and restructured. Current systems often provide additional resources for students labeled with disabilities while maintaining under-resourced conditions that create academic difficulties. Justice-oriented policies would ensure all classrooms have materials for hands-on exploration of spatial concepts, technology that supports diverse ways of engaging with mathematics, and physical space that allows for movement and collaboration.

State and national education policies must address the contradictions between inclusion rhetoric and accountability systems that enforce exclusion. Standardized testing regimes that measure narrow mathematical skills against grade-level expectations fundamentally conflict with recognizing diverse developmental trajectories and ways of knowing. Alternative accountability systems might focus on growth in mathematical thinking broadly conceived, include multiple measures that value different forms of mathematical expression, and assess schools on their success in engaging all students rather than sorting them.

International frameworks like the Sustainable Development Goals must be leveraged to push beyond narrow conceptions of quality education. SDG 4's commitment to inclusive and equitable education provides a platform for challenging systems that exclude, but only if interpreted expansively. This means defining quality not as approximation to Western academic standards but as the development of diverse mathematical capabilities that serve human flourishing and social justice.

Teacher education and certification policies require substantial revision to prepare educators for justice-oriented inclusive practice. Current systems that add special education as a separate certification reinforce the notion that some students require fundamentally different approaches. Alternative models might integrate critical disability studies and inclusive pedagogies throughout teacher preparation, require extensive collaboration with disabled communities and scholars, and assess teacher readiness based on their ability to create learning environments where all students thrive.

Research directions for justice and transformation

The limitations and gaps identified in current research on inclusive mathematics education point toward needed directions for future inquiry. These research priorities must center the experiences and expertise of those most marginalized by current systems while maintaining rigorous scholarly standards.

Participatory and emancipatory research methodologies offer essential tools for understanding inclusive mathematics education from the perspectives of those it claims to serve. Future studies should be conducted with rather than on disabled students and their communities. This might involve disabled students as co-researchers investigating their own mathematical learning experiences, collaborative analysis of how school mathematics includes or excludes different ways of knowing, and community-led evaluation of what mathematical knowledge matters for their contexts.

Intersectional analyses must become standard rather than exceptional in inclusive mathematics education research. Studies should examine how disability intersects

with race, class, gender, language, and other dimensions of difference to create specific experiences of mathematical learning. This requires moving beyond additive models that treat these as separate variables to understand how they co-constitute each other in the context of mathematics education.

Research on alternative mathematical practices and spaces deserves significant expansion. While most studies focus on improving inclusion within conventional schools, we need more investigation of mathematical learning in community centers, social movements, and other spaces where different values and practices emerge. How do disability justice organizations engage with mathematical thinking? What mathematical knowledge develops in communities marginalized by school systems? These questions can reveal possibilities invisible within traditional research paradigms.

Longitudinal studies that follow students across transitions can illuminate how inclusive and exclusive practices compound over time. Rather than snapshot studies of single classrooms or interventions, we need research that tracks how early experiences with spatial concepts shape later opportunities and identities. Such studies should examine not just academic outcomes but also mathematical identity development, relationship to mathematical communities, and broader life trajectories.

Critical policy research must examine how inclusive education policies are subverted, co-opted, or transformed in practice. This includes analyzing how market-based reforms affect students with disabilities, tracking how resources allocated for inclusion are actually used, and documenting forms of resistance to exclusionary policies. Such research can inform both policy advocacy and grassroots organizing for educational justice.

Methodological innovation is needed to capture the complexity of inclusive mathematics education. Traditional research methods often reproduce the very hierarchies and exclusions they claim to study. New approaches might include crip time methodologies that reject normative timelines for data collection, multi-sensory methods that do not privilege written or verbal data, and collective analysis processes that value diverse interpretive perspectives.

Building movements for transformation

Perhaps most importantly, this review points toward the need for collective action that connects inclusive mathematics education to broader struggles for justice. Individual teachers implementing inclusive practices, while important, cannot overcome systemic barriers alone. Transformation requires building movements that connect educators, students, families, and communities in common cause.

Coalition building across different groups affected by mathematical exclusion can create powerful forces for change. Parents of students with disabilities, communities of color fighting racist tracking, and Indigenous groups asserting sovereignty over their mathematical traditions all share interests in transforming mathematics education. These coalitions can advocate for policy changes, create alternative educational spaces, and support each other in resistance to exclusionary practices.

The development of counter-institutions offers another strategy for transformation. Community math spaces that operate outside school hierarchies can model what inclusive mathematical learning might look like. These might include disability justice

math circles that center interdependence and collective problem-solving, culturally grounded programs that teach mathematics through traditional practices, or youth-led research projects that use mathematics to investigate and challenge injustice.

Documentation and dissemination of successful practices remains crucial, but must avoid the trap of seeking universal solutions. Instead of best practices to be replicated everywhere, we need rich descriptions of contextually grounded approaches that inspire local adaptation. Stories of transformation – a classroom where students co-create geometric investigations, a school that eliminates tracked mathematics courses, a community program where disabled youth teach mathematical concepts through art – can fuel imagination and action elsewhere.

Professional networks that support justice-oriented practice provide essential infrastructure for transformation. Teachers working toward inclusive mathematics education often face isolation and resistance within their schools. Networks that connect these educators across contexts can share resources and strategies, provide emotional and political support, and coordinate collective action for systemic change.

Finally, this work requires sustained commitment to the long struggle for justice. The transformation of mathematics education from a sorting mechanism to a tool for liberation will not happen quickly or easily. It requires patient organizing, strategic action, and the courage to imagine and create alternatives even within constraining conditions. The insights and experiences of those currently excluded from mathematics – their ways of understanding space, pattern, and relationship – offer glimpses of what mathematical communities could become when oriented toward collective flourishing rather than individual competition.

Specific recommendations for implementation

Based on our analysis of 87 studies, we offer concrete recommendations for different stakeholder groups seeking to transform inclusive mathematics education:

- For funding bodies:
  - Require all research proposals on inclusive education to include intersectional analysis examining how disability intersects with race, class, gender, and language
  - Prioritize funding for participatory action research that positions marginalized students as co-researchers rather than subjects
  - Support longitudinal studies tracking cumulative effects of mathematical exclusion across educational transitions
  - Fund development of alternative assessment tools that recognize diverse mathematical competencies
- For school administrators:
  - Conduct annual equity audits examining disaggregated data on mathematical participation and achievement
  - Eliminate tracking systems that segregate students by perceived mathematical ability
  - Provide weekly collaborative planning time for teachers to develop inclusive curricula

  - Establish partnerships with disability justice organizations and culturally specific community groups
  - Create physical spaces that support multiple modalities of mathematical exploration
- For teacher educators:
  - Integrate disability studies and critical race theory throughout mathematics methods courses
  - Require extended field experiences in schools serving marginalized communities
  - Develop courses explicitly addressing the politics of mathematical knowledge
  - Create opportunities for pre-service teachers to learn from disabled mathematicians and educators
- For policy makers:
  - Reform accountability systems to measure growth in mathematical thinking rather than standardized achievement
  - Fund universal design in curriculum development that begins with marginalized learners' needs
  - Mandate reporting of intersectional data on mathematical participation and outcomes
  - Support development of culturally sustaining mathematics curricula rooted in local communities

The implications outlined here are not a blueprint to be followed but an invitation to collective thinking and action. Each context requires its own analysis and strategy, developed through dialogue among all those affected by mathematical education. What remains constant is the recognition that inclusive mathematics education is not a technical problem to be solved but a site of political struggle where different visions of knowledge, community, and justice contend. Our choice is whether to maintain systems that exclude and stratify or to join in creating alternatives that honor the full diversity of human mathematical thinking.

Limitations and transferability

This systematic review, while comprehensive in scope, has several important limitations that readers should consider when interpreting and applying our findings. As a systematic review synthesizing 87 diverse studies, we faced inherent challenges in comparing findings across different methodological approaches, sample sizes, and cultural contexts. The heterogeneity of included studies – from large-scale quantitative assessments to intimate ethnographic investigations – made it impossible to conduct meta-analysis or provide standardized effect sizes. Different studies used varying definitions of inclusion, disability, and mathematical competence, complicating direct comparisons.

The reviewed studies employed inconsistent approaches to reporting participant demographics. While some provided detailed intersectional analyses, others used

broad categories or omitted demographic information entirely. This inconsistency reflects broader issues in educational research about how difference is categorized and whose identities are made visible or invisible. Consequently, we cannot provide a comprehensive demographic overview of all participants across the reviewed studies, limiting our ability to make definitive claims about specific subgroups.

By limiting our search to English-language publications, we undoubtedly missed important work from non-Anglophone contexts. Our focus on academic literature excluded the knowledge of practitioners and communities developing inclusive approaches outside formal research channels. The time constraints of a systematic review prevented the deep engagement with individual studies that their complexity warranted.

More fundamentally, even our critical approach operates within academic conventions that may inadvertently reproduce the very hierarchies we seek to challenge. The linear structure of a review article implies a coherence and progression that belies the messy, contested nature of inclusive mathematics education. Our position as university-based researchers shapes what we can see and say despite our efforts at reflexivity.

The applicability of our findings varies across contexts. The framework we propose may be most relevant to:

- Educational systems with formal inclusive education policies but persistent achievement gaps
- Contexts where standardized testing drives curriculum and pedagogy
- Schools serving diverse populations in terms of ability, race, language, and class
- Settings where teachers have some autonomy to modify curriculum and assessment

The framework may be less immediately applicable in contexts with:

- Highly centralized curricula with little room for teacher adaptation
- Severe resource constraints limiting material and human resources
- Cultural values that differ significantly from Western conceptualizations of disability and inclusion
- Educational systems without formal inclusive education mandates

Despite these limitations, we believe the critical questions raised by this review – about whose mathematical knowledge counts, how exclusion operates through seemingly inclusive practices, and what alternatives might be possible – have relevance across diverse educational contexts.

Future research directions

Our analysis, informed by recent work on exclusion dynamics (Kollosche, 2019; Louie, 2017; Xenofontos, 2025), reveals several critical areas requiring investigation:

1. *Auto-exclusion processes:* Building on Kollosche (2019), longitudinal studies should trace how students move from engagement to self-rejection, identifying intervention points where auto-exclusion might be interrupted.

2. *Atmospheric interventions:* Following Xenofontos's (2025) framework, research should develop and evaluate pedagogical approaches that deliberately cultivate inclusive affective atmospheres, examining how changes in tempo, assessment, and spatial arrangement affect collective feelings of belonging.
3. *Cultural capital and mathematical knowledge:* Extending Jorgensen et al. (2014) and Vurayai (2020), studies should document the specific forms of cultural capital privileged in spatial reasoning tasks and develop curricula that recognize diverse cultural approaches to understanding space and measurement.
4. *Persistence of exclusionary cultures:* Following Louie (2017), ethnographic research should examine why cultures of exclusion persist despite teacher commitment to equity, focusing on unconscious practices and institutional constraints.
5. *STEAM as inclusive practice:* Building on Fernandez-Blanco et al. (2024), intervention studies should explore how arts integration might provide alternative entry points to spatial concepts for marginalized learners.
6. *From overt to covert exclusion:* Extending Mhlolo and Ntoatsabone (2023), research should develop tools to identify and address covert forms of exclusion that operate beneath inclusive rhetoric.
7. *Student resistance as mathematical knowledge:* Research should reframe student resistance not as behavioral problems but as forms of mathematical critique that could inform more inclusive pedagogies.
8. *Multi-agent exclusion processes:* Building on Hirpa (2021), research should examine how multiple agents – parents, teachers, administrators, and policymakers – interact to produce mathematical exclusion, identifying leverage points where coordinated intervention could interrupt exclusionary patterns.
9. *Early identification and intervention:* Following the findings of Hirpa (2021) regarding the absence of early identification mechanisms, longitudinal research should develop and evaluate early identification protocols that recognize mathematical strengths in diverse learners rather than focusing solely on deficits.
10. *Economic trajectories and mathematical exclusion:* Research should examine the long-term economic consequences of mathematical exclusion, drawing on frameworks like those developed by del Carmen Valls Martínez et al. (2018) to model how educational "risk" accumulates across the life course and affects economic mobility.

Conclusion: Toward mathematical justice

This critical systematic review has revealed inclusive mathematics education as a profound paradox – a field that promises equity while often delivering more sophisticated forms of exclusion, that celebrates diversity while enforcing conformity, that speaks of access while maintaining gates. Through examining the teaching of squares, cubes, areas, and volumes in grades 5-6, we have seen how abstract mathematical concepts become concrete sites where educational justice is either advanced or denied.

The evidence assembled here tells a disturbing story. Despite decades of inclusive education policies and an international consensus around the right to education for all, mathematics classrooms continue to function as spaces where students are sorted, stratified, and excluded based on narrow conceptions of mathematical ability

that intersect with existing hierarchies of race, class, language, and disability. The students whose spatial reasoning does not match textbook progressions, whose understanding emerges through movement rather than symbols, whose cultural knowledge of shape and space is deemed irrelevant – these students experience not inclusion but a more subtle form of segregation that operates through the very structures claiming to support them.

Yet within this critique lies possibility. The math circles where collaboration replaces competition, the classrooms where students investigate spatial injustice, the communities creating their own mathematical practices – point toward what Love (2019) calls "abolitionist teaching" in mathematics. This is not reform that makes exclusionary systems function more smoothly but transformation that imagines and creates fundamentally different ways of doing mathematics education.

The theoretical framework developed through this review offers tools for this transformation. By centering intersectionality, we can see how singular approaches to inclusion fail students navigating multiple forms of marginalization. By employing critical disability studies, we can shift from accommodating individuals within unjust systems to transforming the systems themselves. By drawing on decolonial and feminist perspectives, we can recognize mathematics itself as culturally situated rather than universal, opening space for multiple mathematical traditions and ways of knowing.

The implications of this analysis extend far beyond mathematics education. As Martin (2019) argues, mathematics education is racial and political project that shapes life opportunities and social positions. When we exclude students from meaningful mathematical learning, we exclude them from fields that require mathematical thinking, from economic opportunities that demand quantitative literacy, and from participation in increasingly data-driven public discourse. More fundamentally, we deny them the opportunity to use mathematical tools to understand and transform their world.

This review's contribution lies not in providing solutions but in reframing problems. Rather than asking how to better include students with disabilities in mathematics as currently conceived, we ask how mathematics education might be transformed to serve justice. Rather than seeking strategies to help marginalized students approximate dominant mathematical performances, we explore how their knowledge and experiences might transform what counts as mathematical thinking. Rather than accepting that some students will inevitably struggle with spatial concepts, we interrogate how those concepts are constructed to create struggle.

The path forward requires courage – courage to acknowledge that inclusive mathematics education as currently practiced often fails those it claims to serve, courage to challenge powerful interests that benefit from exclusionary systems, and courage to imagine and create alternatives even when they seem impossible within current constraints. It requires recognizing that technical solutions, while sometimes helpful, cannot address fundamental issues of power and justice. Most importantly, it requires centering the wisdom of those currently excluded, trusting that their experiences and insights point toward more just possibilities.

Creating such possibilities requires more than research – it requires organizing, advocacy, and sustained struggle for educational justice. Yet research has a role to play in documenting exclusion, imagining alternatives, and providing tools for transformation. This review offers one such tool, a critical lens for seeing inclusive mathematics education not as a technical field concerned with strategies and accommodations but as a site of political struggle where different visions of knowledge, community, and justice contend.

The work ahead is difficult but necessary. In a world facing climate crisis, pandemics, and rising authoritarianism, we need all of our collective intelligence and creativity. We cannot afford to exclude anyone from mathematical thinking – not because mathematics is inherently valuable but because mathematical tools, critically employed, can help us understand and address our shared challenges. More fundamentally, creating mathematical communities where everyone belongs is part of creating a world where everyone belongs.

We close with an invitation and a challenge. To researchers: conduct studies that center the experiences of those most marginalized, that question rather than accept dominant frameworks, that imagine rather than merely critique. To teachers: create classrooms where different ways of mathematical thinking flourish, where assessment supports rather than sorts, where students use mathematics to read and write their world. To policymakers: craft policies that address systemic barriers rather than individual deficits, that resource transformation rather than accommodation, that measure justice rather than standardization. To communities: create your own mathematical spaces, assert your mathematical knowledge, refuse exclusion in all its forms.

The evidence assembled here, enriched by recent investigations of auto-exclusion (Kollosche, 2019), persistent exclusionary cultures (Louie, 2017), and affective atmospheres (Xenofontos, 2025), reveals mathematical exclusion as a multi-layered phenomenon operating simultaneously through structural arrangements, cultural patterns, and embodied experiences. The shift from overt to covert exclusion (Mhlolo & Ntoatsabone, 2023) means that inclusive mathematics education cannot be achieved through surface-level accommodations or good intentions alone. It requires confronting what Soto and Cantoral (2014) identify as the symbolic violence of academic mathematical discourse – the ways that school mathematics imposes particular meanings while erasing others.

Our analysis, informed by the social exclusion framework developed by Hirpa (2021), reveals that mathematical exclusion operates through identifiable agents and mechanisms that can be targeted for intervention. Understanding mathematical exclusion as a form of social exclusion – with its multiple agents, socio-cultural barriers, and compounding effects – points toward the need for coordinated, multi-level responses rather than isolated classroom interventions. The economic dimensions of this exclusion, as suggested by frameworks analyzing risk and uncertainty over time (del Carmen Valls Martínez et al., 2018), underscore that the stakes of mathematical exclusion extend across the life course, affecting not just educational outcomes but economic trajectories and life opportunities.

The transformation of mathematics education from a mechanism of exclusion to a practice of freedom will not come easily. In mathematics education, as in all struggles for justice, our liberation is bound together. The full inclusion of all students in meaningful mathematical learning is not a favor to the marginalized but a necessity for us all. The work begins now, in each classroom and community, as we build the world we need – one where every student's mathematical brilliance is recognized, valued, and nurtured.

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Contributions

Serhiy O. Semerikov led the conceptualization and critical theoretical framing of the review, developed the integrated framework connecting disability studies with mathematics education, and drafted the introduction, theoretical framework, and conclusion sections. Pavlo P. Nechypurenko designed and implemented the systematic search strategy, managed the article screening process, and led the methodological development including the critical approach to quality assessment. Tetiana A. Vakaliuk conducted the thematic analysis and synthesis of findings, developed the critical interpretation of inclusive practices and their contradictions, and authored the results and discussion sections. Iryna S. Mintii performed the critical discourse analysis of policy documents and research texts, created all figures and tables including the critical framework diagram, and contributed to the identification of counter-narratives and alternative practices. All authors participated in the iterative process of critical reflection throughout the review, contributed to the development of implications for practice and policy, and reviewed and approved the final manuscript. The collaborative nature of this work reflects our commitment to challenging individual authorship hierarchies while acknowledging each person's distinctive contributions.

Ethics declarations

Ethical approval

As a systematic review of published literature, this study did not require ethical approval. No human participants were directly involved in the research.

Competing interests

The authors declare that they have no competing interests that could have influenced the work reported in this paper.

Availability of data and material

The studies included in this systematic review are publicly available through their respective publishers or databases. The authors did not generate new primary data for this review.

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