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Review Article

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Unravelling the challenges: A review of Scopus-indexed literature on students' difficulties in learning mathematics across educational levels

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ABSTRACT

The purpose of this study is to categorize and identify the challenges that students at different educational levels have when learning mathematics. By examining papers that were indexed in the Scopus database, this study used a systematic literature review methodology, guided by the PRISMA protocol and the PICO framework. 37 chosen publications that were published in English and made available through open access were the outcome of the four-stage review process, which included identification, screening, eligibility, and inclusion. According to the results, from elementary school through secondary school, pupils typically struggle to comprehend mathematical ideas and procedures, especially arithmetic. . The main causes of these difficulties include inadequate knowledge of foundational ideas, poor abstract reasoning abilities, and inefficient teaching strategies. The findings highlight how crucial it is to identify mathematics learning challenges early on, particularly in primary school, in order to lay a strong basis for understanding increasingly complex mathematical ideas. In an attempt to reduce students' learning challenges, this study suggests improving teaching methods and reinforcing fundamental math ideas.

Keywords: mathematical difficulties, students, learners, scholar

INTRODUCTION

Mathematics is one of the sciences that cannot be detached from its character in various angles of life (Sharma, 2021). By studying maths, an individual is accustomed to thinking systematically and creatively (Bakri et al., 2024; Ibrahim & Widodo, 2020), scientifically, using logic, and critically. Mathematics is essential for self-development, such as in solving problems (Guaypatin Pico et al., 2024). Solving mathematical problems involves logic. and analytical thinking (Qolfathiriyus et al., 2019). This ability can also be applied to solving problems in everyday life (Szabo et al., 2020), such as solving problems in situations that require decision-making. Given the importance of mathematics in daily life, mathematics needs to be realized and mastered at all levels of society, including school students and the next generation (Bredberg, 2020).

Given the importance of the role of maths, elementary school mathematics is an essential foundation until, finally, college (Busso et al., 2025). Mathematics learning should be able to change students' views that mathematics is not just about calculating numbers (Kurepa et al., 2019). Many students consider mathematics a complex and most avoided subject, so many students get low learning results (Mantey et al., 2022). This view makes students give up easily even before they study mathematics (Chand et al., 2021). Students tend to memorize concepts from textbooks or concepts given by their teachers without wanting to understand the meaning and content (Naidoo & Mabaso, 2020).

Learning difficulties are a common problem that can occur in learning activities (Baiti et al., 2024). Factors that influence learning difficulties in mathematics are a person's cognitive abilities (Matamoros Cazares & Agramonte Rosell, 2024). In addition, there are other factors, such as failure of fun and motivation to learn mathematics (Lubis & Ain, 2022) and failure through support from older and the accompanist environment in maths lessons for learners due to failure of understanding to parents and the neighborhood towards mathematics (Khanolainen et al., 2020). So, it is only natural that students who experience learning difficulties in mathematics should be given good support and motivation so that they can follow mathematics learning and enjoy mathematics (Campanilla, 2024)

If left untreated, students' difficulties in learning mathematics will harm them and make them less interested in learning mathematics (Mamolo, 2022; Nurhayani et al., 2020). Mathematics will continue to be the subject students must avoid (Kyttälä & Björn, 2022). Students also get bored more quickly and are easily fed up with learning mathematics (Schwartze et al., 2024).

Table 1. PICO

PICO	Illustration	Motive
P *(population or problem)*	Identify what a specific problem is.	Students
I *(interest)*	Address what is the intervention or else interest in a partition with the matter.	Difficulties in learning mathematics lessons
CO *(context)*	The final situation or outcome perspective from the interpreted problem and submitted an intervention.	Students' difficulties in learning mathematics lessons

Table 2. Inclusion and exclusion criteria

Criteria	Inclusion	Exclusion
Document type	Article	Proceeding, book, chapter, report, and monograph
Publication type	Final	In the process and review
Source type	Journal	Book, chapter, providing, and magazine
Language	English	Not written in English
Open access	Open access	Not open access/close access

Therefore, learning difficulties faced by students should be detected early. These difficulties in learning mathematics will begin to appear when children are in elementary school (Aguilar, 2021). Therefore, students with difficulty learning mathematics need immediate understanding and management (Tran et al., 2020).

There are several articles that are relevant to this article, including from Trujillo et al. (2023) with the research title "*Learning difficulties with the concept of function in maths: A literature review*" Without specifically addressing differences in educational attainment, the study concentrates on how challenging it is to comprehend the idea of mathematical functions. Including from Svane et al. (2023) with the research title "*A systematic literature review of math interventions across educational settings from early childhood education to high school*" employs the systematic literature review (SLR) strategy as well, but instead of concentrating on learning challenges, it examines the efficacy of math learning treatments across a range of educational levels, from early childhood schooling to secondary school. And research from Maulina et al. (2024) with the research title "*Systematic literature review related to learning obstacles of junior high school students in understanding algebra concepts*" which restricts its research to junior high school pupils' challenges comprehending algebraic ideas.

This article uses the SLR approach, which is guided by the PRISMA protocol and the PICO framework, to systematically examine the mathematics learning difficulties faced by students at different educational levels, from preschool to high school, based on the three pertinent articles mentioned above. In order to determine the kinds of challenges, the materials deemed challenging, and the educational levels at which these challenges are most prevalent, a total of 37 Scopus-indexed papers were examined. The primary emphasis is on challenges with mathematical ideas and procedures, particularly in arithmetic-related items.

Research Questions

1. What obstacles prevent students from learning mathematics?
2. Do students need help with mathematics in each topic?
3. At what level do students experience difficulty in mathematics?

METHODOLOGY

PRISMA served as the primary guideline for this SLR. On the other hand (Page et al., 2021). Published a standard that outlined 27 steps for producing a systematic review. PRISMA may be utilized as a methodology to create research questions and a systematic review, even if this SLR is in the science-social domain. Additionally, PRISMA will reduce bias and direct the writer in the study design (Elston, 2022).

Nonetheless, PICO developed and provided direction for the SLR's research questions. In addition to identifying crucial components that the research question needed, the acronym PICO was utilized to help create research questions for SLR (Hosseini et al., 2024). Three main themes are generally referred to as PICO: I (interest), P (population/problem), and Co (context).

Table 1 is a PICO that uses the terms "learner", "student", and "mathematics difficulties" to obtain the information. Create a variety of linguistic terminologies to replace other keywords once the keywords have been generated to locate journal articles related to the research topic, as shown in **Table 2**.

Systematic Review Process

The literature review process has four stages: Identification, screening, eligibility, and, finally, inclusion (**Figure 1**).

Identification

We used Scopus to perform the identification search. **Table 3** displays the keywords recommended for the study based on database searches and previous research, including students, learn, mathematics complex, mathematically challenging, and math difficult.

The three stages of the review process were

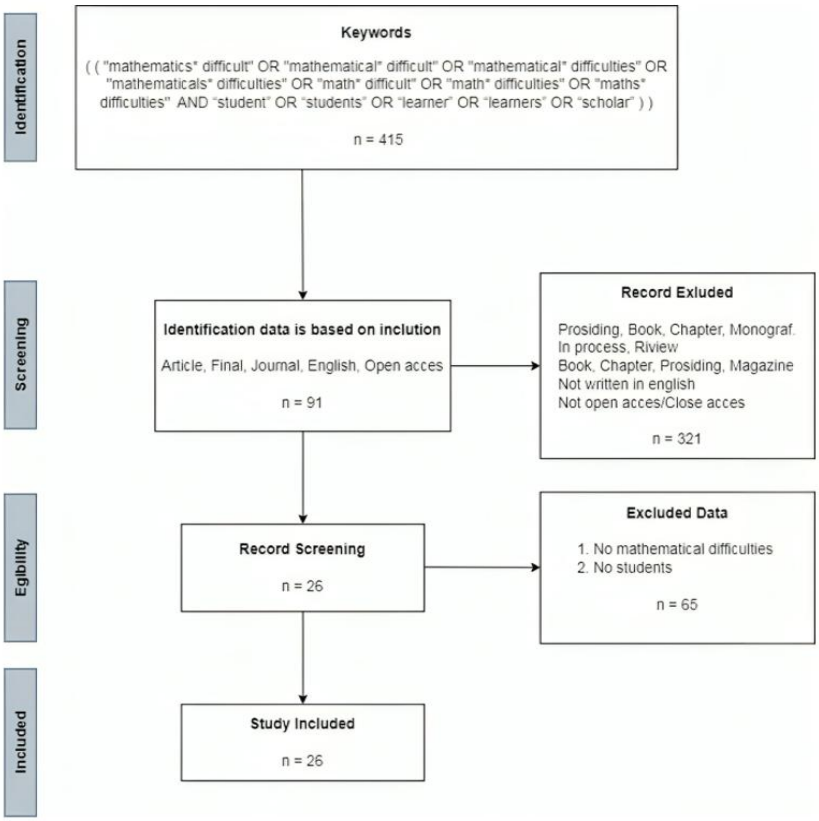

Figure 1. PRISMA flow diagram (Source: Authors' own elaboration)

Table 3. The search string

Database	Search Strings
Scopus	TITLE-ABS-KEY ((“mathematics* difficult” OR “mathematical* difficult” OR “mathematical* difficulties” OR “mathematics* difficulties” OR “math* difficult” OR “math* difficulties” OR “maths* difficulties” AND “student” OR “students” OR “learner” OR “learners” OR “scholar”))

(1) literature search,

(2) selection of pertinent research, and

(3) categorization and synthesis of the results.

The Elsevier databases Scopus were chosen for consultation. Furthermore, this procedure used systematic search methods from the databases and Scopus, including AND, OR, keyword searching, and field codes (**Table 3**). Four hundred fifteen relevant articles or references were found using a methodical search approach, database, and primary domains. Creating precise criteria during article selection and retention will include all relevant articles or references in the second step of the screening process.

Screening

Figure 1 shows that the selection process meets the PRISMA requirements, as Moher et al. (2009) stated. By employing this method, we incorporate and exclude elements according to many standards. The collection of literature excluded book chapters, conference proceedings, and systematic review volumes. We restrict our focus to English-language journal papers because they are the most prevalent type of publishing, reducing the need for imprecise or confusing translations. We also did not impose any restrictions on the year of issue of papers to thoroughly understand study findings across different historical periods. We only offer openly accessible papers to facilitate the research process. There are no exceptions for specific countries or zones. There are no exceptions for certain countries or zones. Only 91 papers survived after the screening stage, with 415 publications not matching the research standards.

Eligibility

Incomplete articles triggered the eligibility phase, as **Figure 1** illustrates. Initially, journal articles that did not see the criteria for students' mathematics difficulties were condemned. Subsequently, a thorough review of each article's title, abstract, methodology, results, and discussion was conducted to ensure that all 91 articles met the criteria and objectives of the study selection. At this stage, 91 articles were rejected because they did not explain the reasons behind students' difficulties in learning mathematics or they did not clearly define and review those findings in the study invention portion. Consequently, 37 articles were chosen for publication on the final scene of the observation process (refer to **Figure 1**).

Table 4. Math difficulties

Authors	Journal	Mathematics difficulties	Mathematical material	Student level
Pappas et al. (2019)	Behavioral Sciences	Calculation process	Arithmetic	Elementary school
Hecht and Vagi (2010)	Journal of Educational Psychology	Concept	Arithmetic (fraction)	Elementary school
Fuchs et al. (2009)	Journal of Educational Psychology	Without explanation	Without explanation	Elementary school
Holopainen et al. (2017)	International of Disability, Development and Education	Without explanation	Arithmetic, algebra and geometry	Secondary school
Martin et al. (2013)	Journal of Learning Disabilities	Understanding of the problem	Arithmetic	Elementary school
El Azzouzi et al. (2023)	International Journal of Evaluation and Research in Education	Mathematical skills	Exponential function and logarithmic (mathematics-physics)	Secondary school
Swanson et al. (2022)	Journal of Experimental Child Psychology	Mathematical skills	Without explanation	Elementary school-secondary school
Barbieri et al. (2020)	Journal of Education Psychology	Concept	Arithmetic (fraction)	Secondary school
Losinski et al. (2021)	Learning disabilities, research and practice	Operations	Arithmetic (fraction)	Elementary school
Namkung and Fuchs (2012)	Learning Disabilities Research & Practice	Operation	Without explanation	Elementary school
Powell and Fuchs (2010)	Journal of Educational Psychology	Understanding the symbol (=)	Without explanation	Elementary school
Dibbs et al. (2020)	International Journal of Education in Mathematics, Science and Technology	Concept	Algebra	Elementary-high school
Jankvist and Niss (2018)	Education Science	Concept	Without explanation	High school
Benavides-Varela et al. (2020)	Computer and Education	Concept	Without explanation	Pre-school-secondary school
Kim et al. (2022)	The Journal of Mathematical Behavior	Operations	Arithmetic	Secondary school
Fuchs et al. (2010)	Learning and Individual Difference	Operations	Arithmetic	Secondary school
Grünke et al.(2023)	International Journal of Special Education	Operation	Arithmetic	Secondary school
Gersib et al. (2024)	Intervention in School and Clinic	Concept	Arithmetic (measurement)	Secondary school
van den Ham and Heinze (2022)	Journal of Research on Educational Effectiveness	Basic arithmetic skills	Arithmetic	Secondary school
Marks et al. (2024)	Developmental Science	Working memory	Without explanation	Elementary-secondary school
Hacker et al. (2019)	ZDM- Mathematics Education	Basic concept	Arithmetic (fractions)	Elementary school
Cirino et al. (2015)	Journal of Learning Disabilities	Numerical competencies, computation, and problem-solving.	Arithmetic	Elementary school
Levi-Keren (2016)	College Education	Solve exam questions	Without explanation	Without explanation
Fuchs et al. (2009)	Journal of Educational Psychology	Without explain	Without explanation	Elementary school
Nelson et al. (2022)	Learning Disability Quarterly	Operation	Integers	Elementary school
de la Hera et al. (2023)	Frontiers in Psychology	Without explanation	Without explanation	High school

Inclusion Criteria and Exclusion Criteria

We used selection criteria, including timeframe, document type, language, and subject area, to weed out items not pertinent to our research after compiling all the data from all the sources we had found. To ensure that the studies chosen are relevant to the main goal of the research, the inclusion criteria and exclusion criteria should be precisely specified when choosing which parts to include and exclude. The research findings, inclusion, and exclusion criteria of this review study are displayed in **Table 2**. 37 papers were found to be pertinent, and the complete texts of these publications were acquired.

RESULTS

Table 4 displays the primary categories into which the results of this SLR have been categorized, each of which represents a significant subject or facet of the material studied.

The information in **Table 4** describes the level of mathematical difficulty that students face in various mathematics subjects; unfortunately, some publications fail to identify the specific difficulties or subject matter that students face.

Students Learning Difficulties in Mathematics

Students' learning challenges must be considered. Numerous studies have examined math learning challenges among kids. **Table 4** shows children's learning challenges in different parts of the world. From preschool through high school, students encounter learning difficulties in mathematics at varying stages of their education.

Students' Mathematics Difficulties Theory

One common issue that can arise during learning activities is learning problems. Many kids struggle, mainly if it includes learning mathematics. **Table 4** illustrates various sorts of mathematical challenges encountered by pupils.

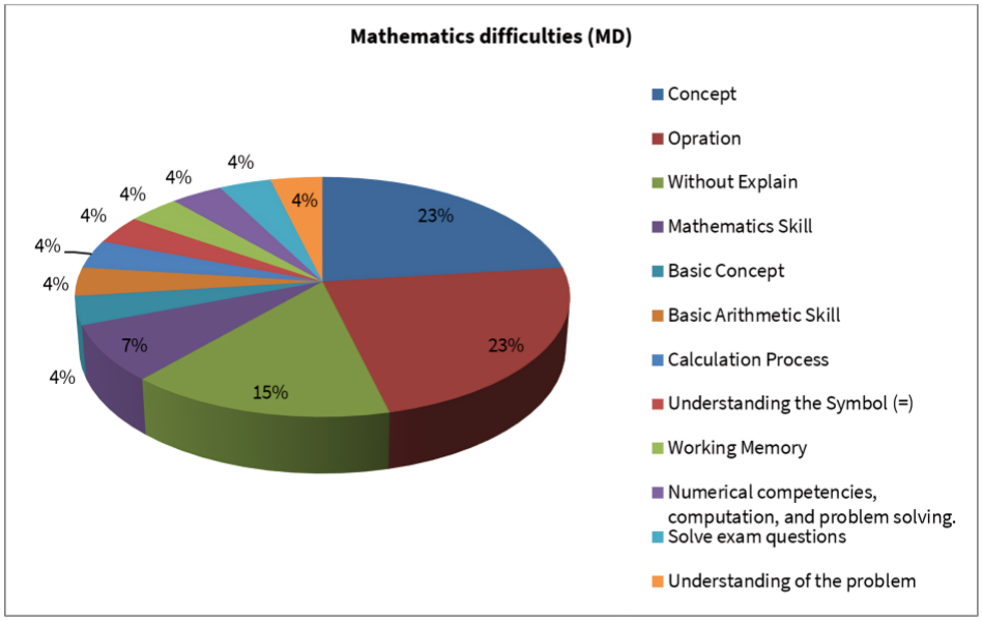

Figure 2. Different math challenges faced by students (Source: Authors' own elaboration)

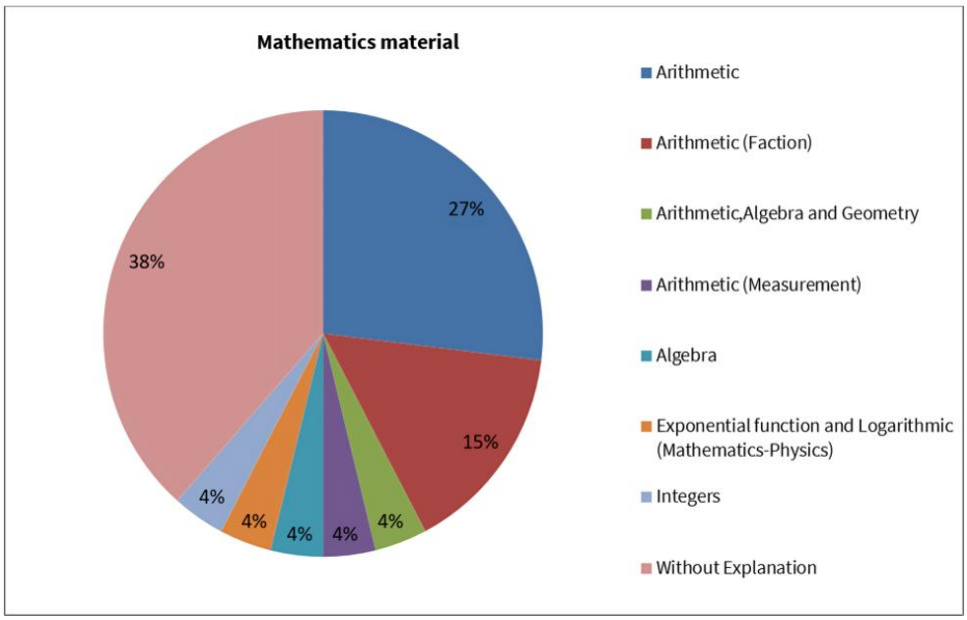

Figure 3. Dominant material that is considered difficult by students (Source: Authors' own elaboration)

The features of the mathematical challenges that students face are depicted in **Figure 2** starting with conceptual understanding issues and moving on to problem-solving challenges. However, several of the findings fail to identify the specifics of the kids' challenges.

In general, pupils' mathematical challenges fall into several categories. These include understanding symbols, operations, narrative problems, test questions, and mathematical abilities like counting. Students who struggle with calculation (4%, 1), concept (23%, n = 6), basic arithmetic concept (4%, n = 1), symbol comprehension (4%, n = 1), difficulty resulting from a lack of mathematical skills (7%, n = 2), fundamental arithmetic difficulty (4%, n = 1), difficulty in operations (23%, n = 6), working memory (4%, n = 1), numerical competence, computation, and problem-solving (4%, n = 1), solve exam questions (4%, n = 1). Four studies indicated that the category of students experiencing learning difficulties in mathematics was not explicitly mentioned.

According to facts, many students struggle with mathematics in the idea and mathematical operations part. This is because students have difficulty focusing when studying, even though arithmetic needs specific reasoning. How a teacher teaches also influences pupils' difficulty learning mathematical ideas and procedures.

Figure 3 shows the progression of challenging mathematical content for students, from fundamental arithmetic to more complex topics like integrals. Nonetheless, certain results fail to pinpoint the precise mathematical content that presents challenges for the participants.

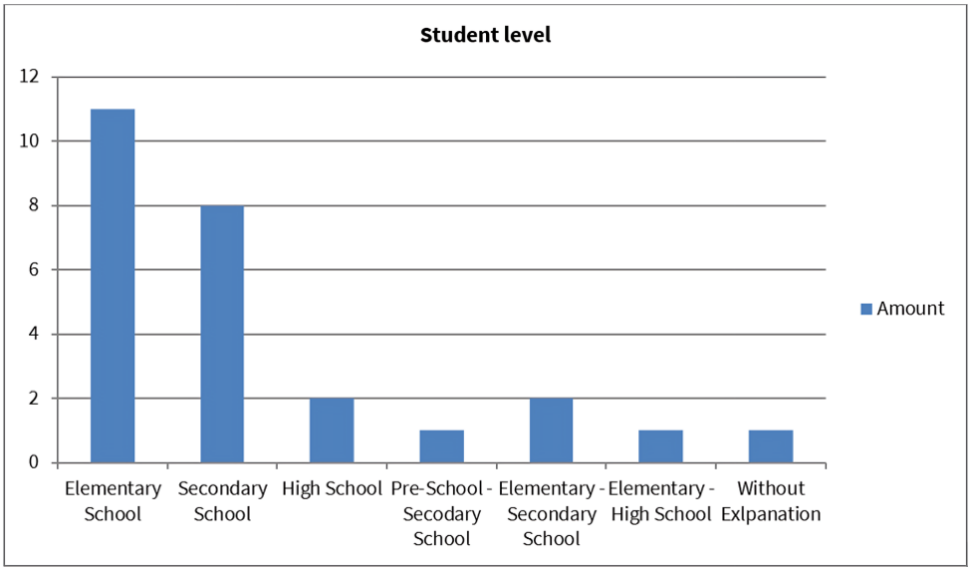

Figure 4. Level of students experiencing mathematics difficulties (Source: Authors' own elaboration)

Students' Challenges in Learning Maths Content

Specifically, what materials make it harder for pupils to understand mathematics is the first study topic. Arithmetic, algebra, geometry, and other subjects comprise the standard materials for pupils who struggle with mathematics study. Pupils who struggle with math in arithmetic subjects (27%, n = 7), arithmetic in fractions (15%, n = 4), arithmetic in measurement (4%, n = 1), arithmetic, algebra, and geometry combined (4%, n = 1), algebra (4%, n = 1), exponential function and logarithmic (4%, n = 1), and integers (4%, n = 1) are all depicted in **Figure 2**. Ten studies state that pupils' learning difficulties in mathematics are not explicitly related to the mathematical material.

Research demonstrated that pupils struggle more with arithmetic-related subjects. Arithmetic is regarded as the most challenging subject because it requires pupils to apply logical and abstract reasoning to solve problems. Additionally, formulas and anything complex need to be solved. Students will find this challenging, particularly those in primary school.

Figure 4 illustrates how mathematics difficulties affect students from elementary school through high school. Nonetheless, a number of studies fail to identify the educational level of pupils who struggle with mathematics.

Mathematics Difficulties at the Student's School Level

Concerning the second query about the percentage of pupils most likely to struggle with math. Math learning challenges can arise at any level for students. From kids in elementary school to those in high school. **Figure 4** demonstrates how many elementary school pupils (n = 11) struggle with mathematics. Numerous standards cause pupils to struggle when studying arithmetic. Furthermore, elementary school pupils' capacity for abstract thought is still developing. Challenging instruction will, therefore, impact students' motivation to study. Lack of internal motivation causes learning to be disorganized, which makes it difficult for children to master mathematics.

DISCUSSION

The study's findings demonstrated that there are various types of math learning challenges among students, such as difficulties with comprehending mathematical ideas, challenges in methods of problem-solving, challenges with mathematical operations, challenges with counting, and other challenges. The findings indicated that concepts and operations were students' most common areas of mathematics difficulties. Most students encounter learning difficulties in mathematics when they stumble to use their theoretical understanding of topics to solve mathematical problems.

This is because thoroughly comprehending mathematical topics necessitates organized problem-solving abilities, logical reasoning, and abstract thought. Limitations in logical reasoning are frequently the root cause of students' difficulties grasping mathematical issues, though other variables are also important. According to Nugraha (2022), early learners struggle to understand mathematical topics because they are incapable of abstract thought. Furthermore, students need help with number operations. This happens for several reasons, including abstract conceptual and fundamental understanding deficiencies. According to Fauzian Rambe et al. (2023), mathematics, synonymous with formulas and symbols, often presents learning challenges for students. Most students can only comprehend the idea; they cannot use it to solve issues.

Sadly, most authors in this literature do not go into more information about the resources utilized to examine problem-solving skills. Knowing this would help with research predictions and remedies. Because pupils still have adamant time-solving material challenges. According to Kusumawati and Hadi (2018) the survey, 40% of the multiple-choice math exam questions were brutal, indicating that pupils' difficulty levels are still relatively high. There are a number of reasons for the relatively high degree of

difficulty that students have in mathematics, and one of the main ones is that they struggle with increasingly complex material because they do not fully grasp the fundamentals. According to Wewe (2020), because they can't fully understand the foundational ideas, students struggle with increasingly advanced calculus problems.

Arithmetic content is frequently utilized to investigate students' challenges. The basic foundation of all more complex mathematical ideas is arithmetic. Basic operations like addition, subtraction, multiplication, and division are included in arithmetic. Arithmetic is the foundation for practically all more complex mathematical ideas. Hence, it is crucial that students comprehend and can do basic operations correctly. Arithmetic errors or deficiencies will affect students' comprehension of more advanced mathematical concepts. According Sidik et al. (2021) stated children who struggle with addition and subtraction or other fundamental mathematics skills will find it challenging to think algebraically.

Children who struggle with addition and subtraction or other fundamental mathematics skills will find it challenging to think algebraically. Our findings show that students' mathematical difficulties can frequently be related to arithmetic content. Integrals are the least used when examining problem-solving techniques. It is incredibly challenging to investigate mathematical abilities when the foundational notions are still weak since integrals demand sophisticated intellectual talents, whereas difficulty is an essential capacity. In integral calculus, students with robust mathematical dispositions and higher levels of prior knowledge demonstrate superior critical thinking and problem-solving abilities. According to Pambudi (2022), in integral calculus, students with robust mathematical dispositions and higher prior knowledge demonstrate superior critical thinking and problem-solving abilities.

There are learning challenges at every educational level, from elementary to higher education. The findings of our study indicate that math problems are frequently encountered starting in elementary school. This is troublesome because issues seen in elementary school carry over to higher education. Students in primary school will only be able to build their critical thinking abilities if they understand the fundamentals. Students who struggle with this topic will have a conceptual gap affecting them as they move on to higher school. According to Ilie et al. (2021), poor basic arithmetic skills in primary school harm higher education.

CONCLUSIONS

Scopus was used to perform a thorough search to gather data pertinent to this investigation. A total of twenty-six periodicals have been chosen to examine the mathematical challenges that pupils face. This study aims to identify common mathematical problems that students encounter. The aggregate results indicate that various factors contribute to students' mathematical challenges. Students have a variety of difficulties when resolving mathematical issues, including a lack of conceptual understanding, trouble manipulating numbers, trouble counting, trouble grasping interpretive problems, and more. Our research indicates that many pupils need help with the idea and use of numbers. Understanding the idea requires using logistic reasoning, abstract thought, and problem-solving techniques. Students who do not fully grasp the notion will struggle with numerical operations because essential and abstract conceptual thinking is necessary to understand mathematical number operations.

There is no question that students' levels of difficulty differ. When it comes to advanced material, students have two options. They barely struggle with the content, but the foundational knowledge is solid; alternatively, their lack of comprehension causes them to struggle. However, advanced material will also be impacted if you discover that pupils have difficulty with still-basic stuff. Similar to our research results, students who struggle with basic math will also struggle to understand advanced content Since advanced material has a foundational knowledge of mathematics.

Students at every level face learning challenges. Our research indicates that mathematics is a more challenging for elementary school pupils. The understanding advanced children have from elementary school accounts for their successes and challenges. Therefore, students who struggle in elementary school will continue to struggle in advanced education. This occurs due to a conceptual understanding gap between more straightforward to more sophisticated ideas.

Recommendations

The study's findings demonstrated that while students had challenges in several areas, comprehending mathematical ideas and procedures posed the most significant challenge. This is because mastering mathematics demands complete concentration. Furthermore, how a teacher approaches a problem also affects the students who have problems. Thus, the appropriate teaching method will reduce or eliminate students' mathematical challenges. Repetition of students' fundamental principles is necessary to ensure they comprehend mathematics well and do not encounter difficulties solving issues. Before advancing to more challenging materials, students must fully grasp the foundational ideas. For instance, pupils need to be proficient at addition, subtraction, multiplication, and division of numbers before comprehending algebra. Students who lack a solid grasp of these fundamentals will find it challenging to tackle more challenging issues.

Their poor comprehension of primary school subjects will impact on their higher-education critical thinking abilities. It is crucial to stress a solid grasp of mathematics starting in elementary school to develop strong foundational abilities and enable pupils to advance to higher education more quickly. It is ensured that students fully grasp foundational ideas such as number concepts and basic mathematical operations (addition, subtraction, multiplication, and division). Thanks to this, students will have a solid foundation for understanding later, more complex subjects. If kids lack this fundamental knowledge, they will struggle in middle and high school when they must apply critical thinking skills and tackle more complex problems.

By methodically charting the terrain of students' learning challenges across different educational levels, this study significantly advances the subject of mathematics teaching. This review offers a thorough synthesis of 37 Scopus-indexed publications, identifying the most common difficulties students encounter in learning mathematics, in contrast to earlier research

that frequently concentrates on certain mathematical subjects or limited educational phases. Assuring scientific rigor and openness, the PRISMA and PICO frameworks provide reproducibility and clarity in identifying important problem areas, such as conceptual misunderstanding and challenges with arithmetic operations.

Furthermore, by classifying learning challenges based on student level and mathematical content, this study provides detailed information about the best times and locations for interventions. Teachers, curriculum designers, and legislators can use the findings as a useful guide to create focused solutions that address the fundamental flaws in mathematics learning. In the end, this study emphasizes how critical it is to identify problems early and improve teaching strategies in order to help students get beyond enduring obstacles to mathematical proficiency.

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AI statement: The authors stated that no AI technology was used in this study.

Declaration of interest: No conflict of interest is declared by the authors.

Data sharing statement: Data supporting the findings and conclusions are available upon request from the corresponding author.

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