MATH ANXIETY IN LEARNING MATHEMATICS

[1]NURUL AINUN FAJRIAH, [2]DJAMILAH BONDAN WIDJAJANTI, [3]SRI ANDAYANI

[1,2]Mathematics Education, Yogyakarta State University, Indonesia
E-mail :- [1]nurulainunfajriah@gmail.com, [2]xxxxxx@gmail.com

Abstract - Students' mathematics learning outcomes can be influenced by various internal and external factors. Psychologically, math anxiety is one of the internal factors that can affect students' mathematics learning outcomes. Mathematical anxiety as a form of negative emotion towards mathematics becomes an obstacle to an individual's abilities. To a certain degree, math anxiety causes a person to avoid mathematics. This can be caused by various factors. Not only students' math anxiety, but teachers' and parents' math anxiety also affect students' math skills. However, various efforts can be made to overcome them. Therefore, this research was conducted to examine efforts to overcome or reduce students' math anxiety. This research was conducted using the systematic literature review method, which went through five stages to determine articles related to strategies or ways to overcome math anxiety. The five stages are: first, identifying research questions; second, identifying relevant studies; third, study selection; fourth, charting the data; and fifth, summarizing and reporting the results utilized in this review of the reports the results used in this review of Causes and how to overcome math anxiety. Through these stages, articles that are relevant to the 2015–2022 holding period are obtained. The results of the study show that there are various causes of math anxiety and strategies that can be used to overcome it. Mathematical anxiety can be overcome through the learning process, namely by applying learning models, using technology, and using scoring systems. Meanwhile, therapy can be done with cognitive-behavioral therapy and art therapy. By paying attention to the various causes and strategies that can be used to overcome math anxiety, students are expected to be able to optimize their learning outcomes in mathematics.

Keywords - Learning Outcomes, Math Anxiety

I. INTRODUCTION

Mathematics has a very important role in human life(Habibi et al., 2021)so the basic concepts of mathematics that are correct and strong must be taught at the elementary to tertiary level of education(Hidayat, 2018). However, in the learning process, math anxiety controls the learning environment(Samuel & Warner, 2019). Math anxiety is one of the factors that influence learning outcomes(Barroso et al., 2021), which also influences the learning process(Klados et al., 2017; Shishigu, 2018).

Mathematics is a subject that can generate negative emotions which are then called math anxiety(Palestro & Jameson, 2020)so individuals avoid mathematics in various ways, such as avoiding doing math problems(Jameson, 2019)and careers that require mathematical competence(Namkung et al., 2019). Anxiety is a normal human reaction to any situation that an individual perceives as a threat(Hackworth, 1985).

Math anxiety arises not because of mathematics itself(Arem, 1993), nor is it caused by a lack of intelligence and is not a natural reaction to mathematics(Hackworth, 1985).

Math anxiety can be caused by negative experiences with mathematics in childhood or early adolescence and insufficient knowledge of following the material(Arem, 1993). Math anxiety can affect students' math skills. In their research,Iraola-Real & Gonzales-Macavilca (2020)stated that high math anxiety causes low academic achievement and vice versa. Likewise, the study ofGonzales et al. (2019)shows that both math anxiety before exams and math anxiety when studying will have a negative effect on academic performance. Math anxiety causes students to be unable to think clearly and understand mathematics well(Habibi et al., 2021). For this reason, this research was conducted to find out the efforts to overcome math anxiety.

II. METHOD

This research is a systematic literature review with five stages namelyfirst, identifying research questions; second, identifying relevant studies; third, study selection; fourth, charting the data; and fifth, summarizing and reporting the results utilized in this review of the reports the results used in this review of causes and how to overcome math anxiety. Through these stages, 15 journals were obtained with a period of 2015-2022.

III. RESULTS AND DISCUSSION

Through five stages of systematic literature review, 15 articles were obtained related to efforts to overcome math anxiety. Information from the articles obtained that met the specified criteria can be seen in the following table.

Authors (Year)	Kurniawan and Budiyono (2021)	Nunez-Pena et al. (2015)	Soewardhini et al. (2019)	Salazar (2019)	Supekar et al. (2015)
Title	Heroe's model: Case study to reduce students' learning loss and anxiety	Feedback on students' performance: A possible way of reducing the negative effect of math anxiety in higher education	An Information Technology-Based learning to Reduce Math Anxiety in Solving Problem	Exploring the effect of coloring mandalas on students' math anxiety in business statistics courses	Remediation of Childhood Math Anxiety and Associated Neural Circuits through Cognitive Tutoring
Subject	87 college students	166 college students	7th-grade students	106 college students	46 children (7-9 years)
Results	The Hero's learning model provides comfort, causing optimism and reducing anxiety.	Providing feedback on student work can reduce the impact of math anxiety.	ICT-based learning can reduce students' mathematical anxiety.	Coloring structured mandalas is more effective at reducing math anxiety than doodling on white paper.	The children showed a decrease in math anxiety after taking tutoring.
Suggestions	Development of teaching materials and creating a learning environment. Developmodelsusingapplications as needed.	-	-	-	-

Table 1. Study Literature Review

Authors (Year)	Purnomo and Loekmono (2021)	Shishigu (2018)	Bazargan and Amiri (2018)	Kamour and Altakhayneh (2021)	Ifdil et al. (2019)
Title	Online counseling: Application of Cognitive Behaviour Therapy and Music Counselling to Reduce Math Anxiety	Mathematics Anxiety and Prevention Strategy: An Attempt to Support Students and Strengthen Mathematics Education	The effectiveness of modular cognitive behavioral therapy on mathematical anxiety and assertiveness in students	Impact of a counseling program based on social-emotional learning toward reducing math anxiety in middle school students	Chromotherapy: An alternative treatment for mathematics anxiety among elementary school students
Subject	9th grade student	370 grade 9th students	24 grade 9th students	207 grade 8th students	5 respondents
Results	Cognitive behavioral therapy and music counseling are effective in reducing students' math anxiety.	Building positive thoughts, motivating students, support from teachers and class structures are strategies to reduce students' math anxiety levels.	Cognitive-behavioral therapy is effective against students' mathematical anxiety.	Counseling programs based on social-emotional learning have a positive effect on reducing math anxiety in students.	Chromotherapy is effective in reducing students' math anxiety.

Suggestions	Research with the same topic but observations and measurements are carried out longer.	Examine students' math anxiety with different methodologies to provide a broader picture of students' feelings.	-	-	-

Table 2. Study Literature Review

Authors (Year)	Caglar and Senol (2021)	Verkijika and Wet (2015)	Pizzie et al. (2020)	Donolato et al. (2020)	Amirnudin and Saleh (2020)
Title	Factors that cause students to develop math anxiety and strategies to diminish	Using a brain-computer interface (BCI) in reducing math anxiety: Evidence from South Africa	Neural evidence for cognitive reappraisal as a strategy to alleviate the effects of math anxiety	Going beyond mathematics Anxiety in primary and middle School students: the role of Ego-resiliency in mathematics	Effectiveness of strategy Disney^{NLP} in reducing math anxiety of students in perak matriculation college
Subject	65 teachers	36 children (9-16 years)	74 students (13-22 years)	264 students (9-15 years)	College students
Results	Six strategies for reducing or eliminating the causes of math anxiety.	Math anxiety can be trained and reduced with the help of BCI based math educational games.	Reappraisal is a strategy to reduce negative emotional responses in individuals with high math anxiety.	Implementing specific intervention programs to target anxiety, and informing parents and teachers of useful strategies for maintaining ego resilience can help reduce math anxiety.	Teaching using the Disney^{NLP} strategy is effective in reducing students' math anxiety levels
Suggestions	-	Compared BCI-based interventions for math anxiety with existing methods to determine the most appropriate method for reducing math anxiety in students.	Investigate the different relationships between math anxiety and the use of different strategies	-	Similar research by adding studies of learning achievement

Table 3. Study Literature Review

Math anxiety has a negative impact on students' math skills.Artama et al. (2021)show that there is a negative effect of math anxiety on student learning outcomes in class VIII.Ikhsan (2019)who researched 30 class X students showed that the higher the student's anxiety, the lower the learning outcomes.Nur (2018)also conducted a similar study on 93 elementary school students and showed that math anxiety had a negative effect on students' math achievement. Not only at the school level but Puspananda and Rahmawati (2020) also conducted research on students which showed a negative effect of math anxiety on statistics learning outcomes. Mathematical anxiety as a factor inhibiting the ability of students and students is important to overcome so several studies were conducted to overcome mathematics anxiety.

Kurniawan dan Budiyono (2021)conducted research on 87 third semester students with an age range between 20 and 21 years. The research was conducted to apply Heroe's online learning model which consisted of three stages, namely: (1) asynchronous self-learning, (2) synchronous confirmation and elaboration, and (3) semi-synchronous feedback. The application of Heroe's online learning model reduces students' math anxiety.Amirnudin dan Saleh (2020)also applies a

learning strategy to reduce math anxiety, namely the Disney^{NLP} strategy with three phases, namely creative, realistic, and critical.

Apart from learning models, technology can also be used to reduce students' math anxiety, such as research conducted bySoewardhini et al. (2019). The classroom action research conducted on the 7th grade students showed that math anxiety was reduced by technology-based learning. This also includes educational games as implemented byVerkijika and Wet (2015).

In addition, the scoring system can also be an alternative to reducing math anxiety.Nunez-Pena, dkk (2015)who conducted a study of 166 students with an age range between 18 and 20 years showed that a formative assessment system based on providing feedback had reduced the impact of math anxiety. Not only learning at school,Supekar et al. (2015)conducted a study of 46 children who attended tutoring programs for 8-9 weeks. The program is beneficial in reducing students' negative emotions towards mathematics, including math anxiety. In contrast toPizzie et al. (2020)who use cognitive reappraisal strategies to reduce math anxiety.

In addition to these strategies, therapy can also be carried out to overcome students' math anxiety.Salazar (2019)applied mandala art therapy to 106 students by drawing and coloring to reduce math anxiety. Cognitive behavioral therapy has also been shown to reduce students' math anxiety, as shown inBazargan and Amiri (2018)study which was conducted for 10 sessions. Cognitive behavioral therapy is also applied byPurnomo and Loekmono (2021)which is carried out for 7 sessions.

In addition, the counseling program conducted byKamour and Altakhayneh (2021)focuses on 5 main competencies, namely: self-awareness, self-management, social awareness, relationship skills, and decision-making to develop social and emotional abilities, including reducing math anxiety.

Several other strategies were also explained byCaglar dan Senol (2021)through their research by conducting semi-structured interviews with 65 teachers who had work experience of more than 5 years. From the interviews, several strategies that can be implemented are individual interactions between teachers and students, motivating students, connecting mathematics with life, using effective teaching strategies, testing dyscalculia, and training teachers.

IV. CONCLUSIONS

The results of the selected research in this study aim to look at efforts/ways of overcoming/reducing/reducing students' math anxiety. The subjects in the article range from elementary schools to tertiary institutions and also teachers who have treated students to reduce their math anxiety. The selected articles show that to overcome math anxiety students can go through the learning process, either by applying methods or by utilizing technology. In addition, to reduce students' math anxiety, therapy or counseling can be given. Based on the selected articles, further research can be carried out by applying other models/methods and developing teaching materials according to student needs. In addition, it can be added to student achievement in order to simultaneously see the effect of student math anxiety on learning achievement.

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