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BARRIERS TO MATHEMATICS LEARNING: IDENTIFYING AT-RISK LEARNERS THROUGH COGNITIVE AND BEHAVIORAL INDICATORS

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Abstract

In South Africa, Students face challenges with learning Mathematics, which causes them to achieve poor results in the subject. The mathematics difficulties that students face are becoming a big concern for parents, teachers, and the Department of Basic Education. The following study examined the importance of identifying students who struggle with learning mathematics in the Intermediate Phase. This study used an interpretivist and a qualitative research approach to explore the topic. We used a variety of techniques, such as partially planned interviews and document reviews. The findings revealed that identifying barriers to mathematics learning is crucial to a student's education. The study provides new insights into the challenges faced by new mathematics teachers in teaching the subject. Additionally, It offers valuable information regarding the obstacles that all mathematics teachers encounter in their instructional practices.

Keywords: Intermediate phase, Mathematics, Mathematics difficulties, Teachers

1. Introduction

Mathematical education is essential for school success, enhancing thinking skills, understanding science and for participating in a world that increasingly relies on data. Although mathematics is important for learning, it remains one of the hardest and most challenging subjects for students in various learning environments. Some problems make it hard to learn mathematics, such as differences in income, language issues, strict teaching methods, and not enough help from teachers. These problems have been shown in several studies (Mutambara & Bhebe, 2019; Research and Scientific Innovation Society (RSIS) International, 2022). Morgan (2016) exposed students that are at risk as those that experience low socioeconomic status and mathematics difficulties between the 3rd and the 8th grade. Also learners that encounter reading problems are at risk and those who are constantly retained. Moreover, Morgan indicated that students undergoing learning difficulties in calculation may likely continue to face these mathematics problems later in their careers.

Teachers play a central and multifaceted role in identifying students with Mathematics Learning Barriers (MLB). Teachers as instructors utilise assessment for learning to screen problem-solving forms and tailor instruction, making it difficult sometimes to pinpoint students who require help (Mahlambi, 2023). Also, collaborative reflections among instructors strengthen groups, offer assistance and ensure that a student's learning challenges are recognized early and precisely (Motitswe, 2025). The study examines the benefits of identifying MLB, the challenges that teachers encounter during mathematics teaching, and struggles with the identification and support strategies that could be implemented. This study compiles recent research to determine what the major challenges are, how they affect students' results, and what proven strategies can help reduce unfairness in mathematics education.

Literature Review

MLB alludes to a run of cognitive, emotional, social and guideline deterrents that hinder students' ability to comprehend and apply scientific information. These obstructions can be inborn, like working memory confinements, dyscalculia, mathematics uneasiness, poor instruction, language impairment, lack of resources, and classroom environments. According to Pišoček, Tõnissaar & Toom (2023), students with particular mathematical learning inabilities frequently show struggles with working memory, both visuospatial and verbal, numerical handling, and recognising math facts compared to their peers due to natural variables. While the orderly survey by RSIS Worldwide (2024) encourages conceptual mistaken assumptions, ineffective educational practices, mathematics uneasiness, and socio-cultural imbalances as interrelated learning boundaries to be distinguished (RSIS Worldwide, 2024). However, the researcher noticed some MLB cases when poor teacher-classroom instruction and teacher follow-up programmes had an impact on performance. These are cases where you find students leaving gaps during calculations, for example, when students forget to carry over or borrow. Identifying process to students facing barriers to mathematics learning is the second step towards the establishment of operative inclusive education. Teacher's clear understanding of student identification of the learning barriers call for intervention programmes to the identified persons (Mulovhedzi & Mudzielwana 2021).

MLB manifests on a global scale as complicated challenges surrounding cognitive deficits, responsive constraints, inadequate instructional quality, and socio-economic inequities. The United Nations Educational, Scientific and Cultural Organization (UNESCO) Global Education Monitoring Report (2024) highlights the relentlessness of the issue. According to the findings, approximately six out of ten students worldwide lack basic math skills by the end of primary school. The crisis was exacerbated by pandemic disturbances and inequities. These global dispositions highlight that consistent barriers result in a lack of access to quality instruction, digital resources, and a conducive learning environment, all of which have an impact on mathematics learning. Currently, the research is based on the idea that MLB is associated with poor mathematical performance that affects students' social lives, which may lead to high numbers of school dropouts. Meanwhile, international performance data such as the Trends in International Mathematics and Science Study (TIMSS) highlighted mathematics achievement gaps as being linked to socio-economic status, language ability, and access to technology among students from marginalized communities. And this may consequently be a factor to students underperforming in mathematical assessments (Chappuis & Stiggins, 2020).

In the South African context, from a local perspective, MLB is linked to socio-historical and universal dimensions. TIMSS and the national Grade 12 results demonstrate a stark divide that shows students in no-fee schools scoring significantly lower than their counterparts in better-resourced schools. Underscoring is more prevalent among these learners. Mathematics anxiety is the state of mind that interrupt the student's daily learning routine, actions, and tests writing (Amam, Darhim, Fatimah & Noto 2019). Further it is outlined that student anxiety towards mathematics learning should be measured as a way of controlling the learning process. Furthermore, the inequality that is connected to apartheid-era inhabited segregation and tenacious poverty. However, presently, overcrowded classrooms, language barriers, and teachers' failure to identify learners are revealed as significantly associated with lower mathematics performance in South Africa. Also, teachers agree that large class sizes limit modified support and effective education. MLB in schools is worsened by MLB identification in the absence of support strategies. This indicates that it is crucial for teachers to identify MLB with the plan to improve mathematics performance. Teachers play a critical role in raising parental awareness of the issue and suggesting Screening, Identification, Assessment and Support (SIAS) for students with mathematics learning barriers. A systematic review by Pišoček *et al.* (2023) highlighted that the cognitive profiles of students with mathematics learning disabilities (MLB) are associated with low achievement. Traditional way of teaching affect learner Mathematics performance (Drljić & Doz, 2025; Kiru, Doabler, Sorrells & Cooc, 2018). They indicated that digital technology resources are very important as they improve mathematics performance. They further specified that different types of technologies, teaching problem solving and outlining mathematical concepts has positive impact to learner knowledge.

It revealed that the impaired working memory, the visuospatial, verbal, and deficits in processing skills significantly differentiate MLB students from their peers. (Pišoček et al., 2023). These distinctions underline the importance of conducting early cognitive assessments to distinguish between students with developmental disorders and those who struggle due to environmental or instructional factors. Informal and formal tasks can assist teachers in identifying MLB (Chappuis & Stiggins, 2020). These tasks reveal that students who struggle with specific mathematical concepts, require intervention strategies aimed at providing support. Hibi (2025) indicated that effective intervention in mathematics learning is enhanced by acquiring the valuable mathematics skills. Also, mart mathematics application improves the learning outcomes among learners experiencing difficulties

In-Service Teacher Training Programs should focus on preparing teachers for classroom instruction, improving their subject knowledge and also assisting them in creating inclusive learning settings (Baker, Fuchs & Fuchs, 2024). The researcher discovered that some teachers use their own methods of identifying MLB, however the problem lies in implementing strategies to provide support for learners with MLB.

Theoretical framework

This study is supported by Piaget's cognitive hypothesis from 1964. The hypothesis bargains with the cognitive and mental advancement of students. Piaget's stage theory provides a valuable framework for understanding how students build mathematical knowledge and where barriers may arise. According to Piaget, children progress through several developmental stages like sensorimotor, preoperational, concrete operational, and formal operational. Each level is made up of specific volumes for intangible reasoning and rational thoughts (Upu & Bustang, 2021). Mathematics learning barriers can be decreased by increasing cultural lessons and teacher training (Kerr, Hess, Smith & Hadfield, 2018). Students may follow a winding pathway that permits time for religious lifestyle. The researcher is of the idea that developmental stages and cultural lessons are able to influence learner behavior and performance. Meaning that if the student encountered problems with developmental stages, MLB could be the result. Piaget's concept of development stages further supports that students with MLB are seen by having inadequate assimilation in initial mathematical schemas such as number sense, algebraic thinking, and proportional reasoning that meet cognitive discord when introduced to progressive tasks. Such difficulty is frequently detected in probability thinking among secondary students. Gaps in schema growth leads to misunderstanding of calculations (Pratama & Lestari, 2020). Integrating Piaget's theory with teacher professional knowledge is also proven beneficial. The Mathematics Teachers' Specific Knowledge model draws on Piaget's schema concept to intellectualise the ways teachers can connect content knowledge, pedagogical strategies, and student thinking (Ariyanto, Herman, Sumarmo & Suryadi, 2017). Teacher resilience is encouraged by high-quality teacher education and allows teachers to identify student misconstructions and developmental deficits more effectively (Gamboa, Juárez-Ruiz, Otero-Valega, & Tascón-Cardona, 2025). The theory assists in identifying that students' reasoning ability through abstract schemas on concrete perceptions is guided effectively through remediation (Upu & Bustang, 2021; Chiphambo, 2022).

2. Method

The study used qualitative research methodology, aiming to uncover the teachers' in-depth experiences in identifying mathematics learning barriers. Purposive sampling was also employed to select the relevant participants for the study. This assisted in yielding richer, more relevant insights to the study (Studocu, 2023; TGM Research, 2025). The information was gathered through face-to-face interviews and document analysis. The subjective data collection methods were used for understanding and to extract information from participants' lived encounters. The researcher concurs with Bhandari when he states that utilisation of these strategies is beneficial as they may be widely and relevantly explored (Bhandari, 2023:5). The population included all Grade 4 teachers from twenty-one primary schools. The sample group for this study consisted of eight primary school teachers who taught Grade 4 Mathematics. The eight schools were chosen because each has only one Grade 4 class. The fourth-grade class was selected since it is the first grade in the Intermediate Phase.

Subjective data gathering methods such as meeting plans and report investigation checklists were also utilised. Data was analysed thematically, which is a method of examining designs and the content of the data (Braun & Clarke, 2021a; Braun & Clarke, 2022a; Braun & Clarke, 2023). The researcher transcribed the interview notes extensively, reading them repeatedly, and reflecting on their initial meanings (Braun & Clarke, 2023). Additionally, data coding involved labelling important sections. Themes were generated and clustered into possible themes that signify central established concepts in the data (Simply Psychology, 2025). Reviewing of themes was checked against the entire data set to safeguard coherence, data accuracy, and research questions (Braun & Clarke, 2023). Defining and naming of themes was articulated to an extent where each theme's essence, scope determination, and brief informative names were considered (Research Gate, 2023; Simply Psychology, 2025). Themes were combined with communicative, analytic narrative and interpreted within existing literature (Braun & Clarke, 2021a; 2022a).

3. Findings

Language barriers were found and identified as a major setback in learning mathematics. It was outlined as one of the common causes of MLB, influencing multiple areas: the challenges encountered by teachers concerning content understanding when teaching Grade 4 students, identifying and supporting strategies for students experiencing difficulties in mathematics, and effective implementation of all mathematics and screening policies. The findings further indicated that the Department of Education published the Education White Paper 6 (EWP 6) policy in 2001, which was revised in 2010. In addition, the SIAS policy was printed in 2014, however not all the policies printed are effectively used in the school environments. Despite the availability of these policies, some teachers are unaware of the policies because some are kept in the principal's office. This depicts that there should be an improvement in publishing and more effective communication regarding policies. Also, follow-ups on the implementation of the policies should be enhanced.

THEME 1: Identification of students with Mathematics Learning Barriers

It is the role of the teachers to use different ways to identify MLB during teaching and learning. The study revealed that teachers are able to identify MLB. They were aware of students who were not doing well in Mathematics. T4 concurs with T1 by showing the useful strategy that can assist Mathematics teachers:

"As a teacher, I think I can use diagnostic assessment; I prefer it because it is easy to identify the student who has barriers to learning in Mathematics. It makes things simple, and it also saves time."

T4 also supported the possibility of identifying MLB by indicating things that reveal MLB among students: "*MLB students exhibit poor mental arithmetic skills, inability to estimate whether a numerical answer is reasonable, and some students may have trouble even with a calculator".*

THEME 2: Challenges that are faced by teachers when teaching Grade 4 students

Teachers are faced with poor performance among students, they are held accountable for the students' mathematics performance in all grades. Face-to-face semi-structured interviews, conducted with 1 to 8 participants, revealed the profundity of challenges that teachers faced when educating students. The challenges included, amongst others, the dialect obstructions, the student's state of mind and careless conduct. T2 from school B concurred with T4 from school D by saying:

"Language to me is a big problem. Cause I have to explain everything eh and then when I explain everything it consumes time. I have to explain to them first in their home language in order to cover those who don't understand what's going on.

THEME 3: Strategies used to identify and support students with MLB

MLB identification strategies form part of what teachers should possess to assist students in improving their performance. The study revealed that teachers are knowledgeable when it comes to MLB identification strategies. They encounter problems with giving support to the difficulties identified. During interviews, the teachers pointed out different strategies they use to identify MLB.

T3 from School C explained:

"You check how often the student needs help. After writing the tests, look at the results. Talking to the student to find out the process that the student uses in solving a problem".

T1 and T4 agreed:

"The teacher must use screening methods or profiling or the teacher must use diagnostic assessment set written questions using each incorrect operation. Asking oral questions, it's easy."

The document analysis revealed that there are no stipulated strategies provided that teachers use to identify MLB. There were no approaches outlined in the Curriculum and Assessment Policy Statement (CAPS). This created a serious problem for teachers as they are left to identify barriers in their own methods. Consequently, there was no uniformity, the lack of guidance leads to inconsistencies in how MLB is identified and addressed across classrooms. As a result, strategies to improve performance through early identification and support become ineffective.

THEME 4: Usage of policy in identifying and supporting

The study revealed that the teachers' main focus in class is the impartation of knowledge to students. They use the CAPS document as a recommendation and guidebook to direct mathematics teaching measures. MLB identification requires the teacher's attention, yet the CAPS document does not indicate how Screening Identification Assessment Support (SIAS) should be done. Furthermore, CAPS does not show instructions on how teaching of students with MLB should be conducted and answering how education should be conducted when using policies that do not address how to identify MLB.

T7 exposed that:

I think it is not being implemented the way they thought; they thought positively; it's like to the teachers, it's just another bulk of paperwork. We are like clerks; we are always writing. And remember, our main focus is teaching, but there is a lot of paperwork to be done.

Teachers expressed that the teaching policy and requirements by the circuit and district are too much and exacerbate poor performance in mathematics. They indicated that they are not able to focus on teaching only, as there is a lot of paperwork they do concurrently with teaching.

The findings fashioned evidence of the significance of identification of students with MLB; it was anticipated that readers would see similarities in their circumstances and judge the reputation of the information produced in their settings.

Implication of the study

After document analysis, the findings revealed that the Department of Education published the EWP 6 policy in 2001, and it was revised in 2010 correspondingly, SIAS policy was printed in 2014. These policies are available, but they are still inconsistently and frequently ineffectively implemented in school settings. Some teachers are not aware of the policies while others are aware of their availability without implementing. Some policies were found to be available in school, but they were kept in the principal's office. This demonstrated the necessity of strengthening publishing and communication regulations. Further monitoring of the policies' implementation is also necessary. Comprehensively on how to identify MLB, deal with the challenges they encounter during teaching, strategies to employ when identifying and supporting learners with MLB.

Discussion

Identification of students with MLB is linked to Piaget's theory that underpinned this study. The findings support the previous study and the theoretical framework. Swanzy, Ansah, Mpondi, Asamoah, & Nyondo (2023) pointed out that formal arithmetic reasoning like deductive thinking emerges in Piaget's formal operational stage (11+ years). Deductive thinking is related to a student's poor performance, which is caused by the inability to comprehend some mathematical concepts.

Conclusions

The conclusion of the study indicated the importance of identification, which should be done by teachers during teaching. Identification plays an important role that assists teachers in finding teaching strategies that they must use to assist learners with MLB. The enablement of learners to improve their performance builds their values, attitude, and communication. Failure to identify learners experiencing MLB, increases the challenges that teachers encounter in the classroom environment. If MLB is identified early, collaboration and corroboration of learners becomes optimised in a way that reduces learning problems. Early identification of learners with MLB can improve the learner's performance and attitude towards the subject. If all stakeholders join hands in reducing and eradicating MLB in our primary schools, mathematics performance may improve globally. Moreover, South African mathematics might be improved since our country's performance is below the expected level. It is important that mathematics learning be prioritised, equipping both teachers and learners. The study recommended and encouraged the screening, identifying, assessing, and supporting of students across the grades, not only at the Intermediate Phase. The SIAS implementation will improve student confidence, attitude, and performance. This will result in an automatic reduction of MLB. Future research should further explore the relationship between teaching strategies and the challenges that are encountered by teachers when teaching mathematics. There is also the need to train teachers

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