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Teachers' difficulties in teaching mathematics for grade XI: case study in Nias Adventist High School

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Abstract

This study aimed to identify and analyze the difficulties experienced by teachers in teaching Mathematics to XI-grade students. The research used a qualitative approach to examine the challenges faced by teachers in teaching Mathematics to IX-grade students. The participants in this study included two mathematics teachers and 32 eighth-grade students. The results of the study showed that teachers faced difficulties in several aspects, including a lack of understanding of basic concepts, difficulties in applying concepts, lack of motivation, lack of parental support, and insufficient skills in using mathematical tools. To address these challenges, teachers implemented various effective teaching strategies, such as project-based learning, computer-based learning, and group-based learning. These strategies helped students better understand mathematical concepts and increased their motivation to learn mathematics. It was also important for teachers to show the connection between mathematics and students' daily lives, so they could see the relevance of mathematics in their lives. Teachers sought assistance and developed their skills in information technology to improve the quality of Mathematics instruction. The importance of teaching mathematics lay in the way teachers engaged students, ensuring they were motivated and interested in learning mathematics by linking the material to real-life situations, creating interactive and engaging lessons, and building positive relationships with students. Teachers adopted innovative strategies such as project-based learning, computer-based learning, and real-life applications to enhance students' understanding and motivation in mathematics. Additionally, professional development programs and stronger collaboration with parents were essential to effectively address teaching challenges.

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1. Introduction

Mathematics is a universal science and forms the foundation for the development of modern science and technology, which in turn advances human thought and analysis (Sudirman). Often considered an abstract subject, mathematics requires serious attention from all parties involved in the learning process, including teachers, the school environment, parents, and the home environment. Mathematics learning is a process where students actively construct mathematical knowledge. The roles of various stakeholders have a significant influence on the success of mathematics education, equipping students with skills such as logical, analytical, systematic, critical, innovative, and creative thinking, as well as collaboration skills (Mahmudah & Fikroh, 2021).

Teachers are most familiar with the classroom situation: how students perform, the abilities they possess, and the adequacy of the infrastructure. Children have different personalities, including academic abilities. In the teaching-learning process, many students face learning difficulties. Learning difficulties occur not only among low-achieving students but also among high-achieving students, and even students of average ability face challenges (Wicaksana & Rachman, 2018). Learning difficulties are indicative of barriers to academic achievement. The importance of problem-solving lies in its essence as a key aspect of knowledge. Problem-solving plays two crucial roles in mathematics education: 1) it is an important aid in mathematics learning, and 2) it provides students with information and tools to formulate and approach problem-solving strategies (Rosalinda et al., 2022).

Students who encounter barriers in learning skills experience difficulties in understanding. Learning disabilities refer to situations where students are unable to learn adequately due to threats, obstacles, or disturbances in the learning process. These obstacles prevent the achievement of educational goals (Zuliani & Rini, 2021). One of the most common difficulties students face is in learning mathematics. Many students struggle with mathematics, and various issues can prevent the optimal achievement of learning objectives. When students face difficulties in mathematics class, it is generally accepted as a common reality. Mathematics is often perceived as a frightening subject, regarded as abstract and difficult to comprehend. Among all subjects taught in schools, mathematics is considered the most challenging, especially for students who struggle with it (Ayu et al., 2021).

The nature of learning difficulties in mathematics varies. Not all students face the same challenges. Common difficulties in learning mathematics include: 1) difficulty distinguishing numbers, symbols, and geometric shapes, 2) difficulty recalling mathematical statements, 3) difficulty reading or writing numbers in small fonts, 4) misunderstanding of mathematical symbols, 5) weakness in abstract thinking, and 6) weak metacognitive skills (difficulty identifying and using algorithms to solve mathematical problems) (Simbolon et al., 2019). Factors influencing students' learning progress include teachers, methods, students themselves, tools, and more. These factors can be categorized into internal (student-related) and external (environmental) factors. Learning difficulties affect academic performance, as good academic results are typically achieved through effective learning therapies both inside and outside of school, proper study organization, and effort. This holds true for mathematics education as well. Hence, it is essential for teachers to understand the learning difficulties students face in mathematics classes to improve the teaching-learning process (Febianti & Joharudin, 2018).

Mathematics, as an exact and abstract science, offers numerous benefits for human life. However, it also requires students to understand and adhere to all its rules. Once students grasp these rules, they can apply them in ways that have a positive impact on their lives. Mathematics also fosters creativity, accuracy, critical thinking, innovation, logic, and diligence. Through mathematics, students learn to persevere in problem-solving, which ultimately boosts self-esteem and satisfaction (Adzima et al., 2022; Pardosi et al., 2023). Mathematics education contributes to other fields of knowledge, as many disciplines rely on mathematical concepts. The term "mathematics" originates from the Greek words "mathematic" (study) and "mathema" (knowledge or science), indicating its broad and foundational role in various fields. Furthermore, mathematics should be accessible to children and relevant to everyday situations. Realistic Mathematics Education (RME) emphasizes relating mathematical problems to real-life scenarios, making the subject matter more meaningful and engaging for students. RME encourages students to find mathematical tools that help them organize and solve real-world problems, gradually building up to more abstract mathematical concepts (Natalia, 2020).

Research highlights the positive impact of RME on student learning outcomes in mathematics. Studies show that the application of RME can improve students' understanding of challenging mathematical concepts, boost their motivation, and enhance their problem-solving abilities (Astuti, 2018; Ningsih, 2013; Honda, 2016; Kurnia, 2020). Mathematics plays a critical role in solving various problems we face in life. It helps develop logical and systematic thinking, preparing students to apply mathematical reasoning in their daily lives. Mathematics is essential for equipping students with skills to manage and analyze data, which are vital for adapting to an ever-changing world.

Mathematics is characterized by abstract concepts that often create confusion and difficulty for many students. It is considered complex, challenging, and sometimes boring. Students often struggle to grasp mathematical concepts, leading to failures in their first year of formal mathematics education.

Therefore, educators must emphasize the importance of mathematics learning, as it is continuously used in daily life. Mathematics is a mandatory subject at all educational levels, from elementary through university (Mahmudah & Fikroh, 2021).

Unfortunately, traditional mathematics teaching methods often focus on simply explaining the material, which requires students to put in a great deal of effort to process the information and understand the concepts. This abstraction in mathematics hinders students' ability to explore the concepts independently. Studies have shown that teachers often lack an understanding of students' characteristics, which leads to challenges in delivering effective learning and results in poor student comprehension (Ditasona, Kartika, & Lumbantoruan, 2023).

2. Method

2.1 Research Design

This study employs a qualitative method with a phenomenological approach. This approach was chosen to explore in-depth experiences of teachers regarding the difficulties they face in teaching mathematics at SMA Nias. The main objective of this research is to understand the challenges teachers face in conveying mathematical concepts to students and how they overcome these difficulties. By using a phenomenological approach, this study focuses on the subjective experiences of teachers in the context of mathematics education.

2.2 Participants

The participants in this study are mathematics teachers who teach at SMA Nias. Participants were selected using purposive sampling, which focuses on teachers with direct experience in teaching mathematics. The selected teachers are those who have a deep understanding of the challenges they face in teaching mathematics and are willing to share their experiences regarding the difficulties they encounter as well as the strategies they use to overcome them. Through purposive sampling, this study aims to obtain relevant and in-depth information from those most knowledgeable in the field.

Data Collection

2.3 Semi-structured Interviews

Semi-structured interviews will be used as the primary method for data collection in this study. This method was chosen because it allows the researcher to explore more in-depth and flexible information regarding the teachers' experiences in teaching mathematics. The interview guide will contain open-ended questions to facilitate an in-depth discussion of the difficulties faced by teachers during the teaching process. Each interview will be recorded using an audio recorder to ensure the accuracy of the collected data. The recordings will assist the researcher in analyzing and transcribing the conversations more carefully.

2.4 Documentation

The documentation method will also be used to collect data that provides contextual information regarding the policies and teaching strategies implemented by the teachers. The documents to be collected include the curriculum used, lesson plans, teaching materials prepared by the teachers, and other relevant documents. This data is expected to provide a clearer picture of the approaches used by teachers in addressing the difficulties they face in mathematics education. The use of documentation allows the researcher to obtain more objective and detailed information about the educational policies and teaching strategies applied in practice.

2.5 Data Analysis

Thematic Analysis

After the interview data is collected, thematic analysis will be conducted. The first step is to transcribe the interview results, then identify the main themes related to the difficulties faced by teachers in teaching mathematics. These themes will be grouped to provide a deeper understanding of the challenges faced by teachers. Thematic analysis aims to identify patterns that emerge in teachers' experiences and understand how they address obstacles in teaching mathematics.

Descriptive Analysis

The data collected through the documentation method will be analyzed using descriptive analysis. This technique is used to identify patterns related to the policies, teaching strategies, and materials used by the teachers. The results of this descriptive analysis are expected to provide a clear picture of the

approaches implemented by teachers in overcoming difficulties in mathematics education. Descriptive analysis will help the researcher to depict in more detail the patterns found in the collected documents, providing broader context regarding the challenges faced by teachers.

3. Results and Discussion

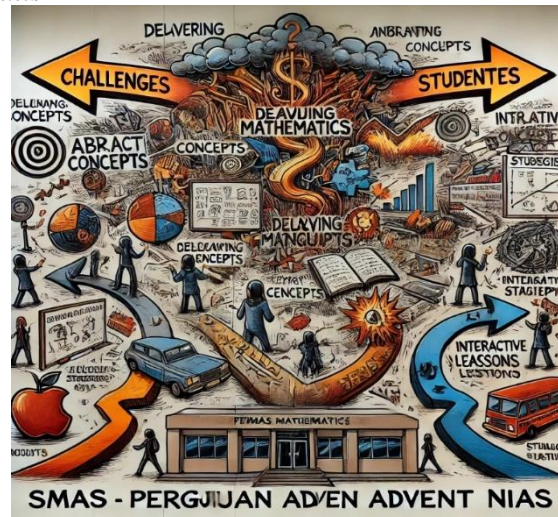
3.1 Results

Difficulties Faced by Teachers in Teaching Mathematics

This study aims to explore in-depth the difficulties faced by teachers in teaching mathematics in class XI at SMAS Perguruan Advent Nias, as well as the strategies applied to overcome these difficulties. The mathematics learning process at this school is characterized by various challenges, both from the teacher's and the students' sides. Teachers face difficulties in delivering abstract mathematical concepts, while students struggle to understand and apply the material in real-life situations. This study focuses on how teachers at SMAS Perguruan Advent Nias try to overcome these obstacles to improve students' interest and understanding of mathematics.

Figure 1.

Illustration of research results



Teachers' Difficulties in Delivering Material

One of the main issues faced by mathematics teachers at SMAS Perguruan Advent Nias is how to address students' difficulties in understanding difficult mathematics materials, particularly in spatial geometry concepts. Students often struggle to visualize three-dimensional shapes and understand the relationship between formulas and real-world objects. Most students become confused when asked to calculate the volume or surface area of three-dimensional shapes such as prisms, cubes, and rectangular prisms. This is due to students' inability to mentally picture these shapes, which is crucial for understanding the formulas.

Teachers at SMAS Perguruan Advent Nias try to overcome this problem by adopting more contextual approaches that are relevant to students' daily lives. However, even though they have used various teaching media such as pictures, 3D models, and other props, there are still challenges in making these concepts easier to understand for students. Some teachers state that despite their efforts to explain using different methods, many students still fail to connect the theory with real-world applications. This leads to students feeling that mathematics is a difficult and boring subject.

Difficulties in Increasing Students' Interest in Learning

Another clear issue at SMAS Perguruan Advent Nias is the low level of students' interest in learning mathematics. Some students even feel forced to attend mathematics lessons and tend to be passive during classes. Teachers at this school acknowledge that engaging students in learning mathematics is not an easy task. Many students view mathematics as an abstract subject that is not relevant to their lives. When students cannot see the immediate benefits of what they are learning, they tend to be less motivated to explore the material further.

To address this issue, teachers at SMAS Perguruan Advent Nias try to better understand students' characteristics and needs. One of the steps taken is conducting discussions and observations of students' attitudes and difficulties. Through this observation, teachers realize that class XI students tend to be more interested in learning that is based on real-life applications and daily relevance. For instance, students are more engaged when discussing how mathematical concepts can be applied in the context of work, technology, or even in everyday activities such as shopping or traveling. Recognizing this, teachers began adapting more student-centered approaches and seeking ways to help students see the relevance of mathematics in their lives. One effort made is to use the RME (Realistic Mathematics Education) approach, which allows students to learn mathematics through real phenomena and applications relevant to their world. In this study, teachers used concrete media, such as 3D models of shapes that students could touch and study directly. This approach allows students to not only understand mathematical concepts but also to see the practical applications of mathematics in their everyday lives.

Challenges in Solving Mathematical Problems

When it comes to solving mathematical problems, students at SMAS Perguruan Advent Nias also face significant difficulties. Most students struggle to apply the concepts they have learned to solve mathematics problems, especially problems that are more complex and require critical thinking. One of the problems students face is an inability to understand the steps required to solve math problems. For example, when dealing with problems involving volume or surface area of 3D shapes, students often become confused about which formula to use and the calculation steps.

Teachers at SMAS Perguruan Advent Nias identify that many students lack a strong foundational understanding of mathematical concepts, which hinders their problem-solving ability. Students often get stuck on seemingly complicated problems because they do not understand the underlying theory behind the formulas used. This leads to frustration and a loss of motivation to attempt more difficult mathematics problems.

To address this, teachers at SMAS Perguruan Advent Nias try to provide a more individualized approach and pay closer attention to each student's needs. Teachers offer more intensive guidance to students who are struggling, providing additional explanations about the steps in problem-solving. Additionally, teachers also apply a psychological approach by offering moral support and creating a classroom atmosphere that is not intimidating, so students feel more comfortable asking questions and attempting to solve mathematics problems.

Application of RME Approach to Improve Students' Understanding

The RME approach applied by teachers at SMAS Perguruan Advent Nias has proven effective in improving students' understanding of spatial geometry concepts. By using concrete media, such as 3D models that students can touch, students find it easier to understand the relationship between formulas and real-world objects. For example, to understand the concept of the volume of a triangular prism, students are invited to assemble a model of a triangular prism using cardboard or other materials, so they can directly see and feel its physical shape. This approach makes it easier for students to connect theory with practice.

Students are also given the opportunity to discuss these concepts in groups, where they can ask questions and help each other solve problems. Teachers act as facilitators, providing guidance and direction during group discussions. This approach allows students to find solutions together, enhancing their critical thinking skills. Furthermore, group discussions also help boost students' confidence in solving mathematics problems, as they feel supported by their peers. Through this approach, students also gain a better understanding of how mathematics is connected to their daily lives. They can see that the mathematical concepts taught are not separate from reality, but are highly relevant and useful in various practical situations. For example, the concepts of volume and surface area of 3D shapes can be applied in the context of calculating materials for building a house or in calculating the capacity of containers to store goods.

Observation and Interview Results

Observations of the learning process at SMAS Perguruan Advent Nias indicate that while teachers make efforts to use more student-centered approaches, many students remain passive during the learning activities. The observations show that during lessons, many students prefer to listen to the teacher's

explanation without actively participating in discussions. However, when teachers begin using concrete media and provide opportunities for group discussions, there is an observable increase in students' interest and active participation.

Interviews with several mathematics teachers at SMAS Perguruan Advent Nias revealed that the main challenge they face is how to address the differences in students' abilities to understand mathematics material. Some students grasp the concepts more quickly, while others take more time and need more guidance. Teachers also recognize the importance of parental involvement in supporting students' learning outside of class. Many teachers suggest that parents become more actively involved in communicating with teachers to track their children's learning progress. In interviews with students, they expressed that they found mathematics lessons more engaging when teachers used examples relevant to daily life. Students also stated that they felt more confident in solving math problems when given the opportunity to discuss with their peers.

Analysis of Student Learning Outcomes

The results of student learning in this study show a significant improvement after the implementation of the RME approach with concrete media. From the tests conducted before and after the learning using this approach, there is a clear improvement in students' understanding of mathematical concepts. Students who previously struggled with understanding spatial geometry concepts such as volume and surface area are now able to solve problems more easily and accurately. However, despite significant progress in understanding basic concepts, some students still struggle to apply these concepts in more complex problems. This shows that while the RME approach helps students understand the basic concepts of mathematics, they still need more practice and reinforcement in applying these concepts.

Evaluation and Impact of Learning

After applying the RME approach with concrete media in mathematics learning, there was a significant improvement in students' understanding of the material taught. Students who previously found it difficult to understand spatial geometry concepts now find it easier to understand the relationship between formulas and real-world objects. They are also more actively engaged in the learning process, especially in group discussions and practical tasks involving the use of concrete media. However, despite positive progress, some issues still remain. Some students continue to struggle with applying the concepts they have learned to solve more complex problems. This indicates that while their basic understanding has improved, students still need more time to develop skills in solving mathematics problems in greater depth.

3.2 Discussion

This discussion will integrate the findings from the research conducted with previous studies and relevant theories to provide a deeper understanding of the challenges faced by teachers in teaching mathematics at SMAS Perguruan Advent Nias, particularly regarding spatial geometry topics in class XI. This section will explain how the findings align or differ from previous research, and how mathematical and educational theories can offer insights into the results obtained.

Research Findings and Their Relationship to Previous Studies

The findings from this research reveal that one of the main challenges faced by teachers at SMAS Perguruan Advent Nias is how to overcome students' difficulties in understanding abstract mathematical concepts, such as the formulas for spatial geometry. Similar issues have been identified in previous studies. For example, according to research by Putra (2019), many students struggle to understand geometric concepts because they are unable to visualize three-dimensional shapes and relate them to the associated formulas. This finding is also echoed in the research by Sari and Indriani (2020), which states that the lack of students' ability to visualize spatial shapes leads to difficulties in understanding concepts like volume and surface area.

Another finding in this study is the low student interest in mathematics. This is consistent with research by Handayani and Santosa (2018), which shows that students are often demotivated in mathematics because they do not see the relevance of the subject to everyday life. They view mathematics as a difficult and impractical subject. Similar problems were found by Kurniawan (2017),

who states that mathematics is often perceived as unappealing due to its abstract nature, which is far removed from real-life experiences.

However, this study found that the application of the Realistic Mathematics Education (RME) approach with tangible media can enhance students' understanding of mathematical concepts. This finding aligns with research by Wijaya (2016), who asserts that the RME approach can help students grasp mathematical concepts in a more concrete and applicable way, by using real-life contexts as the foundation for learning. Furthermore, the study by Hidayati and Fitri (2021) suggests that using concrete media in mathematics instruction can assist students in visualizing mathematical shapes, increasing their interest and motivation to learn.

Mathematics Education at SMAS Perguruan Advent Nias

The findings also indicate that the use of concrete media and a more student-centered approach can help students become more active and engaged in mathematics learning. This is in line with Piaget's (1970) theory of constructivism, which posits that knowledge is built by individuals through direct experiences and interactions with their environment. In the context of mathematics learning, hands-on experiences using concrete media and real-life applications can reinforce students' understanding of abstract mathematical concepts.

Thus, the application of an approach that focuses on real-world experiences and the use of teaching aids can help students relate mathematical concepts to the real world. For example, in the teaching of spatial geometry, using physical models such as prisms and cubes can help students visualize three-dimensional shapes and understand the relationship between formulas and these shapes. This aligns with Vygotsky's (1978) theory, which states that effective learning occurs through social interaction and meaningful experiences. The use of concrete media in mathematics teaching enables students to undergo a more meaningful learning process, as they can directly experience what they are learning.

Another challenge faced by teachers is how to address the varying abilities of students in understanding mathematical material. This study found that some students still struggle to apply the concepts they have learned to more complex problems. This is in line with Anderson's (2005) cognitive learning theory, which states that deep understanding of a concept requires repeated practice and application. Furthermore, in the context of mathematics learning, students need to develop critical thinking skills and problem-solving abilities that rely not only on mechanical memorization of formulas but also on a deep understanding of the fundamental principles underlying those formulas.

Application of RME Approach in Mathematics Learning

The application of the Realistic Mathematics Education (RME) approach found in this study has proven effective in enhancing students' understanding of mathematical concepts, especially in spatial geometry. RME, as explained by Freudenthal (1991), is a mathematics learning approach that emphasizes the importance of using real-world contexts as the basis for instruction. In this way, students can connect the mathematical concepts they learn to experiences they encounter in everyday life.

In the context of spatial geometry instruction, the use of three-dimensional models or concrete media that students can physically interact with provides a direct experience that helps them understand the relationship between theory and practice. Moreover, RME also emphasizes student involvement in learning, where students are given the opportunity to solve problems and discover solutions independently or in groups. This is in line with the constructivist learning theory proposed by Piaget and Vygotsky, which emphasizes the importance of active experiences and social interaction in learning.

The implementation of the RME approach can also help address the problem of low student interest in mathematics. By relating the material to real-life situations and using engaging media, students can see the relevance of mathematics in a more practical context. This can increase their motivation to be more active in the lessons. For example, in this study, the use of spatial geometry models in teaching made students more interested and better able to understand abstract concepts.

Challenges in Solving Complex Mathematics Problems

Although the application of the RME approach has been effective in improving basic understanding, problems remain when students are tasked with solving more complex mathematical problems. Many students still find it challenging to connect the concepts they have learned to more difficult problems. This indicates that a deep understanding of mathematical concepts requires time and

sustained practice. In this regard, cognitive learning theory and problem-solving theory can provide further explanation. Cognitive theory states that students need time to internalize information and transform it into knowledge that can be applied in different situations. This requires more frequent practice and repetition.

Additionally, according to Polya's (1957) problem-solving theory, solving mathematical problems requires the ability to understand the problem, plan a solution strategy, implement the strategy, and ultimately check the solution obtained. In this case, teachers need to provide varied practice problems and give students the opportunity to think critically and search for solutions independently. Problem-solving-based learning, which is based on real-world and relevant situations, will help students develop the critical thinking skills necessary to solve more complex mathematical problems.

4. Conclusion

This study shows that mathematics teachers face several challenges in teaching mathematics, such as low student interest in learning, teacher dependency, lack of creative approaches, difficulties in online learning, challenges in assessing attitude aspects, and difficulties in using teaching media. To address these challenges, teachers can implement strategies such as fostering student interest by choosing topics relevant to their lives and applying more creative and contextual approaches. The use of more interactive and effective learning media, such as information technology applications, is also crucial in enhancing student engagement. In addition, developing teachers' skills in utilizing information technology can help improve the quality of mathematics instruction, particularly in teaching abstract concepts that are difficult for students to understand. The Realistic Mathematics Education (RME) approach has proven to be effective in improving students' understanding of spatial geometry concepts. By using concrete media and presenting problems related to real-life situations, students can more easily connect theory with practice, which enhances their motivation and understanding.

The implication of this research is that teachers should pay more attention to students' needs and employ various strategies that support the development of mathematical understanding. Approaches such as RME can be an effective alternative in creating a more enjoyable and meaningful learning experience. Thus, improving the quality of teaching and student learning outcomes can be achieved, which in turn will enhance the overall quality of mathematics education.

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Conflict of Interest:

There is no conflict of interest in this research.

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