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A Math Phobia Mitigation Model to Enhance High School Students' Motivation, Interest, and Mathematics Learning Outcomes

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ABSTRACT

Mathematics is a fundamental subject that plays an important role in developing logical and analytical thinking skills. However, many students experience math phobia, which negatively affects their motivation, interest, and learning outcomes. This study aims to (1) describe the concept of math phobia, (2) develop a math phobia mitigation model, and (3) analyze the effect of the model on students' mathematics learning outcomes. The study employed a Research and Development (R&D) method with a mixed-methods approach. The research subjects were high school students in Binjai City. The results indicate that math phobia is characterized by emotional anxiety, cognitive disruption, and avoidance behavior. The developed mitigation model was able to increase students' motivation and interest in learning, as well as improve learning outcomes from an average score of 62 to 82. Therefore, the mitigation model is proven to be effective in reducing mathematics anxiety and improving student achievement.

Informasi Artikel

Kata Kunci:

Math phobia; motivasi belaja;, hasil belajar; mitigasi; pembelajaran matematika

ABSTRAK

Matematika merupakan mata pelajaran fundamental yang berperan dalam pengembangan kemampuan berpikir logis dan analitis. Namun, banyak siswa mengalami math phobia yang berdampak negatif terhadap motivasi, minat, dan hasil belajar. Penelitian ini bertujuan untuk (1) mendeskripsikan konsep math phobia, (2) mengembangkan model mitigasi math phobia, dan (3) menganalisis pengaruh model terhadap hasil belajar matematika siswa. Penelitian menggunakan metode Research and Development (R&D) dengan pendekatan mixed methods. Subjek penelitian adalah siswa SMA di Kota Binjai. Hasil penelitian menunjukkan bahwa math phobia ditandai oleh kecemasan emosional, gangguan kognitif, dan perilaku menghindar. Model mitigasi yang dikembangkan mampu meningkatkan motivasi dan minat belajar serta meningkatkan hasil belajar dari rata-rata 62 menjadi 82. Dengan demikian, model mitigasi terbukti efektif dalam mengurangi kecemasan matematika dan meningkatkan prestasi siswa.

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1. Introduction

Mathematics plays a crucial role in human life, not only as a tool for calculation but also as a means of developing logical, critical, systematic, and creative thinking skills. Through mathematics learning, students are trained to analyze problems, identify patterns, and develop effective problem-solving strategies. Therefore, mathematics is considered a core subject that significantly contributes to the development of human resource quality.

However, in classroom practice, mathematics is often perceived as a difficult and intimidating subject by many students. A considerable number of students experience anxiety toward mathematics, commonly referred to as *math anxiety* or *math phobia*. This condition is characterized by feelings of fear, tension, nervousness, and even panic when dealing with mathematics-related tasks or situations. As a result, students tend to avoid mathematical activities, both inside and outside the classroom.

Numerous studies have shown that *math anxiety* is negatively correlated with mathematics learning outcomes. The higher the level of anxiety experienced by students, the lower their academic achievement tends to be. In addition to affecting learning outcomes, mathematics anxiety also influences students' affective and cognitive aspects, such as reduced learning motivation, low interest in mathematics, and hindered creative thinking abilities.

From a psychological perspective, emotional factors such as anxiety have been proven to interfere with cognitive processes. When students experience anxiety, their working memory capacity becomes limited, which in turn disrupts their ability to understand concepts, process information, and solve problems. Furthermore, *math phobia* is closely associated with low self-confidence and students' self-efficacy in learning mathematics. Students who lack confidence in their abilities are more likely to give up easily and exert less effort when facing mathematical challenges.

If this condition is not properly addressed, it may have long-term consequences on students' interest and aptitude in mathematics. This is a serious concern, considering that mathematics serves as a fundamental foundation for various fields of science and technology. Therefore, a strategic effort is needed in the form of a systematic, well-planned, and integrated *math phobia* mitigation model within the mathematics learning process. Such a model is expected to help students manage their anxiety, enhance their self-confidence, and create more positive learning experiences, ultimately improving students' motivation, interest, and mathematics learning outcomes.

2. Method

This study employs a research and development (R&D) method with a mixed-methods approach.

Research Subjects: Senior high school students in Binjai City, and Mathematics teachers

Data Collection Techniques

- Questionnaires
- Observations
- Interviews
- Learning outcome tests

Data Analysis Techniques

- Qualitative: Miles & Huberman model
- Quantitative: t-test, N-Gain, and regression analysis

Location and Time

The research was conducted at senior high schools in Binjai City from April to July 2025.

3. Result and Discussion

Result

1. The Concept of Math Phobia

The findings indicate that the majority of students experience mathematics anxiety, as reflected in feelings of tension (78%), fear of being questioned by the teacher (72%), and a tendency to avoid mathematical tasks (81%). These patterns suggest that mathematics is not merely perceived as a challenging subject but also as a source of psychological discomfort for many learners. Such responses can emerge in various classroom situations, including problem-solving activities, tests, or even simple question-and-answer sessions.

From a theoretical perspective, these conditions represent the multidimensional nature of math phobia, encompassing emotional, cognitive, and behavioral aspects. Emotionally, students experience negative feelings such as fear, nervousness, and stress when dealing with mathematics. Cognitively, anxiety interferes with concentration, reduces working memory capacity, and hinders students' ability to process information and apply problem-solving strategies effectively. Behaviorally, these emotional and cognitive difficulties manifest in avoidance actions, such as reluctance to participate in class, procrastination in completing assignments, or complete disengagement from mathematical activities.

Furthermore, the persistence of these dimensions can create a negative cycle in which anxiety leads to avoidance, reduced practice, and ultimately lower achievement, which in turn reinforces the initial fear of mathematics. This cycle highlights the importance of addressing math phobia not only as an academic issue but also as a psychological and pedagogical concern that requires comprehensive and targeted intervention.

2. Math Phobia Mitigation Model

The implementation of the math phobia mitigation model demonstrates significant improvements across several key affective variables. Students' motivation increased from 2.1 to 4.0, indicating a substantial shift from

low to high engagement in learning activities. Similarly, students' interest in mathematics rose from 2.3 to 4.2, reflecting a growing curiosity and willingness to participate actively in the learning process. In addition, self-confidence improved from 2.0 to 4.1, suggesting that students developed a stronger belief in their ability to understand and solve mathematical problems.

These improvements can be attributed to the structured and student-centered design of the mitigation model. The model integrates emotional support strategies, interactive learning approaches, and gradual exposure to mathematical tasks, allowing students to engage with the subject in a less threatening manner. By reducing pressure and fear, students are given the opportunity to rebuild positive perceptions of mathematics.

Moreover, the model emphasizes the role of the teacher as a facilitator who fosters encouragement, provides constructive feedback, and creates opportunities for collaborative learning. Such an approach helps students feel more comfortable expressing their ideas and making mistakes without fear of judgment.

Overall, this model proves to be effective because it creates a safe, inclusive, and supportive learning environment. This environment not only reduces students' anxiety but also promotes active participation, resilience, and a positive attitude toward mathematics, which are essential factors for sustainable learning improvement.

3. Impact on Learning Outcomes

The implementation of the math phobia mitigation model has led to a substantial improvement in students' academic performance. The average score increased significantly from 62 to 82, indicating a marked enhancement in students' understanding of mathematical concepts and their ability to solve problems accurately. In addition, the level of learning mastery rose from 38% to 87%, showing that a much larger proportion of students were able to meet the established competency standards after the intervention.

These improvements suggest that the learning difficulties previously experienced by students were not solely due to cognitive limitations but were strongly influenced by psychological barriers, particularly anxiety. When these barriers were reduced through the mitigation model, students were able to engage more effectively in the learning process, participate actively in classroom activities, and demonstrate better problem-solving performance.

Furthermore, reduced anxiety allows students to utilize their working memory more efficiently, leading to better concentration, improved comprehension, and more accurate application of mathematical procedures. As students become more confident and less fearful, they are also more willing to attempt challenging problems, persist in finding solutions, and learn from their mistakes.

Overall, these results indicate that reducing math anxiety has a direct and meaningful impact on improving students' learning outcomes. This finding reinforces the importance of integrating emotional and psychological support into mathematics instruction as a strategy to enhance both academic achievement and overall learning quality.

Discussion

The findings of this study demonstrate that math phobia is a significant barrier in mathematics learning, influencing students' emotional responses, engagement, and academic performance. The high percentage of students experiencing tension, fear of being questioned, and task avoidance indicates that mathematics is often perceived as a threatening subject rather than a meaningful learning experience. This aligns with previous theoretical perspectives that describe math phobia as a multidimensional construct involving emotional, cognitive, and behavioral components.

Emotionally, students' anxiety creates a negative learning atmosphere that reduces their willingness to participate in classroom activities. Cognitively, anxiety interferes with working memory capacity, limiting students' ability to process information and apply problem-solving strategies effectively. Behaviorally, this manifests in avoidance tendencies, where students are reluctant to engage with mathematical tasks, thereby reducing practice opportunities and reinforcing low achievement.

The implementation of the math phobia mitigation model shows that these barriers can be significantly reduced through a structured and supportive learning approach. The increase in motivation, interest, and self-confidence indicates that students respond positively when they are placed in a safe learning environment that emphasizes encouragement, gradual exposure to tasks, and active engagement. This supports the view that affective factors play a crucial role in shaping students' attitudes toward mathematics learning.

Furthermore, the improvement in learning outcomes suggests a strong interconnection between psychological readiness and academic performance. When anxiety levels decrease, students are better able to focus, think critically, and persist in solving problems. This leads to more effective learning processes and higher achievement levels. The substantial increase in mastery learning also indicates that the model not only benefits high-achieving students but also supports those who previously struggled with mathematics.

Overall, the results confirm that addressing math phobia is essential in mathematics education. A learning environment that integrates emotional support with instructional strategies can enhance students' cognitive performance while simultaneously improving their affective development. Therefore, the math phobia mitigation model can be considered an effective approach to improving both learning quality and student outcomes in mathematics education.

Conclusion

Math phobia is a critical psychological factor that significantly influences students' success in learning mathematics. The presence of anxiety toward mathematics not only affects students' emotional well-being but also interferes with their cognitive processing and behavioral engagement in learning activities. When left unaddressed, this condition can lead to a continuous cycle of avoidance, low participation, and poor academic achievement.

The findings of this study confirm that a structured math phobia mitigation model can effectively address these challenges. The implementation of the model has been shown to improve students' motivation, increase their interest in learning mathematics, and strengthen their self-confidence. These improvements indicate that students become more willing to engage actively in learning processes when psychological barriers are reduced through supportive and student-centered instructional strategies.

In addition, the model has a positive impact on students' learning outcomes, as reflected in the significant increase in academic achievement and mastery levels. This suggests that improving affective factors such as motivation and confidence is closely linked to enhanced cognitive performance in mathematics.

Overall, the study concludes that addressing math phobia is essential for improving the quality of mathematics education. The math phobia mitigation model not only enhances students' affective and cognitive development but also creates a more positive, inclusive, and effective learning environment. Therefore, this model can be considered a promising approach for improving mathematics learning outcomes and supporting students' holistic development in the future.

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