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Factors Affecting Mathematics Achievement Among Rural Students: A Scoping Review (2000–2025)

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ABSTRAK

Abstrak: Kesenjangan capaian matematika antara siswa perdesaan dan perkotaan masih menjadi isu global yang berdampak pada pemerataan kualitas pendidikan. Rendahnya prestasi matematika siswa perdesaan dipengaruhi oleh berbagai faktor yang saling berkelindan dan bersifat sistemik. Penelitian ini bertujuan untuk memetakan dan mensintesis faktor-faktor utama yang memengaruhi prestasi matematika siswa perdesaan berdasarkan literatur internasional periode 2000–2025. Penelitian menggunakan metode scoping review dengan kerangka Arksey dan O'Malley melalui penelusuran sistematis pada basis data ERIC, Scopus, Web of Science, dan Google Scholar. Analisis data dilakukan secara deskriptif dan tematik. Hasil kajian menunjukkan bahwa rendahnya capaian matematika siswa perdesaan dipengaruhi oleh keterbatasan kemampuan dasar, hambatan bahasa, praktik pembelajaran tradisional, minimnya dukungan keluarga, akses teknologi yang terbatas, kualitas pengajaran yang tidak merata, serta asesmen yang kurang diagnostik. Temuan ini menegaskan pentingnya pendekatan holistik dan kontekstual dalam meningkatkan pendidikan matematika di wilayah perdesaan.

Keywords:
Mathematics Achievement;
Rural Students;
Scoping Review;
Educational Inequality

Abstract: *The disparity in mathematics achievement between rural and urban students remains a global challenge affecting educational equity. Low mathematics achievement among rural students is shaped by interconnected and systemic factors rather than isolated causes. This study aims to map and synthesize key factors influencing rural students' mathematics achievement based on international literature published between 2000 and 2025. A scoping review methodology following the Arksey and O'Malley framework was employed through systematic searches of ERIC, Scopus, Web of Science, and Google Scholar databases. Data were analyzed using descriptive and thematic approaches. The findings indicate that rural mathematics underachievement is associated with weak foundational skills, language barriers, teacher-centered instructional practices, limited family support, restricted access to technology, uneven teaching quality, and non-diagnostic assessment practices. These interrelated factors contribute to the persistence of the rural–urban achievement gap. The study highlights the need for holistic, context-sensitive, and sustainable interventions to improve mathematics education outcomes in rural settings.*

A. INTRODUCTION

The global discourse on educational equity consistently emphasizes disparities in academic achievement between urban and rural populations, with mathematics emerging as one of the most critical areas of concern (Manalu & Chang, 2025). As a foundational discipline, mathematics underpins logical reasoning, problem-solving abilities, and access to higher education as well as STEM-related careers. Persistent underachievement in mathematics among rural students therefore represents not only

an educational issue but also a structural socio-economic challenge affecting national development and social mobility (Ogegbo & Aina, 2024). This phenomenon is not confined to a single country; rather, it is evident across both developing and developed nations, including Malaysia. International large-scale assessments have repeatedly demonstrated that rural learners lag behind their urban peers in mathematical performance, highlighting a systemic and enduring inequity. Addressing this gap is essential to ensuring inclusive and sustainable educational outcomes (Valverde, 2020).

Mathematics underachievement in rural contexts is inherently complex and multidimensional, shaped by an interplay of pedagogical, socio-cultural, linguistic, and infrastructural factors (Smith et al., 2025). Rural students often face constraints such as limited school resources, inadequate learning facilities, and socio-economic pressures that negatively influence both in-school and out-of-school learning environments. These challenges are frequently compounded by cultural norms and community perceptions that may deprioritize academic achievement, particularly in mathematics. Unlike urban learners, rural students may have fewer academic role models and reduced exposure to mathematics-related applications in everyday life. Consequently, their engagement with mathematics tends to be lower, reinforcing cycles of disengagement and underperformance (Kabuye Batiibwe, 2024). Understanding this complexity is crucial for designing meaningful and context-sensitive interventions.

A recurring theme in the literature is the weakness of foundational mathematical skills among rural students, which significantly impedes their progression to higher-level mathematical concepts. Walkington, (2025) Early difficulties with basic arithmetic operations and insufficient conceptual understanding of fractions, decimals, and percentages often create cumulative learning deficits. These foundational gaps typically originate in the early years of schooling and persist over time, widening achievement disparities as curricular demands increase. Closely related to this issue is the role of language in mathematics learning. Lailiyah et al. (2021) Limited proficiency in the language of instruction restricts students' ability to comprehend word problems, follow instructions, and articulate mathematical reasoning. In rural areas, where local dialects dominate daily communication, this linguistic mismatch presents a substantial barrier to effective mathematics learning.

Pedagogical practices and instructional quality further contribute to weak mathematics achievement in rural schools. Research indicates a continued reliance on traditional, teacher-centered approaches that emphasize rote learning rather than conceptual understanding. Such methods often lack interactive activities, manipulative materials, and the integration of educational technology that could enhance student engagement (Amani & Fussy, 2025). Instructional quality is also affected by structural challenges, including teacher shortages, frequent staff transfers, and the assignment of non-specialist teachers to mathematics subjects. These

conditions disrupt instructional continuity and limit the implementation of innovative teaching strategies. Moreover, assessment practices in many rural schools remain predominantly summative, offering limited diagnostic feedback to identify and address individual learning gaps in a timely manner (Di Felice, 2018).

The influence of early childhood education and the home learning environment is equally significant in shaping rural students' mathematics achievement. Many rural children have limited access to quality preschool education and numeracy-rich learning experiences prior to entering primary school. This lack of early exposure undermines cognitive readiness and places students at an initial disadvantage (Pietropoli & Gracia, 2025). At home, parental support for mathematics learning is often constrained by lower levels of formal education, limited time, and socio-economic pressures. In some cases, children are required to assist with household or income-generating activities, reducing time available for study . The absence of supportive learning environments outside school further exacerbates existing academic challenges.

Based on the foregoing discussion, a clear research gap emerges in the literature on mathematics achievement among rural students, particularly in the absence of a comprehensive and systematic synthesis that maps the multifaceted factors influencing rural learners' mathematical performance over an extended period and across diverse national contexts. Moreover, despite the growing body of empirical research on rural mathematics education, there remains a limited number of scoping review studies that critically examine the evolution of research findings from 2000 to 2025, identify dominant themes and methodological patterns, and highlight persistent gaps in the literature. Therefore, the objective of this study is to systematically map and synthesize the key factors affecting mathematics achievement among rural students based on international literature published between 2000 and 2025, to identify research trends and underexplored areas, and to provide evidence-based insights that can inform the development of more contextualized, inclusive, and sustainable instructional practices and educational policies for rural education systems.

B. METHODS

This study employed a scoping review methodology based on the Arksey and O'Malley scoping review framework, which is widely used to map the breadth and depth of research evidence on complex and heterogeneous topics (Esfandiari et al., 2025). This methodological approach was selected to systematically explore factors influencing mathematics achievement among rural students and to identify intervention strategies reported in the literature between 2000 and 2025. Data were collected through a comprehensive literature search across major academic databases, including ERIC, Scopus, Web of Science, and Google Scholar. The primary instrument in this study was a structured literature search protocol supported by predefined

inclusion and exclusion criteria, as well as a data charting form designed to extract key information such as study characteristics, contextual settings, identified factors, and intervention types related to rural mathematics achievement.

Data analysis was conducted using a combination of descriptive and thematic analysis techniques. Extracted data were systematically charted and organized into thematic categories representing recurrent factors contributing to weak mathematics achievement and commonly reported intervention approaches. A descriptive numerical analysis was used to summarize the distribution of studies across themes, research designs, and geographical contexts, while a narrative synthesis was applied to interpret patterns, relationships, and gaps within the literature. This analytical strategy enabled the integration of diverse forms of evidence, including empirical studies and policy reports, and facilitated a comprehensive understanding of how pedagogical, socio-cultural, linguistic, and structural factors intersect in rural mathematics education. The results were then synthesized to inform implications for educational practice, policy development, and future research directions.

C. RESULTS AND DISCUSSION

The systematic charting of data from the identified studies revealed a consistent pattern of factors contributing to weak mathematics achievement among rural students. These factors can be broadly categorized into student-level, teacher-level, home-environment level, and systemic/infrastructural challenges. The thematic synthesis of these results provides a comprehensive overview of the problem's complexity.

1. Student-Level Factors

The most frequently cited student-level factor was weak mathematical foundations. Numerous studies from various geographical contexts underscored that rural students often enter higher grades without a solid grasp of basic arithmetic operations, fractions, decimals, and percentages. This deficit was consistently linked to subsequent difficulties in algebra, geometry, and problem-solving, indicating a cumulative learning disadvantage (Wang et al., 2022). Closely related was the issue of limited early exposure to mathematical concepts. Studies highlighted that rural children often lack access to stimulating educational toys, informal numeracy activities, and quality preschool education, leading to inadequate cognitive readiness for formal mathematics at primary school entry. Another significant student-level factor was the negative math mindset and low self-efficacy. Research indicated that many rural students perceive mathematics as inherently difficult, abstract, or boring, leading to reduced motivation, increased anxiety, and a decreased willingness to engage with challenging tasks.

2. Teacher-Level and Pedagogical Factors

Traditional teaching methods were consistently identified as prevalent in rural schools, characterized by a didactic, chalk and talk approach with limited use of manipulatives, technology, or interactive activities. This instructional style was found to foster rote memorization rather than conceptual understanding and contributed to student disengagement. Linked to this was inconsistent teaching quality, particularly in regions facing teacher shortages or high teacher turnover. Studies revealed that mathematics might be taught by non-specialist teachers, or experienced teachers are frequently transferred, leading to a lack of sustained pedagogical expertise and professional development in rural schools (Ning et al., 2024). Limited family support emerged as a critical home-environment factor. Research highlighted that parents in rural areas often have lower formal education levels, limiting their capacity to assist with homework or reinforce learning. Socio-economic constraints frequently meant that homes lacked dedicated study spaces, educational resources, or parental time due to livelihood demands. Furthermore, the necessity for students to contribute to family work (e.g., farming, childcare) resulted in insufficient study time outside of school hours, reducing opportunities for revision and practice.

A pervasive language barrier was another recurring theme. For many rural students, the language of instruction in mathematics (e.g., Standard Malay or English) differs from their home language or dialect. This linguistic gap severely affected their comprehension of word problems and abstract mathematical concepts, even when they understood the numerical operations themselves.

3. Systemic and Infrastructural Factors

Restricted access to technology was widely reported as a significant infrastructural challenge. Rural schools and homes often lack reliable internet connectivity, computers, or tablets, limiting access to educational software, online resources, and digital learning platforms. This exacerbated learning disparities, particularly during remote learning periods. Finally, non-diagnostic assessment practices were identified as a systemic issue. General, summative assessments often failed to pinpoint specific learning gaps or provide timely feedback, meaning that students' fundamental misunderstandings could persist and accumulate without targeted intervention. In summary, the results indicate a complex web of interconnected factors contributing to the mathematics achievement gap in rural areas (Adom & Simatele, 2024). No single factor operates in isolation; rather, they interact to create a challenging learning environment. The identified factors highlight the need for comprehensive and integrated intervention strategies that address multiple dimensions of the problem, as will be discussed in the subsequent section.

The findings of this scoping review underscore the intricate and multifaceted nature of mathematics underachievement among rural students. The identified factors-ranging from foundational skill deficits and language barriers to pedagogical shortcomings, home environment constraints, and systemic infrastructural challenges-are not isolated but rather interact in complex ways, creating a reinforcing cycle of disadvantage. This discussion aims to interpret these findings, explore their interconnections, compare them with broader educational literature, and highlight implications for policy and practice. A key insight from this review is the strong interconnectedness of the identified factors. Forinstance, weak mathematical foundations are often exacerbated by traditional teaching methods that prioritize rote memorization over conceptual understanding, failing to address core misconceptions. If teachers predominantly use chalk and talk, students with pre-existing gaps in understanding are less likely to catch up. Furthermore, the language barrier compounds these issues, as students may struggle to understand the very instructions or conceptual explanations that could help them build their foundations, even if the pedagogy were otherwise effective. This linguistic challenge is particularly acute in mathematics, where precise terminology and problem interpretation are paramount.

The role of limited early exposure also cannot be overstated, as it sets the initial trajectory for mathematical development. Children starting school without a basic sense of number or logic are at an immediate disadvantage, which subsequent classroom experiences, especially with traditional teaching methods, may fail to rectify. This initial disadvantage is then perpetuated by limited family support and insufficient study time at home, which deprive students of crucial opportunities for reinforcement and practice outside school hours. The home environment, often burdened by socio-economic pressures, thus becomes a site where academic struggles are further entrenched.

The pervasive negative math mindset is both a cause and a consequence of these challenges. Students who consistently struggle due to foundational gaps, language barriers, or disengaging pedagogy are more likely to develop anxiety and a belief that mathematics is beyond their capability. This mindset, in turn, reduces motivation and engagement, creating a vicious cycle that makes overcoming difficulties even harder. Finally, restricted access to technology and non-diagnostic assessment practices represents systemic failures that prevent timely and tailored interventions. Without the digital tools that could offer personalized learning paths or diagnostic assessments that pinpoint specific areas of weakness, students' struggles often go unaddressed, allowing problems to accumulate.

4. Implications for Policy and Practice

The comprehensive understanding of these interconnected factors points towards several critical implications for policy and practice: Policies must prioritize high-quality, accessible early childhood education programs in rural areas that specifically focus on developing foundational numeracy skills and positive attitudes towards learning. Interventions should also target primary school years to address initial gaps before they become insurmountable (Englezos et al., 2023).

a. Context-Sensitive Pedagogy

Teacher training and professional development programs for rural educators must shift away from traditional methods towards more active, student-centered, and concept-driven approaches. This includes incorporating manipulatives, game-based learning, and problem-based learning (PBL) that make mathematics tangible and relevant. Training should also equip teachers to effectively manage linguistically diverse classrooms, potentially leveraging mother tongue instruction for initial concept understanding.

b. Holistic Support Systems

Efforts to improve mathematics achievement must extend beyond the classroom. This requires community engagement initiatives, parental workshops on supporting home learning, and programs that provide conducive study spaces and educational resources in rural communities. Recognizing and mitigating the impact of students' familial responsibilities on study time is also crucial.

c. Bridging the Digital Divide

Significant investment is needed to ensure equitable access to reliable internet connectivity and digital learning devices in rural schools and homes. Furthermore, training for both teachers and students on effectively utilizing educational technology for mathematics learning is essential.

d. Diagnostic and Formative Assessment

Assessment systems need to move beyond summative evaluations to incorporate robust diagnostic and formative assessments. These assessments should be used to continuously monitor individual student progress, pinpoint specific learning difficulties, and inform personalized instructional strategies.

e. **Addressing Teacher Quality and Retention**

Policies must address the systemic issues of teacher shortages and turnover in rural areas. This could include incentives for qualified mathematics teachers to work in rural schools, providing ongoing professional development tailored to rural contexts, and supporting specialist mathematics teachers.

f. **Fostering Positive Mindsets**

Educational interventions should actively work to cultivate a growth mindset among students and counter negative perceptions of mathematics. This can be

achieved through positive reinforcement, celebrating effort, and demonstrating the relevance and applicability of mathematics to real-world scenarios.

g. Comparison with Broader Literature

Findings from this review align broadly with international literature on educational disadvantage and mathematics education. Similar challenges regarding teacher quality, socio-economic status, and access to resources have been identified in rural or disadvantaged contexts globally. The emphasis on foundational skills, language, and mindset resonates with established cognitive and educational psychology principles. This reinforces the notion that while the specific manifestations may vary by context, the underlying mechanisms contributing to achievement gaps are often universal. However, the specific interplay and weighting of these factors in Malaysian rural contexts, particularly concerning the confluence of language issues with traditional pedagogy and technology access, provide nuanced insights. The insights gained from this discussion lead to the identification of critical research gaps and outline future directions, ensuring that subsequent efforts are well-informed and impactful.

D. CONCLUSION

This scoping review synthesizes studies published between 2000 and 2025 and concludes that weak mathematics achievement among rural students is a systemic and multidimensional problem shaped by the interaction of numerous factors rather than a single determinant. Deficiencies in foundational mathematical skills, language barriers, traditional and teacher-centered instructional practices, limited early childhood exposure, inadequate family and home learning support, restricted access to technology, insufficient study time, negative mathematical mindsets, inconsistent teaching quality, and non-diagnostic assessment practices collectively create an unfavorable learning ecosystem for rural learners. These interconnected challenges reinforce one another and contribute to the persistence of the rural–urban mathematics achievement gap, indicating that isolated or short-term interventions are unlikely to produce sustainable improvements.

Accordingly, future efforts to address rural mathematics underachievement should adopt holistic, integrated, and context-sensitive approaches that simultaneously strengthen early childhood education, enhance teacher pedagogical capacity, promote effective assessment practices, foster strong home–school partnerships, and ensure equitable access to educational technology. Future research is recommended to focus on longitudinal and experimental studies that evaluate the long-term effectiveness of comprehensive intervention models, as well as on the development of scalable and culturally responsive strategies tailored to the socio-cultural and infrastructural realities of diverse rural communities.

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