

An Analysis of Mathematics Anxiety Among Prospective Mathematics Teachers in Discrete Mathematics Courses

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ABSTRACT

Anxiety is one of the affective factors that can influence success in learning mathematics. Many studies have shown that the majority of students experience high levels of mathematics anxiety, and this condition can even be transferred to future mathematics teachers. This study aims to describe the mathematics anxiety of prospective mathematics teachers during discrete mathematics lectures. The research employed a descriptive quantitative method. The instrument used was an anxiety questionnaire, administered using a Likert scale. In addition, several open-ended questions were included to further describe the anxiety profile and support the quantitative data. The study involved 29 students from the Mathematics Department of the Ponorogo Islamic Institute of Religion. The results revealed that the majority (93.1%) of students experienced moderate levels of mathematics anxiety, while a small proportion (3.45%) experienced low or high anxiety. Based on the dimensional analysis, mathematics anxiety across the cognitive, psychological, and physiological dimensions was mostly categorized as moderate. However, in the physiological dimension, a considerable number of students (44.44%) reported low anxiety. The findings imply that lecturers should continue to develop innovative teaching strategies to help reduce students' mathematics anxiety.

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INTRODUCTION

A bibliometric analysis conducted by Julius et al. (2021) shows that over the past few decades, mathematics teaching and learning research has become a major concern. The discussion of the importance of mathematical skills for students is an interesting topic to be studied more deeply in various subjects and career fields. Mathematical skills are needed not only in the field of science and technology, but also in the social sciences and various professions in the future (Ahmed, 2018). It is undeniable that mathematics plays an important role in life. However, in reality, math is considered a scary thing. This is characterized by the large number of students who choose social science majors just to avoid mathematics (Meece, Wigfield, and Eccles, 1990). The feeling of anxiety, discomfort, or fear felt by someone related to mathematics is known as mathematical anxiety (Nunez-Pena, Suarez-Pellicioni, and Colome, 2016). The concept of

mathematical anxiety has been an important topic of study since the concept of "number anxiety" was introduced by Dreger and Aiken (1957) and has received increasing attention in recent years. This has been proven by a bibliometric analysis conducted by Gokdag, Ozmantar, & Bozkurt (2024). Mathematical anxiety is defined as "tense and anxious feelings that interfere with the manipulation of numbers and the solving of mathematical problems in everyday life and academic situations" (Richardson and Suinn, 1972). Math anxiety is also defined as negative emotions that arise during mathematics learning and have the potential to interfere with the ability to solve math problems (Shishigu, 2018). Low achievement in mathematics is a problem in various countries not only due to cognitive difficulties. Most people have math anxiety which can greatly interfere with their learning and understanding of math. Many studies over the years have shown that many people have a very negative attitude towards math, sometimes leading to severe anxiety (Hembree, 1990; Ashcraft, 2002; Maloney and Beilock, 2012). Based on research conducted by Dowker, Sarkar, & Looi (2016), research on math anxiety in the last 60 years has been caused by various factors, one of which is perception of mathematics.

Mathematical anxiety is classified based on its dimensions into three, namely cognitive, psychological, and physiological (Ashcraft & Moore, 2009). Ashcraft & Moore (2009) explain that the cognitive dimension includes feelings of worry and negative expectations. The psychological dimension includes reactions such as fear, nervousness, panic, and feelings of discomfort that often trigger concentration disorders and hinder the mathematics learning process (Fitrianti, Nopriyanti, & Septiati, 2021). Meanwhile, the physiological dimension includes reactions that appear to be palpitations, sweating, shortness of breath, muscle tension, abdominal pain, and nausea (Ashcraft & Moore, 2009:7). This dimension of anxiety illustrates that mathematical anxiety is not only seen from the symptoms that arise through the physical, but must also be seen from the cognitive and psychological sides.

Mathematics anxiety is influenced by various factors, one of which is abstract material that is considered complicated (Iksan, 2019). One of the abstract courses is discrete mathematics. Discrete mathematics is known as a branch of mathematics that is abstract and full of formal logic concepts, so it is often considered complicated by students (Kusumaningrum & Lestari, 2023). Although many other courses are abstract such as real analysis and abstract algebra, discrete mathematics is considered more important because it will later be taught by prospective teachers to students at the secondary school level. On the other hand, an understanding of discrete mathematics is important for prospective teachers because this field trains abstract thinking skills, logical reasoning, and analytical skills in problem solving, so that they are used to dealing with

mathematical problems in a critical and rational way (Hart & Martin, 2018; Nopriana & Noto, 2017). This shows the potential anxiety of prospective mathematics teacher students in discrete mathematics lectures, so it needs to be further researched. The specialization of prospective teacher students is because their graduates will also teach discrete mathematics concepts at the school level, so that prospective teachers' anxiety about discrete mathematics tends to be inherited to their students when teaching.

Research on math anxiety for students in mathematics learning has been done before. Khasawneh, Gosling, & Williams (2021) state that math anxiety occurs in students in almost all parts of the world and is influenced by a variety of complex factors. At the university level, several researchers, such as Pitaloka & Darmawan (2025), have also conducted research on mathematics anxiety experienced by prospective mathematics teacher students. Although there is a lot of research on math anxiety, there is still little that focuses on discrete math learning. As Magda et al. (2025) research focuses on discrete mathematics learning, but the discussion on the thinking process and general problems of students in their learning does not highlight mathematics anxiety directly.

Based on this description, it is necessary to conduct research on the anxiety analysis of prospective mathematics teacher students in discrete mathematics lectures. This study analyzes mathematics anxiety specifically in discrete mathematics learning and investigates mathematics anxiety in more depth by paying attention to the dimensions of anxiety, namely cognitive, psychological, and physiological.

METHOD

This study uses a descriptive quantitative method. The research was conducted at the Ponorogo State Islamic Institute in the odd semester of the 2024/2025 school year. The target of this research is mathematics education students as a representation of prospective mathematics teachers. The research subjects consisted of 29 students in the 5th semester of the Mathematics Education study program at the Ponorogo State Islamic Religious Institute. The selection of 5th semester students is because students have taken most of the core mathematics courses and have begun to be directed to prepare teaching practices, so that the mathematics anxiety that arises can be more clearly described as a representation of prospective mathematics teachers. A total of 29 students were selected based on the real conditions of the class population available in the semester, so this study used a total sampling technique. The research instrument was in the form of a mathematical anxiety questionnaire using a 4-scale likert scale. The mathematical anxiety questionnaire instrument consists of 40 items. The questionnaire used is a modification of the Hidayat & Abadi (2024) mathematical anxiety questionnaire. Indicators of each dimension of anxiety in the questionnaire are presented in Table 1.

Table 1. Mathematical Anxiety Indicators

No.	Aspek	Indikator
1	Cognitive (Thinking)	Chaos in the mind directs attention to possible perceived dangers or threats, such as negative thinking, difficulty concentrating, or inability to make decisions
2	Psychological (Negative emotions)	Negative emotions in the form of feelings such as tension, worry or restlessness, fear and nervousness
3	Physiological (Body Language)	The body's response to threats, such as a faster heart palpitations, sweaty palms, abdominal pain, and a mild headache (dizziness).

The results of the questionnaire assessment in the form of mathematical anxiety scores were categorized based on the categorization technique of Sudijono (2010) and adapted from Zahra & Haerudin (2023) as shown in Table 2.

Table 2. Categories of Mathematical Anxiety

No.	Aspect	Category
1	Score $> M+1,5s$	Very high
2	$M +0,5s < \text{Score} \leq M+1,5s$	High
3	$M -0,5s < \text{Score} \leq M+0,5s$	Moderate
4	$M -1,5s < \text{Score} \leq M- 0,5s$	Low
5	Score $\leq M-1,5s$	Very low

Information:

- M : Average mathematical anxiety score
 s : Standard deviation

The data were then analyzed descriptively to describe mathematical perceptions and anxiety. Furthermore, data in the form of open-ended questions is used to complete the description of the subject in each category of mathematical perception and anxiety.

RESULTS AND DISCUSSION

Respondent Characteristics

This research was carried out by distributing questionnaires to a number of subjects. The subject of the study was a 5th semester student at the Ponorogo State Islamic Institute who programmed discrete mathematics courses. The distribution of subjects by gender is presented in Table 3.

Table 3. Distribution of Research Subjects by Gender

No.	Aspects	Number of Students	Percentage
1	Male	3	10,34%
2	Female	26	89,66%
	Total	29	100%

It appears that the dominance of female students is very high, namely 9:1. However, this

distribution is not used as the main variable of the study because the focus of the research lies on the level of mathematical anxiety of students in general. The unequal proportion between men and women is a real condition in the population of Mathematics Education students in the research site, so that the data obtained remains representative to illustrate the phenomenon of mathematical anxiety in prospective mathematics teacher students. Thus, this proportion does occur in real places of study.

Student Anxiety Level

Based on the results of the study on 29 prospective mathematics teacher students after discrete mathematics lectures, a brief overview of the distribution of mathematical anxiety as presented in Figure 1 was obtained.

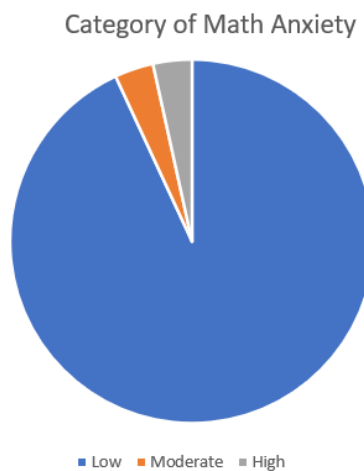


Figure 1. Student Anxiety Distribution Diagram

Based on the image above, it appears that the majority (93.1%) of students experience moderate anxiety. A small percentage (3.45%) of students experienced high and low anxiety, and none of the students experienced extreme anxiety (very low and very high). In more detail, the results of the categorization of students' mathematical anxiety are presented in the following Table 4.

Table 4. Distribution of Students by Category of Math Anxiety

No.	Category	Number of Students	Percentage (%)
1	Very high	0	0
2	High	1	3,45
3	Moderate	27	93,1
4	Low	1	3,45
5	Very low	0	0

Based on Table 4, it appears that students are divided into three categories of mathematical anxiety, namely low, moderate, and high anxiety. The majority of subjects in each category tend to show similar responses, so answers from 3 subjects representing

each category related to open-ended questions will be displayed. The point of the open-ended question is "How are your anxiety about discrete mathematics lectures?". Subject 1 with a low mathematical anxiety category stated that, "Usually, sir, the anxiety of the grade, the fear is that if the answer is slightly wrong or written wrong, it will even be blamed to the bottom". It appears that Subject 1 is quite calm but has concerns of human error that results in the end result being wrong. This kind of worry can be categorized as a form of cognitive anxiety, as it is associated with the appearance of negative thoughts, excessive worry, and concentration disorders that focus on the possibility of making mistakes. In other words, even though the subject looks calm emotionally, the cognitive aspect is still influenced by the fear of making mistakes that can have an impact on learning outcomes. When asked to give advice related to discrete mathematics lectures, Subject 1 stated that "I think that during discrete mathematics lectures it is interesting to learn, the material can be understood if there is enough time and the friend who presents also understands what will be presented, then students may understand the material better. For future advice, hopefully we can make the best use of our time in class." This means that subject 1 suggests that discrete mathematics learning should emphasize contextual aspects to make it easier to learn.

Meanwhile, Subject 2 with the category of mathematical anxiety is stating that, "I am actually afraid that I cannot understand the material in discrete mathematics and the way to overcome the fear or anxiety is to explain the material clearly by the teacher/lecturer because if it is not explained clearly there will be many conjectures and thoughts that may be wrong so that I am afraid of not understanding". It appears that Subject 2 has anxiety in discrete mathematics lectures, especially if learning is more *student-centered*. This suggests that Subject 2's rejection of student-centered learning can be attributed to cognitive load theory. Learning that requires students to be more independent has the potential to increase the cognitive burden, especially if students do not have adequate independent learning readiness. When intrinsic and extraneous cognitive loads are too high, they may exceed working memory limits and hinder meaningful learning. (Paas, Renkl, & Sweller, 2003). As a result, students feel anxious because they are afraid of not being able to master the material independently without a detailed explanation from the lecturer. Thus, the anxiety that arises is not only due to the difficulty of the discrete mathematics material itself, but also because of the demands of self-regulation that are not fully prepared by students. Subject 2 also states that "students find discrete mathematics very difficult and abstract because the concepts are often new and indirectly related to everyday life". This statement is in line with the suggestion of Subject 1 which is to relate discrete mathematics to contextual matters so that it is easier to understand.

Subject 3 with the category of high mathematical anxiety stated that "It is difficult to concentrate during learning", this can be triggered by various factors such as external disturbances and internal conditions. However, when Subject 3 continues the answer by stating that "Discrete mathematics lectures are difficult to understand when only students explain, lecturers only explain a little." This turns out to be similar to the argument in Subject 2, that students still have difficulty learning independently (*student-centered*). This finding is in line with Karjanto (2019) who stated that students tend to be uncomfortable and even dislike the student-centered learning approach in mathematics learning.

Anxiety Levels in the Anxiety Dimension

Based on the results of the research on the anxiety aspect, a more detailed analysis was carried out on each dimension of anxiety. There are three dimensions of mathematical anxiety, namely the cognitive dimension, the psychological dimension, and the physiological dimension. The results of the distribution of anxiety scores in each dimension of anxiety are presented in Table 5.

Table 5. Distribution of Anxiety Scores on Each Dimension of Anxiety

No.	Dimension	Categories				
		VH	H	M	L	VL
1	Cognitive	0	2	27	0	0
2	Psychological	0	2	27	0	0
3	Physiological	0	1	14	12	0

Based on Table 5, the dimensions of cognitive and psychological anxiety obtained the same results, namely most (93.1%) students experienced moderate anxiety and a small percentage (6.9%) of students experienced high anxiety. This is reflected in the subject's narrative which states that negative thoughts often arise such as fear of not being able to solve problems and feeling pressured when appointed to answer in class. In the psychological dimension, students also expressed excessive nervousness and worry before the exam, which was in line with the high percentage of moderate anxiety. Meanwhile, the physiological dimension of students tended (51.85%) to experience moderate anxiety and (44.44%) to experience low anxiety, the rest (3.71%) experienced high anxiety. Although there are not many, some subjects simultaneously experience physical symptoms such as heart palpitations or sweaty hands when facing difficult questions or exams.

These results show that actually student anxiety is more reflected in the cognitive and psychological side than physiological. This finding is similar to the results of

Sammalahti et al. (2023) who stated that mathematical anxiety not only triggers bodily reactions but also affects cognitive capacity. These results strengthen the argument of Suarez-Pellicioni et al. (2016) that anxiety does not only appear physiologically, but also occurs more often in cognitive and psychological aspects. In addition, these findings suggest that although not a high category, anxiety persists in information processing and emotional responses to mathematics learning, particularly in discrete mathematics lectures. In contrast to cognitive and psychological, the dimensions of physiological anxiety were more varied, namely 14 students in the medium category and 12 students in the low category. This suggests that physical symptoms such as heart palpitations, sweating, or abdominal discomfort are not always experienced strongly, even if they are mentally anxious. In line with the statement of Ashcraft & Moore (2009) which states that physiological responses are often not as high as cognitive or affective aspects in mathematics learning, especially if students are not in a direct exam situation. This study assesses mathematics learning as a whole, both in the process and during evaluation. Dominant cognitive and psychological anxiety has the potential to hinder the understanding of mathematical concepts and reduce motivation to learn, especially for prospective mathematics teachers. While the lighter physiological dimension suggests that psycho-educational interventions are more important than medical approaches. According to Mutodi & Ngirande (2014), pleasant teaching strategies and the application of humanistic approaches can suppress anxiety in cognitive and psychological dimensions.

These findings indicate that many students still experience pressure in the form of negative thoughts, self-confidence, and excessive worry in understanding abstract concepts and symbolic logic (Núñez-Peña, Suárez-Pellicioni, & Bono, 2016). This is possible because discrete mathematics lectures tend to examine proofs full of abstract concepts and mathematical symbols. Furthermore, a milder variation in anxiety levels was found in the physiological dimension. In other words, college students are less likely to show symptoms of sweating or heart palpitations. This condition shows that the internal emotional response is more dominant than the body's direct response. In this study, no students were found to experience extreme anxiety. This suggests that anxiety is in the moderate range and tends to be manageable, although it still has the potential to interfere with mathematical thinking and decision-making.

Students' mathematical anxiety in learning Discrete Mathematics is most likely due to the complexity of topics such as deductive-inductive proof logic, set theory, relations, inclusion, and overly abstract ways of delivery. Factors such as fear of making mistakes, previous learning experiences, and perceptions of lecturers are also suspected to reinforce this anxiety. Mathematics anxiety that is not immediately addressed pedagogically can

reduce students' self-efficacy and hinder their readiness as prospective professional teachers. Therefore, a learning approach that supports positive emotions, gradual problem-solving strategies, and two-way communication between lecturers and students is very important to be implemented (Zetriuslita, Wahyuni, and Darhim, 2019). These findings are in line with the framework offered by Ramirez et al. (2018), which emphasize that math anxiety arises not only due to cognitive weakness, but also due to affective stress and a less supportive learning environment. Furthermore, Ablian & Parangat (2022) found that self-perception and the level of complexity of the material (Discrete Mathematics) play a significant role in causing mathematical anxiety.

CONCLUSION

Based on the results of the analysis, it can be concluded that prospective mathematics teacher students still experience a significant level of anxiety in participating in discrete mathematics lectures. From the perspective of its dimensions, the level of anxiety of students is dominated by the cognitive and psychological dimensions. The majority of students are still in the category of moderate anxiety. However, it is still found that students have high anxiety about discrete mathematics. The low level of anxiety in the physiological dimension compared to other dimensions indicates that students tend to experience more symptoms of anxiety cognitively or psychologically than physical symptoms. This condition indicates that students who seem mediocre may experience high enough math anxiety, so they need further attention.

The implication of this research is to suggest to lecturers to continue to innovate in teaching discrete mathematics courses. Although the level of anxiety of students is not too high, some students show anxiety that needs special attention. Lecturers must combine several learning models and methods to design learning to be more interesting and meaningful. The suggestion for the next research is to consider the variables of the learning model, the learning method, and also the learning tools used.

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