

LITERATURE REVIEW: THE ROLE OF MULTIMEDIA LEARNING IN REDUCING MATH ANXIETY TO IMPROVE STUDENTS' MATHEMATICAL ABILITIES

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Mathematics is an abstract theory, which causes many students to experience difficulties in learning it, leading to the emergence of math anxiety. This math anxiety affects students' attitudes and performance in mathematics. To reduce this issue, it is necessary to design learning that is enjoyable and motivating for students in mathematics education. Learning that utilizes digital technology provides a solution to reduce math anxiety. Students feel happy learning with interactive multimedia. Through multimedia, they can apply and solve problems using the theories they have learned. The use of technology in mathematics learning helps students achieve better results, enhances interaction and participation in learning, and offers significant opportunities to improve their learning experience.

Keyword:, Digital technology, education, mathematics anxiety

1. Introduction

Mathematics is one of the mandatory subjects in elementary school through high school, and even in the early semesters of natural science programs at universities. Despite learning it from elementary school to university, mathematics is considered the most difficult and intimidating subject. This perception leads to math anxiety in students. Math anxiety is a condition in which a student experiences panic, making them unable to solve problems or tackle mathematical tasks. This condition will, of course, affect the student's mathematics learning outcomes. Cavanagh & Sparrow (2010) in Kasus et al., (2017) stated that, in general, indicators of math anxiety psychologically include feelings of tension, fear, and worry, low self-confidence, a sense of being threatened, failure to reach potential, and reduced memory capacity. Physically, it can be observed through sweaty hands, a racing heart, nausea, and difficulty breathing.

One of the factors that contribute to math anxiety is the lack of student readiness due to limited prior knowledge. However, it can also be influenced by the learning environment created by the teacher. According to Gresham (2009), most mathematics curricula and

teaching practices are traditional, as they focus on memorization of facts, teachers lecturing, and students having limited opportunities to actively engage in the learning process.

There are many educational media that can be used to make the learning process more effective and meaningful for students. The use of technology in learning can be fully optimized, including in mathematics education. Students today are very familiar with technology. They enjoy spending hours playing games or using social media. Therefore, teachers need to consider technology-based learning strategies that align with the current conditions and characteristics of students, which may help reduce their anxiety levels, thereby improving their mathematical performance.

This aligns with Khan's (1997) opinion in Guzeller & Akin (2012) that to improve student learning outcomes, conventional classroom teaching should be complemented with online technology that connects students with classmates and instructors outside the classroom. Information and communication technology can be applied innovatively at all stages of the teaching and learning process, from lesson planning, material preparation,

material presentation, implementation of learning, to evaluation (Surjono, 2013).

In addition, Daud Yahya et al., (2023) explain that the effectiveness of multimedia use in education is influenced by several factors, such as the design and content of the multimedia, the teaching methods used, the characteristics of the students, and the available learning environment. These factors are crucial to consider in order to enhance student learning outcomes, particularly in mathematics education. So far, there are many mathematics learning applications that are considered to facilitate students in learning mathematics, such as GeoGebra, Talking Math, Graphmatica, and others, which also help teachers in designing lessons. However, it remains to be seen whether digital learning and these applications or learning websites and LMS have a significant impact on reducing students' anxiety towards mathematics and improving their mathematical skills.

2. Research Method

Metode This study employs a literature review approach, with data collection carried out through the process of reading and examining various books and previous research journals. The sources were obtained from online journals focused on multimedia learning and student mathematics anxiety. The data collected includes relevant studies within a specific time frame, which are then analyzed to identify effective learning strategies for addressing mathematics anxiety using interactive digital media. This approach allows the researcher to gain a broader perspective on the relationship between the use of multimedia technology in education and its impact on student anxiety.

3. Discussion And Result

Mathematics anxiety began with the investigation by Dreger and Aiken (1957), who defined it as an emotional reaction syndrome to arithmetic and mathematics (Olango, n.d. 2016). They introduced mathematics anxiety as a new term to describe students' attitudinal difficulties towards mathematics. In the compilation of articles by Irene C. Mammarella et al, (2019), Ascraf stated that mathematics anxiety is generally defined as feelings of tension, worry, and fear of not performing well in mathematics.

Many factors influence the occurrence of mathematics anxiety, including internal factors that arise from within the student, such as cognitive ability, and external factors like the learning environment. Situations that cause students to feel anxious in the classroom are classified as authority created by the teacher. The limited time teachers have for instruction and testing, along with the expectations of parents and teachers for students, contribute to students' feelings of pressure (Caglar & Senol, 2021). Continuous pressure leads to mathematics anxiety among students, which needs to be addressed to prevent long-term effects. As noted by (Alanazi, 2020), teachers need to be aware of the impact of mathematics anxiety on student performance and motivation. They should strive to create an environment where students feel comfortable to reduce their anxiety and enhance their learning outcomes and motivation.

Recently, several researchers have examined learning designs that can reduce the levels of mathematics anxiety. One of the widely used models or designs is the integration of traditional and digital learning.

Tabel 1. Research results on the use of multimedia in mathematics learning

No	Author and reaserch title	Year	Result
1	H M D Soewardini, et al. journal publication at IOP Conf. Series: materials Science and Engineering 434 with the title "Multimedia Learning to overcome anxiety and mathematics difficulties"	2018	Based on the results of observations and interviews conducted after learning using multimedia for junior high school students, researchers concluded that multimedia learning can overcome anxiety and difficulties in learning mathematics. In this way, low anxiety about mathematics can make it easier for students to understand mathematical concepts.
2	Chen, wrote an article entitled Effect of Mobile Augmented Reality on Learning Performance,	2019	Mathematics learning uses mobile AR which integrates the ARCS motivation model in an effort to help students, especially students with high anxiety. Students

No	Author and reaserch title	Year	Result
	Motivation, and math Anxiety in a math course which was published in the Journal of educational computing research		who learn using Mobile AR have higher motivation, better performance, and lower anxiety, compared to those who do not use mobile AR. A fun learning system provides effective support for students with high anxiety and increases their motivation. In addition to the technological benefits gained from AR, pedagogical and learning issues also need to be considered when preparing students with an appropriate mathematics learning environment.
3	S H Nasution et al conducted research with the title "Computer-Assisted Assessment model to decrease math Anxiety and Increase Mathematical Self Efficacy of Junior High School Students." Which was then published in the Journal of Physics	2019	Presenting assignments in an applied form with editorial assignments that are tailored to students' cognitive level makes students challenged to complete these assignments. Presenting assignments using Moodle LMS accompanied by interactive illustrations for each assignment can increase students' self-confidence in carrying out assignments. Interactive illustrations can motivate students, increase curiosity, increase student interest, and increase student enthusiasm in solving mathematical problems
4	Soewardini et al published an article with the title "An Information Technology-Based Learning to Reduce Math Anxiety in solving problems" in the journal International Journal of Engineering and advanced technology (IJEAT)	2019	An information technology-based learning approach can reduce mathematical anxiety in solving problems. Students' concentration is not disturbed because they are busy using the computer to view learning videos. They enjoy discussing with friends and teachers via chat rooms where they are no longer face to face.
5	Hidayat & Asmalah, published an article with the title "Augmented reality on Smartphone to Increase Learning Motivation and Reduce Mathematics" in the journal Emasains: Mathematics & Science Education	2020	The research results show that educational technology, especially during and after the pandemic, cannot be separated from the world of education. After the pandemic ends, teachers should continue to use technology in teaching and learning activities. One technology that can help increase learning motivation and reduce math anxiety is augmented reality. Thus, the use of augmented reality should be carried out regularly in schools
6	Dwi Juniati & I Ketut Budayasa wrote an article entitled "Field-Based Tasks with technology to reduce mathematics anxiety" in the journal World Transaction on Engineering and Technology Education	2021	Research was conducted to develop field-based geometry tasks with technology to increase students' motivation in learning geometry so that their mathematics performance increases. The tasks developed consist of three parts, namely application tasks, experimental tasks, and field-based projects. Field-based assignments enable students to understand the concept and its properties better. The use of appropriate technology in field-based assignments helps students to explore models and rules, and helps them realize ideas and strategies for solving problems that are sometimes too difficult to solve manually.
7	Yaftian & Barghamadi wrote an article with the title; "The effect of teaching using multimedia on mathematical anxiety and motivation" published in the Journal of Research and advances in mathematics education	2022	This research is concerned with the effect of teaching using multimedia on mathematics anxiety and motivation. The results of this research using an experimental method comparing the results of the pre-test and post-test concluded that the use of multimedia can reduce students' mathematics anxiety. Some of the multimedia used in this research class are PowerPoint slides, animations, Geogebra applications and manipulative and educational videos. Teaching using multimedia makes the mathematics teaching and

No	Author and reaserch title	Year	Result
			learning process more interesting. Students become more interested and motivated to learn mathematics. The use of multimedia will eliminate boredom in mathematics class and make students and the class more active and dynamic.
8	Emily Ross & Margaret Marshman conducted research entitled "Barrires to Integration: A case Study of STEM -Learning in Mathematics and digital technology.	2023	Teachers often feel obstacles in integrating technology with mathematics, so a curriculum review is carried out, identifying the obstacles that prevent teachers from learning mathematics. There are two categories of barriers to embedding digital technology in the classroom. The first barrier refers to problems outside the teacher, such as access to technological devices or necessary software, insufficient teaching time and inadequate technical support. The second barrier concerns teachers, including beliefs, towards digital technology, inappropriate pedagogy and reluctance to engage with technology.
9	Kour, wrote the article "Factors Affecting mathematical anxiety: A systematic review of related literature" in the Rajatshali Journal	2024	Mathematics anxiety is caused by 5 factors, namely cognitive factors, learning approach methods, the environment, the students themselves, the role of parents. Regarding learning method factors, there are several things that need attention, namely poor communication between teachers and students, heavy workloads, and the use of outdated resources. Inappropriate learning methods, in learning mathematics the teacher applies memorized formulas and procedures, the teacher focuses too much on speed and accuracy, uses less technology in learning, does not emphasize understanding concepts.
10	Khaled Ahmed & Aqeel Alzoubi wrote an article entitled "The effect of virtual reality technology in teaching mathematics on students' ability to process data and graphic representation"	2024	Experimental research was conducted on 70 grade 10 students with a research duration of 2022-2023. Of the 70 students, 35 were in the experimental group, and 35 were in the control group. Application of VR in the experimental group and traditional teaching in the control group. Pretests and posttests were carried out to measure students' abilities in handling data and graphical representation. The test is designed with 8 questions to measure students' ability to handle data, while the other four measure graphical representation. The use of virtual reality technology in mathematics teaching can help students achieve better results, increase levels of interaction and participation, and provide significant opportunities to improve the learning experience for students.

Based on the table, it provides information related to research conducted over the last seven years that focuses on the integration of multimedia or digital technology in mathematics education. Mathematics learning using multimedia has been shown to reduce levels of mathematics anxiety among students, thereby improving their learning outcomes and achievements in mathematics. Students enjoy and are happy to learn using multimedia. They are also more motivated to

study. Interactive illustrations can motivate students, increase their curiosity, enhance their interest, and boost their enthusiasm for solving mathematical problems (Yaftian & Barghamadi, 2022). Learning with technology does not disrupt students' concentration, as they are busy using computers to view instructional videos. They enjoy discussing with peers and teachers through chat rooms, even in a non-face-to-face setting (Soewardini et al., 2019).

The role of technology in solving mathematical problems influences many aspects because technology can be used to verify the correctness of methods, strategies, hypotheses, and results obtained, to explore and identify mathematical concepts and relationships, and to create models or general rules that facilitate the resolution of complex and difficult problems that are challenging to solve manually (juniati, et al, 2021). Several pieces of literature written since 2018–2019 also review various applications and digital media that can be used in mathematics education, which are not limited to a single topic. Educators can adjust which applications will be used and what material will be presented, allowing for flexibility in designing mathematics instruction using digital technology. One of the technologies that can help increase learning motivation and reduce mathematics anxiety is augmented reality. Therefore, the use of augmented reality should be routinely implemented in schools (Hidayat et al., 2020).

Augmented reality is a technology that can combine two- or three-dimensional virtual objects with real life, creating an interactive digital learning environment. In addition to the technological benefits provided by augmented reality, pedagogical and learning issues also need to be considered when preparing students for a suitable mathematics learning environment (Chen, 2019). Furthermore, there is the use of virtual reality, which is quite similar to augmented reality. The use of virtual reality technology in mathematics teaching can help students achieve better outcomes and increase their level of interaction and participation in learning (Alzoubi, 2024). Additionally, the use of the GeoGebra application for learning algebra and other topics, as well as the Moodle application to support distance learning processes by creating a learning management system.

In reducing mathematics anxiety, teachers should consider the teaching methods they use. Inappropriate teaching methods, such as relying on memorization of formulas and procedures, focusing too much on speed and accuracy, using technology insufficiently, and neglecting conceptual understanding in mathematics (Kour et al., 2024), can contribute to this anxiety. Additionally, teachers face obstacles in integrating technology into

mathematics education. There are two categories of barriers to embedding digital technology in the classroom. The first barrier refers to issues outside the teacher, such as access to the necessary technology or software, insufficient teaching time, and inadequate technical support. The second barrier pertains to the teachers themselves, including their beliefs about digital technology, inappropriate pedagogy, and reluctance to engage with technology (Ross & Marshman, 2023). This issue needs to be specifically addressed by educational institutions to ensure that teachers' capacities align with student needs and technological advancements.

4. Conclusion

Mathematics is an abstract theory, making it difficult for many students to learn, which can lead to the emergence of anxiety towards the subject. This mathematics anxiety affects students' attitudes and performance in math. To reduce this, a learning design that is enjoyable and motivating for students is essential. Learning through digital technology offers a solution to alleviate mathematics anxiety. Students enjoy learning with interactive multimedia. Through multimedia, they can apply and solve problems using the theories they have studied. The use of technology in mathematics education helps students achieve better results, enhances interaction and participation in learning, and provides significant opportunities to improve their learning experiences.

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