Exploration of Learning Difficulties in Mathematics Among Prospective Teacher Candidates

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Abstract. Classroom learning is inherently complex, necessitating a variety of skills from educators. This research, using a qualitative, phenomenological approach, aims to improve faculty understanding of the challenges faced by prospective mathematics teachers. It explores how they perceive their learning difficulties in mathematics and seeks to develop effective teaching strategies. Data was collected through interviews with eight first-year prospective mathematics teachers at a private university in West Java, Indonesia. The study found that participants primarily discussed factors contributing to their learning difficulties rather than defining these difficulties. Key factors identified include the impact of teacher attitudes (positive and negative), the interplay between students' interest in mathematics and their learning methods, and the influence of student fatigue and teacher competence and methods. Teacher attitudes were notably significant in influencing students' experiences in learning mathematics, along with student interest, fatigue, and teacher competence. However, experts argue that factors like teacher attitudes and competence, being external to students, should not be seen as direct causes of learning difficulties. Instead, they suggest that the root causes are internal, particularly in terms of students' personal interest in mathematics and the fatigue they experience during learning.

Keywords: Prospective Teachers, Learning Difficulties, Teacher Attitudes, Phenomenological Approach.

1 Introduction

Engaging students actively in the classroom, particularly in mathematics education, is a complex process that requires a myriad of skills from teachers. This includes not only planning and executing teaching but also conducting assessments that encompass cognitive, affective, and psychomotor components [1]. The challenges in teaching are influenced by numerous factors, including student characteristics, school conditions, government policies, and teacher abilities. Understanding prospective teachers' mathematical learning difficulties is vital for developing effective mathematics educators.

In the realm of mathematics education, addressing learning difficulties requires a multifaceted approach, drawing insights from various studies. [2] highlight the impact of practicing mathematics without feedback, emphasizing how this approach can address learning difficulties by promoting independent problem-solving skills. [3]

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address learning difficulties by promoting independent problem-solving skills. [3] delve into the intersection of mathematics and reading difficulties, suggesting the need for differentiated instructional strategies to cater to these overlapping challenges [3]. [4] present an approach where testing is used as a tool to build knowledge structures, particularly beneficial for students with mathematical learning difficulties. [5] examines the complexity of mathematics examination questions for weaker readers, indicating the necessity of adaptable question designs to aid students with learning difficulties. [6] provide a comprehensive meta-analysis of teaching strategies, offering valuable insights into effective methods for teaching students with learning difficulties in mathematics. [7] focuses on assessment techniques for children who struggle with mathematics, advocating for assessments that truly reflect students' understanding and learning needs. [8] conduct a systematic review of longitudinal studies, shedding light on the evolving nature of mathematics difficulties and the importance of long-term educational strategies. Lastly, [9] emphasize the critical role of teachers' professional knowledge in identifying and addressing mathematics learning difficulties in primary education.

The research by by [1] and [9] alignment between foundational understanding and advanced learning highlights the importance of effective teaching strategies and appropriate curriculum development to cater to the needs of all students, particularly those with learning difficulties.

Building on this understanding, the research by [10] and [11] becomes particularly pertinent. [10] underscores the role of language proficiency in mathematics, suggesting that students with limited language skills, especially English Learners, may struggle with mathematical vocabulary, which is fundamental to understanding complex concepts. This implies that teachers must integrate language support within mathematics instruction from early stages to foster a comprehensive understanding of mathematical concepts. Similarly, [11] highlights the importance of explicit vocabulary instruction in mathematics for students with Mathematical Difficulties (MD). This approach can help bridge potential gaps in understanding that might hinder progress to more advanced topics.

Additionally, [12] emphasis on the need for specific strategies and interventions in algebra for students with MD or MLD aligns with this perspective. Algebra, often considered a gateway to higher mathematics, requires a solid foundation that students with learning difficulties might lack. Hott suggests the use of empirically validated interventions like CRA (Concrete-Representational-Abstract) and schema-based strategies to strengthen this foundation, thereby enabling students to better handle advanced mathematical concepts.

Moreover, [13] research on equitable opportunities in mathematics education resonates with this need for a strong foundation. Wilhelm emphasizes the role of teachers in creating an inclusive learning environment where students from diverse backgrounds, including those with learning difficulties, are given the opportunity to develop a robust mathematical foundation. This is critical for ensuring that all students have the necessary grounding to progress in mathematics.

In the broader context, the empirical gap focuses on the tangible aspects of mathematics education, such as the effectiveness of instructional methods, teacher training, and assessment strategies. Meanwhile, the theoretical gap explores the deeper, psychological and cognitive principles that underpin the learning process in

mathematics. Addressing both gaps is pivotal for a holistic understanding of mathematics education and for devising strategies that meet the varied needs of learners, especially those experiencing learning challenges. This dual approach ensures that both practical teaching methodologies and theoretical understanding work in tandem to provide a comprehensive educational experience.

This research aims to explore the learning difficulties in mathematics as experienced and expressed by prospective teachers, with a focus on understanding these challenges from their unique perspectives and seeking solutions to address them. By employing a phenomenological approach, this study seeks to bridge both the empirical and theoretical gaps in the existing literature, contributing to a more comprehensive understanding of the challenges faced by future mathematics educators. This research was conducted on second semester mathematics education students (prospective teachers) at one of the private universities in Cirebon, West Java, Indonesia.

This research thus contributes significantly to the field of mathematics education by providing a nuanced understanding of the challenges faced by those training to become mathematics teachers and suggesting the importance of addressing internal factors in learning difficulties

2 Theoretical Framework

2.1 Affective Domain in Learning Mathematics

Attitude, interest, and motivation are integral components of the affective domain in education, playing a crucial role in student learning. [14] notes, being interested in a topic is a mental resource that enhances learning and leads to better performance. However, academic motivation tends to decline from elementary school to high school, as observed by the [15]. This decline is coupled with the changing nature of adolescence, where students may struggle to appreciate the value of school success. [16] underscores that the motivation to learn is a competence developed through experiences and is influenced by modeling, communication of expectations, and direct instruction or socialization, particularly by significant figures like parents and teachers.

2.2 Importance of Prerequisites in Mathematics

Mathematics is sequential, where mastery of basic concepts is essential for understanding advanced topics; thus, early gaps in learning can greatly impede later progress. [17] emphasizes that knowledge in mathematics is structured within a student's mind, based on their existing cognitive framework. A lack of elementary mathematics mastery can hinder higher-level learning, making it essential to identify and address foundational knowledge gaps for successful math education.

2.3 Self-Efficacy and Self-Confidence in Mathematics Learning

The concepts of self-efficacy and self-confidence, though often used interchangeably, are distinct yet interconnected. [18] describe self-efficacy as a belief specific to particular situations, whereas self-confidence is more of a general personality trait. For instance, a student's belief in their ability to complete a mathematics task is a reflection of self-efficacy, while their overall confidence in their mathematical abilities signifies self-confidence. Self-confidence, a metacognitive trait that evolves over an individual's lifetime, can be influenced by various life experiences, as noted by [19]. Enhancing students' self-confidence in mathematics requires patience and consistent positive reinforcement from teachers.

2.4 Enhancing Self-Confidence in Mathematics Education

[1] recommend respecting the 'mathematical privacy' of students with learning difficulties, suggesting that they should not be pressured to respond to questions when unsure of the answers. Teachers are crucial in boosting students' math confidence, affected by even minor negative experiences, through patient guidance and recognition of their efforts.

2.5 Guiding Research Interviews

This theoretical framework provides researchers with insights into the complexities of learning mathematics. It guides the exploration of students' learning difficulties, highlighting affective, cognitive, and metacognitive factors influencing math learning.

3 Material and Methods

This qualitative, phenomenological study uses in-depth interviews to explore prospective teacher candidates' experiences and perceptions of learning difficulties in mathematics. Phenomenology centers on describing the commonalities shared by all participants as they experience the phenomenon fenomena [20]. The following paragraph will provide a more detailed explanation of how this phenomenological study was conducted.

3.1 Participants

Research participants, known as subjects, respondents, interviewees, and other terms, play a crucial role in enhancing our understanding of human behavior. According to [21], participants can contribute data to research through diverse means, including questionnaires, interviews, experiments, personal health records, narratives, focus groups, and direct observations. This study involved interviews with eight first-year mathematics education majors at a large private university in West Java, Indonesia, comprising five female and three male students aged 18 to 20 years.

3.2 Data Collection

This study involved interviewing prospective teacher candidates who struggled with mathematics, after obtaining their consent. Conducted individually over the phone and recorded for accuracy, these interviews explored their math learning experiences from childhood to college. Participants shared challenges, coping strategies, and their definitions of math learning difficulties, offering personal insights.

3.3 Data Analysis

Data analysis in this study was executed through thematic analysis, a method delineated by [22] as a process for identifying, analyzing, and reporting patterns or themes within the data. This method involves an organized and detailed examination of the data set. The thematic analysis involved segmenting and coding the data to identify initial themes, categorizing them, and naming the categories. This iterative process, focused on extracting meaningful insights, was facilitated using ATLAS.ti 9, a specialized qualitative analysis software.

4 Results

Data analysis reveals that prospective teacher candidates attribute their math learning difficulties to four main factors: teacher attitudes, the relationship between student interest and teaching methods, learning fatigue, and teacher competence and methodologies.

4.1 The Positive and Negative Influence of Teacher Attitudes

Participants reported negative attitudes from their math teachers, including undisciplined lesson conduct, reluctance to answer questions, and off-topic discussions. One participant, Syamil, described his high school mathematics learning experience, noting, "My teacher was not open to discussions. Whenever we asked questions, he would often counter with more questions instead of providing answers. On one occasion, my question led to an argument, making it difficult to have a constructive discussion. This environment made me uncomfortable and hesitant to ask further questions."

Sulisa highlighted teacher indiscipline, recalling, "Our classes were supposed to last for two 45-minute sessions, but my teacher often only arrived for the last 45 minutes," and from junior high, "In 7th and 8th grade, rather than explaining the math material, the teacher often spent time talking about their child who was in college." These behaviors led to reduced learning time and off-topic discussions.

The negative attitudes displayed by teachers have led to learning difficulties among students. This was highlighted by Syamil, who explained, "Some teachers show disinterest when you ask them questions. They often avoid answering, which makes you feel incapable. As a result, your grades suffer, and you start developing a dislike for mathematics, especially in high school."

Ginanti, unlike others, faced challenges in primary school due to a strict teacher, leading to her hesitation in seeking help. She stated, "In primary school, much like in early childhood education, I struggled with math and consistently received low grades. My lack of understanding was compounded by the teacher's strict demeanor, which intimidated me and deterred me from asking questions." This negatively impacted her engagement and learning in mathematics.

Positive teacher attitudes, including clear lesson delivery, regular assessments, motivation, availability for queries, and a friendly demeanor, significantly helped students overcome learning challenges. Ginanti described this impact, stating, "When the teacher is good and engaging, it positively influences my learning. I find myself understanding the material better when the teacher explains it clearly, which helps me grasp the concepts more effectively."

Ali's experience in junior high school appears to have been more advantageous compared to other participants, owing to his teacher's accessibility and support. He shared, "In junior high, we received the syllabus early, which allowed me to research topics on Google, especially those I found challenging. I would study independently to at least understand the formulas and methods. Whenever I encountered something unclear, I had resources: I could ask knowledgeable peers, and importantly, I had my teacher's WhatsApp number. I often texted her with questions like, 'How do I solve this?'".

4.2 The Relationship Between Interest, Learning Methods, and Learning Difficulties

Participants' interest in learning correlated with teaching methods; they preferred traditional, face-to-face instruction and often struggled with online learning, especially in mathematics, which exacerbated their learning difficulties. Ali, reflecting on his experiences with both online and offline learning, commented, "Offline explanations are more effective, aren't they? They're conducted in person, not through a screen. In virtual classes, some might still be in bed or not fully prepared, affecting their concentration."

4.3 Fatigue

Ginanti recounted an experience where fatigue impacted her ability to learn effectively. She explained, "In high school, there were times when I felt really tired, especially after returning from an organizational event. Then, having a math class scheduled for the following morning only compounded my tiredness, making it difficult for me to concentrate and understand the material."

4.4 Teacher Competence and Teaching Methods

Study participants attributed their math learning difficulties to poor teacher competence and ineffective teaching methods, such as insufficient explanations and overly rapid concept delivery. Ulfani expressed, "Sometimes the explanation is too

fast-paced, or it feels inadequate. It's like they only go through the steps without really teaching the fundamental concepts." These issues significantly hampered her learning.

Data analysis showed more female participants than males reported difficulties in learning mathematics, leading many to seek extra help through tutoring. Despite their preference for online learning, female participants also faced greater challenges with this mode of instruction.

Figure 1 illustrates the crucial interplay between student fatigue, teacher attitudes, and student interest in mathematics learning. Fatigue, arising from busy schedules, hinders comprehension, and is worsened by negative teacher attitudes like unstructured lessons and rushed explanations. Conversely, positive teacher support enhances learning. Student interest is key; it boosts engagement, while its absence, combined with negative factors, impedes progress. This figure underscores the need for comprehensive educational approaches to address these interconnected elements.

Fig. 1. Relationship between Themes and Students' Learning Difficulties

5 Discussion

This research provides critical insights into mathematics learning difficulties, offering valuable information for educational practitioners, teachers, and policymakers. For educational practitioners, the nuanced understanding of learning difficulties as heterogeneous conditions, as highlighted by [23] emphasizes the need for precise identification and intervention. This study supports the development of individualized educational programs, in line with the recommendations by Lerner in [24] which are crucial for addressing the specific needs of students with learning difficulties.

Teachers can benefit from the clarification this research offers regarding the causes of learning difficulties. While factors like teacher attitudes and teaching methods are influential, they do not constitute the primary causes of learning difficulties, as these are external to the student. This understanding, drawn from the definitions provided by ACALD (as cited by Lovitt in [24]) and [23], can guide teachers in focusing on enhancing student engagement and motivation, and in adopting specific strategies to address challenges related to dyslexia, dysgraphia, and dyscalculia.

From a policy perspective, the insights provided by this research are invaluable for government and policymakers. These findings can inform the development of

educational policies that support students with learning difficulties, ensuring the provision of necessary resources for assessments and tailored interventions. Moreover, the study underscores the importance of targeted teacher training programs and inclusive curriculum design, as advocated by Reber in [25] and [26]. These programs and curriculums can equip educators with the skills to identify and address learning difficulties effectively, thus fostering a more inclusive and effective educational environment.

6 Conclusion

This study has highlighted the complexities surrounding the difficulties experienced by prospective mathematics teachers in their learning process. The findings reveal that while teacher attitudes, alongside interest, fatigue, and teacher competence, play a significant role in influencing students' learning experiences, they are not the root causes of learning difficulties. Experts suggest that true learning difficulties originate from within the students themselves. This includes factors such as a lack of intrinsic affective abilities like interest in learning, and cognitive abilities like insufficient prerequisite knowledge.

The research data has facilitated the construction of themes that reflect how participants perceive and experience difficulties in learning mathematics. This perspective is crucial, as it emphasizes the internal origins of learning challenges, moving away from external attributions.

Authors' Contributions

Hartono: Conceptualization, analysis, manuscript drafting, writing, securing funding. Hadi: Editing/reviewing, supervision, final approval. Rosnawati: critical revision of the manuscript.

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