

Difficulties in Learning Mathematics: A Systematic Review

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ABSTRACT

This write-up from a systematic review of research approach focuses on the difficulties of students in learning Mathematics. Findings show that difficulties include conceptual understanding and cognitive barriers, mathematics anxiety, ineffective teaching methods, socio-cultural factors and access to resources.

Keywords: difficulties, learning, Mathematics

INTRODUCTION

Mathematics is a fundamental subject that is crucial for developing logical reasoning, problem-solving skills, and analytical thinking. Learning mathematics is crucial because it develops critical thinking and problem-solving skills that are applicable in everyday life and a wide range of professions. It enhances logical reasoning, enabling individuals to approach complex situations methodically and make informed decisions. Mathematics also plays a foundational role in science, technology, engineering, and economics, making it essential for innovation and progress in these fields. Moreover, understanding mathematical concepts fosters analytical abilities that help people interpret data, recognize patterns, and think abstractly, skills that are increasingly valuable in our data-driven world.

Many students struggle with the way mathematics is taught, which often emphasizes memorization and repetitive practice over conceptual understanding. This approach can cause students to feel disconnected from the subject, leading to a lack of motivation and engagement. Additionally, students may struggle to see the relevance of mathematics to real-life situations, further diminishing their interest and persistence in learning the subject (Boaler, 2016).

Emotional factors also play a significant role in students' difficulties with mathematics. Math anxiety, a widespread phenomenon, can create a psychological barrier that prevents students from performing well. Ashcraft and Moore (2009) argue that students who experience high levels of anxiety during math tasks often have reduced working memory capacity, which hampers their ability to solve problems effectively. This can create a vicious cycle, where poor performance increases anxiety, and anxiety, in turn, leads to further academic struggles. Environmental factors, such as a lack of supportive learning environments or insufficient access to quality math instruction, further compound these difficulties, leaving many students feeling frustrated and defeated when trying to learn mathematics.

With the abovementioned, Mathematics remains one of the most challenging subjects for students worldwide. Several factors contribute to the difficulties students face in learning mathematics, ranging from cognitive barriers to environmental and instructional challenges. This research paper aimed to explore the various difficulties students encounter in learning mathematics, including conceptual understanding, anxiety, teaching methods, and socio-cultural factors.

Research Question

What are the difficulties encountered by students in learning Mathematics?

METHODOLOGY

This study utilized a review of related literature approach analyzing findings of existing studies. This is a critical approach in research that involves systematically analyzing previous studies and scholarly works relevant to a specific topic or research question. The primary objective of the Review of Related Literature (RRL) is to identify gaps in the existing body of knowledge and provide a context for the current study. According to Creswell (2014), an effective literature review enables researchers to build on the foundations of previous work, preventing redundancy and fostering the development of new insights. By synthesizing related studies, researchers can also identify trends, theoretical frameworks, and methodologies that inform their own research design. Furthermore, a comprehensive literature review helps in defining the scope of a study, ensuring that the research problem is clearly understood within the context of what is already known.

Another important function of the RRL is to critically evaluate and compare the findings of previous research. Ridley (2012) argues that this critical assessment allows researchers to assess the validity, reliability, and relevance of existing studies, which can shape the direction of new investigations. A well-structured RRL also helps identify conflicting viewpoints or inconsistencies in the literature, which may warrant further exploration. In addition, it provides the theoretical foundation necessary to justify the significance of a study, guiding researchers in the formulation of hypotheses and research questions. By carefully reviewing related literature, scholars not only situate their work within the broader academic discourse but also contribute to the cumulative advancement of knowledge in their respective fields.

RESULTS AND DISCUSSION

The following were findings from different studies that reveal the different difficulties in learning Mathematics.

Difficulties in Learning Mathematics

Matrix 1. Difficulties in Learning Mathematics

Issue	Proponent
Conceptual Understanding and Cognitive Barriers	Rittle-Johnson & Schneider (2015)
	Alloway & Passolunghi (2011)
	Waswa & Al-kassab (2023)
	Acharaya (2017)
Mathematics Anxiety	Ashcraft & Krause (2007)
	Ramirez et al. (2013)
	Mangarin & Gonzalo (2024)
Ineffective Teaching Methods	Boaler (2016)
	Hiebert & Grouws (2007)
	Waswa & Al-kassab (2023)
	Acharaya (2017)
	Darling-Hammond (2010)

Socio-Cultural Factors and Access to Resources	Cimpian et al. (2016)
	Waswa & Al-kassab (2023)
	Acharaya (2017)

Conceptual Understanding and Cognitive Barriers

A major challenge students face in mathematics is the absence of a thorough conceptual understanding. Often, students concentrate on memorizing formulas and procedures without truly comprehending the fundamental concepts (Rittle-Johnson & Schneider, 2015). This shallow grasp of the material limits their ability to apply mathematical principles to unfamiliar problems, causing difficulties with tasks that deviate from routine exercises. For instance, students might find it hard to solve word problems that require them to apply their knowledge of operations to real-life scenarios.

Research indicates that working memory capacity is closely linked to mathematical performance, with students who have lower working memory skills often facing challenges in arithmetic and problem-solving tasks (Alloway & Passolunghi, 2011). Additionally, the abstract nature of mathematical concepts exacerbates these cognitive difficulties, making it harder for students to visualize and fully understand the information.

Further, Waswa and Al-kassab (2023) also emphasized that learners innate cognitive abilities contribute to learning difficulty of students in Mathematics. In addition, Acharaya (2017) emphasized that lack of prior knowledge of the student creates problems to study mathematics. Lack of student's labor in learning mathematics learning is also contributing factor for this.

Mathematics Anxiety

Another significant challenge students encounter is mathematics anxiety, which considerably affects their learning and performance. This anxiety is marked by feelings of tension, fear, and unease when tackling mathematical tasks. Students experiencing high levels of math anxiety often face cognitive interference, making it difficult for them to concentrate on the task and diminishing their problem-solving abilities (Ashcraft & Krause, 2007). This anxiety can create a self-perpetuating cycle, where poor performance increases anxiety, making it harder to improve.

Research indicates that mathematics anxiety often starts early and can be influenced by negative experiences with math teachers, performance pressure, and comparisons with peers (Ramirez et al., 2013). Students with math anxiety are more likely to avoid math-related tasks, which impairs their learning and widens the gap in their mathematical knowledge over time.

Mangarin and Gonzalo (2024) found that students in the Philippines exhibit a moderate level of negative attitudes towards mathematics, showing moderate negative emotions during assessments and exams, and being influenced by others in developing these negative attitudes.

Ineffective Teaching Methods. The methods used to teach mathematics greatly influence students' learning outcomes. Traditional approaches that focus on lectures, rote memorization, and repetitive exercises often fail to engage students in meaningful learning and do not foster a deep understanding of mathematical concepts or the development of critical thinking and problem-solving skills (Boaler, 2016). When students passively receive information, they are less likely to retain and apply their knowledge effectively.

Research shows that inquiry-based learning, which encourages students to actively engage through exploration, questioning, and problem-solving, results in more effective learning outcomes in mathematics (Hiebert & Grouws, 2007). Nonetheless, many educators lack the necessary training or resources to implement these strategies, leading to continued reliance on traditional, lecture-based instruction. This can be particularly detrimental for students who benefit from more interactive and hands-on learning experiences.

Hamukwaya and Haser (2021) highlighted the need for teacher education programs to enhance preservice teachers' awareness of how their knowledge, practices, and beliefs about math learning difficulties might impact students' outcomes.

Additionally, Waswa and Al-Kassab (2023) found that both instructors and instructional materials contribute to difficulties in learning mathematics, while Acharya (2017) noted that teacher-related factors are a key reason for low pass rates in secondary-level math.

Socio-Cultural Factors and Access to Resources. Socio-cultural factors significantly affect students' ability to learn mathematics. Those from low-income backgrounds or attending underfunded schools often face limited access to quality math education. Such schools may lack essential resources like up-to-date textbooks, technology, and skilled teachers, all of which are vital for effective math instruction (Darling-Hammond, 2010). This scarcity of resources (human, financial, and material) exacerbates the achievement gap between students from different socio-economic backgrounds, leading to inequities in mathematical achievement.

Cultural attitudes towards mathematics also impact students' engagement and success. In some cultures, there is a prevalent belief that mathematics is inherently difficult and that only certain individuals are naturally "gifted" in the subject (Cimpian et al., 2016). This fixed mindset can deter students from exerting effort in learning math, as they may think their abilities are fixed. Promoting a growth mindset, where students recognize that their skills can improve with effort and practice, is crucial for overcoming these socio-cultural challenges.

Additionally, Waswa and Al-Kassab (2023) identified external factors such as overcrowded classrooms, fear and anxiety, and weak foundational knowledge as contributors to difficulties in learning mathematics.

Ways Forward

To address the difficulties in learning mathematics, a comprehensive strategy is needed that targets enhancing conceptual understanding, addressing cognitive obstacles, and overcoming socio-cultural barriers. Initially, educational methods should prioritize deep conceptual learning over mere rote memorization. This can be accomplished by incorporating inquiry-based learning techniques that prompt students to investigate mathematical concepts, pose questions, and apply their knowledge to real-life scenarios. Such an approach helps students develop a more profound understanding of mathematical principles and improves their ability to tackle a variety of problems.

Moreover, addressing cognitive barriers, including working memory constraints and math anxiety, is crucial. Teachers can use strategies to minimize cognitive load, such as breaking down complex problems into simpler parts and employing visual aids to facilitate comprehension. Additionally, creating a supportive classroom environment that actively reduces math anxiety is essential for enhancing student performance. Techniques such as offering consistent positive feedback, fostering a growth mindset, and incorporating stress-relief methods can help students build confidence and overcome psychological barriers to learning.

Lastly, it is important to address socio-cultural factors to foster an equitable learning environment. Schools and policymakers should aim to improve resource distribution to underfunded schools, ensuring all students have access to quality resources and skilled educators. Promoting a growth mindset and challenging cultural stereotypes about mathematical ability can further motivate students to study harder to learn Mathematics. Professional development for teachers should also emphasize awareness of socio-cultural influences and the adoption of inclusive teaching practices. By tackling these socio-cultural issues, we can work towards closing achievement gaps and supporting all students in their mathematical education.

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