

Challenges Related to Mathematics Education

Mr. Mohd Amir¹, Dr. Aftab Ahmad Ansari²

¹Research Scholar, Department Of Education, Aligarh Muslim University

²Associate Professor, Department Of Education, Aligarh Muslim University

Abstract:

Mathematics education continues to face persistent, multidimensional challenges that affect students' achievement, engagement, and long-term participation in STEM fields. Despite decades of research and reform efforts, a substantial proportion of learners struggle to develop deep conceptual understanding and positive mathematical identities. This review paper critically synthesises existing literature to examine four interconnected domains influencing mathematics learning: cognitive barriers, social and psychological factors, systemic and curricular issues, and instructional challenges. Research indicates that gaps in foundational knowledge and an overemphasis on procedural fluency hinder conceptual development (Kilpatrick, Swafford, & Findell, 2001; Lamon, 2020). Simultaneously, affective variables such as mathematics anxiety (Ashcraft, 2002; Hembree, 1990), fixed mindset beliefs (Dweck, 2006), and negative social stereotypes (Martin, 2009) significantly impair students' performance and engagement.

At the systemic level, rigid curricula and assessment-driven practices often prioritise rote learning over problem-solving and critical thinking (NCTM, 2014). Furthermore, inequitable access to qualified teachers and high-quality instructional resources exacerbates achievement gaps (Darling-Hammond, 2015). Instructionally, traditional lecture-based approaches and limited professional development opportunities restrict the implementation of student-centred pedagogies (Ball, Thames, & Phelps, 2008; Lester & Cai, 2016).

Drawing on theoretical perspectives including Cognitive Load Theory (Sweller, 1988), Constructivist Learning Theory (Vygotsky, 1978), Growth Mindset Theory (Dweck, 2006), and Culturally Relevant Pedagogy (Ladson-Billings, 1995), this review underscores the need for integrated reforms that address both cognitive and affective dimensions of learning. The paper argues that sustainable improvement in mathematics education requires systemic transformation encompassing curriculum design, inclusive pedagogical practices, formative assessment (Black & Wiliam, 1998), and continuous teacher professional development.

Keywords: Mathematics education, Mathematics learning difficulties, Mathematics Anxiety, Cognitive and Affective factors

1. Introduction:

Mathematics occupies a central position in contemporary education systems due to its foundational role in scientific reasoning, technological advancement, and economic development. Beyond its instrumental value, mathematics fosters logical thinking, analytical reasoning, and problem-solving abilities that are essential for informed citizenship. However, despite its recognised importance, mathematics remains one of the most challenging and anxiety-provoking subjects for students across educational contexts. Persistent underachievement, disengagement, and negative attitudes toward mathematics continue to raise concerns

among educators, policymakers, and researchers worldwide. Recent international reports further indicate that post-pandemic learning disruptions have intensified existing gaps in mathematical achievement, particularly among students from disadvantaged backgrounds, thereby reinforcing the urgency of addressing systemic and instructional challenges (OECD, 2022; UNESCO, 2023).

Research consistently demonstrates that students' difficulties in mathematics are multidimensional and cannot be attributed to a single cause. One significant factor is cognitive barriers arising from the cumulative nature of mathematical knowledge. Mathematics learning is hierarchical; understanding advanced concepts requires mastery of foundational ideas such as number sense, proportional reasoning, and fractions. Kilpatrick, Swafford, and Findell (2001) argue that mathematical proficiency comprises interrelated strands, including conceptual understanding, procedural fluency, strategic competence, adaptive reasoning, and productive disposition. When early conceptual gaps remain unaddressed, students often rely on memorisation rather than genuine understanding, leading to fragile knowledge structures that collapse under the demands of complex problem-solving. Lamon (2020) similarly emphasises that superficial treatment of fractions and ratios undermines long-term mathematical development, illustrating how procedural dominance can hinder deep comprehension. Contemporary studies also suggest that digital learning environments, while expanding access, may inadvertently encourage surface-level engagement when not supported by conceptual scaffolding (Lo & Hew, 2017).

In addition to cognitive challenges, psychological and affective factors significantly influence mathematics learning. Among these, mathematics anxiety has emerged as a well-documented barrier. Ashcraft (2002) defines mathematics anxiety as a feeling of tension or fear that interferes with mathematical performance. Empirical findings suggest that high levels of math anxiety reduce working memory capacity, thereby impairing problem-solving efficiency (Maloney & Beilock, 2015). Hembree's (1990) meta-analysis further indicates that math anxiety correlates negatively with achievement and positively with avoidance behaviours. Students who experience repeated failure may internalise beliefs that they are inherently incapable of succeeding in mathematics. Recent research continues to highlight the persistence of math anxiety in contemporary classrooms and underscores the importance of integrating socio-emotional learning approaches within mathematics instruction to mitigate its effects (Ramirez, Shaw, & Maloney, 2018).

These beliefs are closely linked to mindset theory. Dweck (2006) differentiates between fixed and growth mindsets, arguing that students who perceive intelligence as static are more likely to avoid challenges and interpret mistakes as evidence of low ability. In contrast, a growth mindset fosters resilience and persistence. Within mathematics education, the prevalence of fixed-ability narratives—such as the notion that mathematical talent is innate—can discourage sustained effort. Boaler (2016) contends that classrooms that emphasise speed, correctness, and competition reinforce such fixed beliefs, whereas environments that promote exploration and collaboration enhance students' mathematical identities. Recent scholarship further emphasises that fostering positive mathematical identities and agency is critical for sustaining engagement in increasingly diverse and technologically mediated classrooms (OECD, 2023).

Social and cultural dimensions further complicate the landscape of mathematics education. Martin (2009) highlights how systemic inequities and racialised narratives shape students' access to quality instruction and influence their mathematical experiences. Students from marginalised communities may encounter lowered expectations, limited instructional resources, and culturally disconnected curricula. Ladson-Billings (1995) argues that culturally relevant pedagogy can bridge this disconnect by integrating students'

lived experiences into the learning process, thereby enhancing engagement and meaning-making. Emerging research on equity-oriented mathematics education reinforces the importance of inclusive pedagogies that address structural disparities and support diverse learners' participation in mathematical practices (UNESCO, 2023).

At the systemic level, curriculum design and assessment practices often reinforce existing challenges. Many educational systems prioritise standardised testing, which tends to reward procedural fluency over conceptual reasoning. The National Council of Teachers of Mathematics (NCTM, 2014) advocates for balanced instruction that integrates conceptual understanding, problem-solving, and real-world application. Nevertheless, assessment-driven accountability structures frequently narrow instructional focus, limiting opportunities for inquiry-based learning and critical thinking. Recent policy analyses similarly call for competency-based curricula and formative assessment frameworks to better align evaluation practices with meaningful mathematical learning (OECD, 2022).

Instructional practices and teacher preparation also play a pivotal role in shaping student outcomes. Effective mathematics teaching requires not only content knowledge but also pedagogical content knowledge—the ability to represent mathematical ideas in ways that are accessible to learners (Ball, Thames, & Phelps, 2008). However, many teachers receive insufficient professional development in research-based strategies such as formative assessment, differentiated instruction, and collaborative problem-solving. Black and Wiliam (1998) demonstrate that formative assessment practices significantly enhance student achievement by identifying misconceptions and guiding instructional adjustments. However, such practices remain inconsistently implemented across classrooms. Contemporary research further highlights the need for sustained professional learning models that support teachers in integrating technology, inclusive practices, and evidence-based pedagogies in mathematics classrooms.

Theoretical perspectives provide further insight into these challenges. Cognitive Load Theory (Sweller, 1988) explains how excessive cognitive demands during instruction can overwhelm working memory, particularly when foundational knowledge is weak. Constructivist theory (Vygotsky, 1978) underscores the importance of social interaction and guided support within the learner's zone of proximal development. Together, these frameworks suggest that effective mathematics instruction must balance cognitive structure with interactive engagement.

Given the interplay among cognitive, affective, social, and systemic factors, addressing challenges in mathematics education requires an integrated, comprehensive approach. Isolated interventions targeting only curriculum, pedagogy, or mindset are unlikely to yield sustained improvement. Instead, reform efforts must align theoretical understanding with classroom practice and policy-level decision-making. By critically reviewing existing literature across these domains, this paper seeks to illuminate the complex mechanisms underlying students' struggles in mathematics and to contribute to ongoing discussions on transformative and inclusive reform in mathematics education. Future research should continue to examine the long-term implications of digital transformation and post-pandemic recovery initiatives for equitable mathematics learning opportunities.

2. Review Methodology:

This paper adopts a structured narrative review approach to synthesise and critically analyse existing research on challenges in mathematics education. While not a statistical meta-analysis, the review follows systematic procedures to ensure transparency, rigour, and conceptual coherence in identifying, selecting, and interpreting relevant literature. The objective is not merely to summarise prior studies but to integrate

theoretical and empirical findings across cognitive, psychological, systemic, and instructional dimensions of mathematics learning.

2.1 Search Strategy and Data Sources:

A comprehensive search of the scholarly literature was conducted across major academic databases, including ERIC (Education Resources Information Centre), JSTOR, Google Scholar, SpringerLink, and Scopus. Peer-reviewed journal articles, scholarly books, institutional policy reports, and seminal theoretical works were included to ensure both empirical grounding and conceptual depth.

Search terms were used in various combinations to maximise coverage and relevance. These included: mathematics learning difficulties, conceptual versus procedural knowledge, math anxiety, growth mindset in mathematics, cognitive load theory, constructivist mathematics instruction, teacher professional development in mathematics, curriculum reform, and equity in mathematics education. Boolean operators (AND, OR) were applied to refine results and filter discipline-specific publications.

The primary time frame for inclusion was 1990–2024 to ensure contemporary relevance. However, foundational theoretical works such as Vygotsky (1978) and Sweller (1988) were retained due to their enduring influence on educational psychology and instructional theory.

2.2 Inclusion and Exclusion Criteria:

To enhance scholarly rigour, explicit inclusion and exclusion criteria were established.

Studies were included if they:

Examined cognitive, affective, social, curricular, or instructional factors influencing mathematics learning.

Provided empirical findings, theoretical development, or policy-level analysis relevant to school mathematics education.

They were published in peer-reviewed journals or reputable academic presses.

Demonstrated methodological clarity and theoretical grounding.

Studies were excluded if they:

Focused exclusively on advanced mathematical theory without educational implications.

Lacked clear methodological or theoretical foundations.

They were opinion-based commentaries without empirical or conceptual support.

They were duplicative or outdated without continued scholarly relevance.

2.3 Analytical Framework

The selected literature was analysed using thematic synthesis. Initial coding involved identifying primary constructs, research findings, and theoretical perspectives across studies. Through iterative comparison and cross-analysis, four dominant and interrelated domains emerged:

Cognitive Barriers in Mathematics Learning

Psychological and Affective Constraints

Systemic and Curricular Limitations

Instructional and Teacher-Related Challenges

Rather than organising studies chronologically or author by author, this review synthesises the literature thematically to reveal structural relationships among these domains. Particular attention was given to areas of theoretical convergence and tension—for instance, the relationship between constructivist pedagogies (Vygotsky, 1978) and cognitive load considerations (Sweller, 1988), or the interplay between mindset-based explanations (Dweck, 2006) and broader structural inequities (Martin, 2009; Darling-Hammond, 2015).

2.4 Limitations of the Review

Although systematic procedures were followed, this review remains limited by its reliance on secondary data and published scholarship. As a narrative synthesis, it does not statistically aggregate effect sizes across studies. Additionally, a substantial portion of the reviewed literature originates from Western educational contexts, which may limit universal generalizability. Future empirical research is necessary to examine context-specific dynamics, particularly within diverse and developing educational systems.

Objectives:

1. To identify key challenges students, face in learning mathematics.
2. To explore psychological and social factors that influence students' performance in mathematics.
3. To examine issues related to mathematics education systems, including curriculum and teaching methods.
4. To investigate challenges in mathematics instruction and teacher preparation.
5. To propose suggestions for improving mathematics education through more effective teaching approaches.

3. Theoretical Framework:

Understanding challenges in mathematics education requires an integrative theoretical lens that accounts for cognitive processing, affective regulation, social context, and instructional design. This review draws upon five complementary yet occasionally tension-filled theoretical perspectives: Cognitive Load Theory, Constructivist Learning Theory, Growth Mindset Theory, the Affective Domain framework of mathematics anxiety, and Culturally Relevant Pedagogy.

Cognitive Load Theory (Sweller, 1988) provides a cognitive architecture for understanding why students struggle with complex mathematical tasks. The theory posits that working memory has limited capacity; when instructional design fails to manage intrinsic and extraneous cognitive load, learning efficiency declines. In mathematics classrooms, excessive procedural steps, symbolic density, and poorly sequenced instruction can overwhelm learners, particularly those with weak foundational schemas. This perspective shifts the explanation of failure from student deficiency to instructional design limitations. In contrast, Constructivist Learning Theory (Vygotsky, 1978) emphasises social interaction and guided participation within the learner's zone of proximal development. From this view, mathematical understanding is constructed through dialogue, collaboration, and scaffolded support. However, tension arises between constructivist minimal guidance approaches and cognitive load principles, which caution against excessive discovery learning for novices. This theoretical tension remains a central debate in mathematics pedagogy. Growth Mindset Theory (Dweck, 2006) introduces an affective-cognitive dimension, arguing that beliefs about intelligence shape persistence and engagement. In mathematics education, fixed-ability narratives can lead students to interpret difficulty as evidence of incapacity. However, mindset interventions alone cannot address structural inequities or curricular rigidity, highlighting the limits of purely psychological explanations.

The affective domain perspective, particularly research on mathematics anxiety (Ashcraft, 2002; Maloney & Beilock, 2015), further demonstrates that emotional states directly influence working memory performance. Anxiety is not merely a by-product of poor achievement; it actively constrains cognitive processing. Finally, Culturally Relevant Pedagogy (Ladson-Billings, 1995) situates mathematics learning within sociocultural power structures. It argues that students disengage when curriculum and instruction

fail to reflect their identities and lived experiences. This framework broadens the analysis beyond individual cognition to systemic inequality and representation.

Taken together, these theoretical perspectives underscore that a single domain cannot explain challenges in mathematics education. Cognitive processing, affective regulation, social identity, and instructional structure operate as interacting systems. A theoretically grounded reform agenda must therefore integrate, rather than isolate, these dimensions.

4. Thematic Critical Analysis of Challenges in Mathematics Education:

The literature reveals that challenges in mathematics education are not isolated phenomena but interconnected constraints operating across cognitive, affective, systemic, and instructional domains. A critical synthesis demonstrates that fragmented reform efforts fail precisely because these domains function as mutually reinforcing structures.

4.1 Cognitive Fragility and Procedural Dominance:

Research consistently identifies a structural imbalance between procedural fluency and conceptual understanding as a primary cognitive barrier (Kilpatrick, Swafford, & Findell, 2001; Lamon, 2020). While procedural knowledge is measurable and easily assessed, conceptual understanding requires relational thinking and structural insight. Educational systems driven by standardised testing often privilege speed and correctness, reinforcing algorithmic dependency rather than adaptive reasoning.

From a Cognitive Load Theory perspective (Sweller, 1988), superficial procedural instruction increases extraneous cognitive load. Students lacking coherent schemas must allocate working memory resources to fragmented rules, reducing capacity for problem-solving. However, constructivist approaches that advocate minimal guidance can similarly overload novice learners if scaffolding is insufficient (Kirschner, Sweller, & Clark, 2006). This theoretical tension exposes a central contradiction in reform discourse: calls for inquiry-based learning frequently ignore cognitive architecture constraints. Thus, the cognitive challenge in mathematics is not merely student deficiency but instructional misalignment.

4.2 Affective Constraints and Identity Formation

Mathematics anxiety operates as both a cause and a consequence of low achievement. Empirical evidence demonstrates that anxiety consumes working memory resources, directly impairing numerical processing (Ashcraft, 2002; Maloney & Beilock, 2012). However, affective barriers cannot be reduced to individual emotional deficits. Dweck's (2006) growth mindset framework explains how fixed-ability beliefs inhibit persistence, yet overreliance on mindset interventions risks individualising systemic problems.

Martin (2009) critiques deficit narratives that attribute underperformance solely to student attitudes, emphasising the role of racialised expectations and institutional inequities. Thus, anxiety and fixed mindset beliefs often emerge within structurally unequal environments. Culturally Relevant Pedagogy (Ladson-Billings, 1995) suggests that when mathematics instruction fails to reflect students' identities, disengagement becomes a rational response rather than a psychological flaw. The literature, therefore, indicates that affective constraints are socially embedded rather than purely cognitive.

4.3 Systemic and Curricular Reinforcement of Inequality

Curricular rigidity and accountability-driven assessment structures further entrench these challenges. The National Council of Teachers of Mathematics (NCTM, 2014) advocates conceptual coherence and problem-solving emphasis; yet, policy frameworks frequently incentivise procedural mastery due to assessment efficiency. Darling-Hammond (2015) highlights how inequitable access to qualified teachers and instructional resources exacerbates achievement gaps, particularly in marginalised communities.

A critical reading reveals a policy-practice contradiction: reform rhetoric promotes equity and reasoning, while institutional mechanisms reward compliance and speed. This structural misalignment undermines classroom-level innovation and perpetuates stratification.

4.4 Instructional Capacity and Professional Development

Effective mathematics instruction requires pedagogical content knowledge—the capacity to represent concepts flexibly and anticipate misconceptions (Ball, Thames, & Phelps, 2008). However, professional development initiatives are often episodic rather than sustained. Black and Wiliam (1998) demonstrate that formative assessment significantly enhances learning outcomes, yet its implementation demands institutional commitment and teacher expertise.

The literature suggests that instructional reform cannot succeed without systemic investment in teacher capacity-building. Absent sustained professional learning communities, curriculum reforms remain superficial and inconsistently enacted.

Integrated Insight

Collectively, these domains form a self-reinforcing cycle: cognitive gaps heighten anxiety; anxiety reduces performance; assessment structures privilege procedures; limited instructional support prevents conceptual repair; and systemic inequities magnify disparities. The evidence indicates that mathematics underachievement is not a singular problem but a complex adaptive system requiring integrated reform rather than isolated intervention.

5. Synthesis and Reform Implications

The preceding analysis demonstrates that challenges in mathematics education operate as an interconnected system rather than as isolated deficiencies within students or teachers. Cognitive gaps, affective barriers, systemic inequities, and instructional limitations reinforce one another in cyclical patterns. Therefore, reform strategies that target only a single dimension—whether mindset interventions, curriculum revision, or assessment restructuring—are unlikely to produce sustained improvement. A coherent and theoretically integrated reform framework is required.

5.1 Toward an Integrated Reform Model

A critical synthesis of the literature suggests four interdependent pillars necessary for meaningful transformation:

(1) Cognitive Coherence in Curriculum Design

Curriculum reform must prioritise conceptual coherence over procedural acceleration. Drawing on Kilpatrick et al. (2001), mathematical proficiency should be framed as the integration of conceptual understanding, procedural fluency, adaptive reasoning, and productive disposition. Instructional sequencing must align with Cognitive Load Theory (Sweller, 1988) to ensure that foundational schemas are consolidated before introducing abstraction. Reform must move beyond superficial calls for "conceptual learning" and instead embed cognitive architecture principles into curriculum design.

(2) Affective and Identity-Sensitive Pedagogy

Efforts to reduce mathematics anxiety and fixed mindset beliefs must be situated within socially responsive pedagogies. While growth mindset interventions (Dweck, 2006) may foster resilience, they are insufficient without addressing structural inequities. Culturally Relevant Pedagogy (Ladson-Billings, 1995) provides a pathway for aligning mathematical instruction with students lived experiences, thereby strengthening engagement and identity formation. Emotional safety, collaborative inquiry, and error-positive classroom cultures must become systemic norms rather than individual teacher initiatives.

(3) Assessment Reform and Accountability Alignment

A major structural contradiction identified in the literature is the misalignment between reform rhetoric and assessment practice. As long as standardised systems reward speed and procedural accuracy, classroom innovation will remain constrained. Assessment frameworks must incorporate reasoning, explanation, and conceptual transfer. Formative assessment practices (Black & Wiliam, 1998) should be institutionalised rather than treated as optional pedagogical enhancements. Policy coherence between curriculum goals and accountability systems is essential.

(4) Sustained Teacher Professional Development

Instructional transformation hinges on teacher capacity. Ball, Thames, and Phelps (2008) emphasise the importance of pedagogical content knowledge, yet professional development models often lack continuity and depth. Reform must shift from episodic workshops to sustained professional learning communities focused on lesson study, formative assessment, and culturally responsive strategies. Without systemic investment in teacher expertise, curriculum reforms risk superficial implementation.

5.2 Implications for Policy and Research

The synthesis indicates that mathematics underachievement is best conceptualised as a complex adaptive system in which cognitive, emotional, and structural variables interact dynamically. Policymakers must therefore adopt multi-level interventions that integrate curriculum design, teacher preparation, assessment alignment, and equity-focused funding models.

Future research should move beyond isolated variable studies and examine longitudinal interactions among cognitive development, affective identity formation, and institutional policy structures. Cross-cultural investigations are essential to contextualise reform within diverse educational systems.

Concluding Analytical Position

The literature does not support deficit-oriented explanations of mathematics failure. Rather, it reveals structural misalignments between theory, policy, and practice. Sustainable improvement in mathematics education requires systemic coherence—where cognitive science, sociocultural awareness, instructional design, and policy frameworks operate in alignment rather than contradiction.

Conclusion:

This study has critically examined the persistent and multidimensional challenges shaping mathematics education through cognitive, affective, systemic, and instructional lenses. The synthesis of literature demonstrates that students' struggles in mathematics cannot be reduced to isolated deficits in ability, motivation, or effort. Instead, they emerge from structurally interconnected dynamics involving fragile conceptual foundations, anxiety-mediated cognitive interference, curriculum rigidity, inequitable resource distribution, and inconsistencies in instructional capacity.

A central insight of this review is that fragmented reform efforts are insufficient. Cognitive restructuring without affective support fails to address identity formation; mindset interventions without structural equity remain superficial; curriculum redesign without assessment reform perpetuates misalignment; and teacher professional development without sustained institutional support limits implementation fidelity. The evidence, therefore, points toward the necessity of systemic coherence—where curriculum, pedagogy, assessment, and policy operate in theoretical and practical alignment.

Theoretical integration across Cognitive Load Theory (Sweller, 1988), Constructivist Learning Theory (Vygotsky, 1978), Growth Mindset Theory (Dweck, 2006), and Culturally Relevant Pedagogy (Ladson-

Billings, 1995) underscores that effective mathematics reform must simultaneously address cognitive architecture, emotional regulation, sociocultural identity, and instructional design. Mathematics education should be conceptualised not as a technical transmission of procedures, but as a cognitively structured, emotionally mediated, and socially situated practice.

Future research must move beyond single-variable investigations and adopt interdisciplinary, longitudinal approaches that examine how policy structures, teacher preparation models, and classroom practices interact over time. Only through integrated, theory-informed, and equity-oriented reform can mathematics education evolve from procedural compliance toward conceptual empowerment and inclusive excellence.

References:

1. Ashcraft, M. H. (2002). Math anxiety: Personal, educational, and cognitive consequences. *Current directions in psychological science*, 11(5), 181-185.
2. Ball, D. L., Thames, M. H., & Phelps, G. (2008). Content knowledge for teaching: What makes it special? *Journal of Teacher Education*, 59(5), 389–407.
3. Beilock, S. L., & Maloney, E. A. (2015). Math anxiety: A factor in math achievement not to be ignored. *Policy Insights from the Behavioral and Brain Sciences*, 2(1), 4-12.
4. Black, P., & Wiliam, D. (1998). Assessment and classroom learning. *Assessment in Education: principles, policy & practice*, 5(1), 7-74.
5. Boaler, J. (2016). Mathematical mindsets: Unleashing students' potential through creative math, inspiring messages and innovative teaching.
6. Darling-Hammond, L. (2015). *The flat world and education: How America's commitment to equity will determine our future*. Teachers College Press.
7. Dweck, C. S. (2006). *Mindset: The new psychology of success*. Random house.
8. Findell, B., Swafford, J., & Kilpatrick, J. (Eds.). (2001). *Adding it up: Helping children learn mathematics*. National Academies Press.
9. Hembree, R. (1990). The nature, effects, and relief of mathematics anxiety. *Journal for research in mathematics education*, 21(1), 33-46.
10. Hodges, C., Moore, S., Lockee, B., Trust, T., & Bond, A. (2022). The difference between emergency remote teaching and online learning. *Educational Technology Research and Development*, 70(1), 1–5.
11. Kirschner, P. A., Sweller, J., & Clark, R. E. (2006). *Why minimal guidance during instruction does not work: An analysis of the failure of constructivist, discovery, problem-based, experiential, and inquiry-based teaching*. *Educational Psychologist*, 41(2), 75–86.
12. Ladson-Billings, G. (1995). Toward a theory of culturally relevant pedagogy. *American educational research journal*, 32(3), 465-491.
13. Lamon, S. J. (2020). *Teaching fractions and ratios for understanding: Essential content knowledge and instructional strategies for teachers*. Routledge.
14. Lester Jr, F. K., & Cai, J. (2016). Can mathematical problem solving be taught? Preliminary answers from 30 years of research. *Posing and solving mathematical problems: Advances and new perspectives*, 117-135.
15. Lo, C. K., & Hew, K. F. (2017). A critical review of flipped classroom challenges in K-12 education: Possible solutions and recommendations for future research. *Research and practice in technology enhanced learning*, 12(1), 4.

16. Martin, D. B. (2009). Researching race in mathematics education. *Teachers College Record*, 111(2), 295-338.
17. National Council of Teachers of Mathematics. (2014). *Principles to actions: Ensuring mathematical success for all*. National Council of Teachers of Mathematics.
18. OECD. (2022). *Education at a glance 2022: OECD indicators*. OECD Publishing.
19. OECD. (2023). *Equity and inclusion in education*. OECD Publishing.
20. Ramirez, G., Shaw, S. T., & Maloney, E. A. (2018). Math anxiety: Past research, promising interventions, and a new interpretation framework. *Educational psychologist*, 53(3), 145-164.
21. Sweller, J. (1988). Cognitive load during problem solving: Effects on learning. *Cognitive Science*, 12(2), 257–285.
22. UNESCO. (2023). *Global education monitoring report 2023*. UNESCO.
23. Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Harvard University Press.