Mathematics Test Anxiety of Undergraduate Mathematics Students: Mixed Mode Approach

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Posted Date: 23 December 2024

doi: 10.20944/preprints202412.1702.v2

Keywords: Mathematics; Test Anxiety; Undergraduate students; Gender; Major/Minor students

 doi:10.20944/preprints202412.1702.v2

Article

Mathematics Test Anxiety of Undergraduate Mathematics Students: Mixed Mode Approach

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Abstract: The article is conducting research on the level of anxiety experienced by university students in Bangladesh when taking mathematics tests, and it is using a mixed-mode approach, which likely includes both quantitative and qualitative methods of data collection. The article is likely analyzing the overall level of mathematics test anxiety among university students in Bangladesh, as well as examining any differences in anxiety levels between male and female students and across different courses of study. The mixed mode approach, which combines both quantitative and qualitative methods, would allow for a more comprehensive understanding of the topic. The article has likely gathered data from a sample of approximately 700 university mathematics students in Bangladesh through a combination of quantitative and qualitative methods. The quantitative data would be analyzed statistically, while the qualitative data would be analyzed through the use of the focus group discussions (FGD) technique. The FGD technique allows for an in-depth exploration of the student's experiences and perceptions of mathematics test anxiety through open-ended discussions among small groups of participants. The study's findings indicate that the university students in Bangladesh who participated in the research were experiencing some level of anxiety when it comes to taking mathematics tests. However, the study found that there was no significant difference in anxiety levels between male and female students or among students in different courses of study. This suggests that the level of mathematics test anxiety among the participants is not affected by gender or course type. The conclusion is that there is a need for increased awareness among students, teachers, and parents about the issue of mathematics test anxiety among university students in Bangladesh. The study has shown that students are experiencing some level of anxiety when it comes to taking mathematics tests, and the conclusion is that this needs to be addressed in order to reduce its negative effects on learning and performance. Therefore, the authors may recommend strategies such as providing counseling, teacher training, or parental involvement.

Keywords: mathematics; test anxiety; undergraduate students; gender; major/minor students

1. Introduction

Test anxiety is an emotion related to assessments and is defined as an individual's perception of assessments as threats. There are two factors that contribute to the development of test anxiety, known as distal and proximal antecedents. Distal antecedents include organismic and contextual factors such as specific parent-child/teacher-student relationships, early learning experiences, and academic failure that can enhance anxiety reactions when facing evaluative situations. Proximal antecedents, on the other hand, are factors that directly generate anxiety reactions in an assessment or test setting, such as difficult or important exams. Distal factors shape students' overall test anxiety, while proximal factors have more immediate impacts on test anxiety. [1–3] Therefore, test anxiety is a condition characterized by excessive nervousness, worry, or fear in response to taking a test. These feelings can interfere with a person's ability to perform to the best of their abilities on a test. Symptoms of test anxiety can include physical symptoms such as sweating, shaking, and a racing heart, as well

 doi:10.20944/preprints202412.1702.v2

as cognitive symptoms such as difficulty concentrating, forgetfulness, and negative self-talk. Test anxiety can also cause students to experience a lack of motivation and procrastination on studying. Test anxiety can have a negative impact on a student's academic performance, as the anxiety can interfere with their ability to remember and apply what they have learned. It can also lead to lower self-esteem and self-confidence, which can impact not just academic performance but also overall well-being. Test anxiety is a common condition, and can affect people of all ages, gender, and levels of education. It is important to understand that test anxiety is not a measure of intelligence or ability, and that there are strategies and techniques to manage test anxiety and improve performance.

Researchers have attempted to conceptualize mathematics anxiety in a variety of ways. Vinson [4] defines mathematics anxiety as not only disliking mathematics but also something more advanced than fear or unease. Math anxiety is discomfort during performing mathematical tasks, which often affects one's self-esteem [5]. Studies by Hembree [6] and Luo et al. [7] describe mathematics anxiety as one type of disease. Moreover, students experience various body reactions such as sweaty palms, stiff hands, feeling sick, nausea, and thirst to approach maths tests, which make students feel math anxiety and they start to lose interest in learning mathematics [7]. McGlynn-Stewart [8] states this math phobia undermines students' self-confidence, which in turn makes them apathetic towards maths and increases math test anxiety.

The study by Asif & Khan [9] aimed to examine the relationships between fear, interest, and achievement in mathematics among 78 Pakistani undergraduate economics students. The authors found that students' mathematics interest was not related to mathematics anxiety or achievement, and that gender had no effect on math anxiety. Sevindir et al.'s study [10] found that low achieving Turkish university students had higher math anxiety than high-grade achievers. They provided insight on how to overcome negative emotions in mathematics. The research also suggests that the level of mathematics anxiety is related to students' positive attitudes and interests in mathematics [11]. The findings align with those of Asif & Khan [9] and Sevindir et al. [10] that there is no correlation between gender and math anxiety. A comparative analysis of Egyptian and American university students' math anxiety [12] revealed positive results, highlighting the impact of cultural differences on math anxiety. Similarly, Brown et al. [13] found significant cultural influences on math anxiety among American and Colombian university students, with no impact of gender, which differs from the findings of Hamza & Helal [12]. Karjanto & Yong [14] studied mathematics test anxiety among 206 undergraduate students and found that test anxiety was stronger among students who expected to get lower grades, but they still scored higher than their expectations. The study also found that test anxiety was not related to gender, nationality, or academic performance. Seng's study [15] found a positive relationship between mathematics test anxiety and mathematics achievement, which is supported by the research of Yousafi et al. [16] and other studies in this field by Zettle & Raines [17], Kazelskis et al. [18], Yousefi et al. [16], Faleye [19], and Stowell & Bennett [20]. This literature highlights a prevalent pattern of mathematics test anxiety among university students worldwide.

According to a study [21], 76% of secondary school teachers reported experiencing a moderate level of mathematics anxiety, while the remaining teachers reported either high or low levels of math anxiety. Female teachers were found to have higher personal math anxiety compared to male teachers, but lower math teaching anxiety. The study also found that there was no difference in personal math anxiety and math teaching anxiety between urban and rural teachers. Additionally, the study found that pre-service training in mathematics influenced teachers' math anxiety, with those who were trained experiencing higher anxiety than those who were not. A study of Bangladeshi High School students [21] found that they have different levels of math anxiety, and that gender has no significant correlation with this level. Reasons for math test anxiety among these students include difficulties with teaching, boredom, low confidence, and inadequate family support. Another study [22] suggested that an entirely ICT-based Mathematics Skills Development Program (MSDP) involving fun and hands-on activities can help students overcome math anxiety by enhancing their positive attitudes towards mathematics at the elementary and secondary levels. This article is among a limited number of studies that have specifically focused on exploring the levels of mathematics test

 doi:10.20944/preprints202412.1702.v2

anxiety among university students in Bangladesh and how it may be related to external variables such as gender and course type. The authors may indicate that there is a lack of research in this area and that more studies are needed to fully understand the issue and develop effective interventions.

2. Methodology

The proposed study includes the following questions:

a. What is the test anxiety level of Bangladeshi university mathematics students?
b. Does gender or course impact their anxiety level?

The research participants were 702 Mathematics students from both public and private universities in Bangladesh. The sample included 113 first-year, 233 second-year, 180 third-year, and 176 fourth-year students from a total of 15 public and 9 private universities. 190 of the students were from private universities, while the remaining 512 were from various public universities. Additionally, the research participants were divided into 482 males and 220 females. Furthermore, 384 of the participants were majoring in Mathematics while 318 were minor students. The research used the Abbreviated Math Anxiety Scale (AMAS) questionnaire, proposed by Carey et al. [23], to measure the math anxiety level of the participants. The survey questionnaire was distributed to a large number of participants using various methods such as Google Forms, social media, institutional and personal emails, and student networking groups. In addition to collecting demographic information, such as participant gender and course type, a Likert-type questionnaire containing 10 questions with 5 different options (Strongly agree = 5, Agree = 4, Neutral = 3, Disagree = 2, Strongly disagree = 1) was used to measure the anxiety levels of the participants. The reliability of the questionnaire was evaluated using the Cronbach alpha and the obtained value was 0.81, indicating that the Abbreviated Math Anxiety Scale (AMAS) questionnaire has a high level of consistency. Data were analyzed using SPSS software and presented in this article. Additionally, a qualitative approach called Participatory Action Research (PAR) was used in this study. [24]. A sample of 5 students were selected for structured interviews conducted using Zoom, in the Bengali language. These recorded interviews were transcribed and analyzed later. The participant's details are presented in Table 3 and discussed in section 3.2 of the article.

3. Results and Discussion

3.1. Quantitative Approach

Figure 1 in the article is likely presenting data on the levels of stress reported by the students during mathematics tests. The data shows that 46% of the students complained of stomach issues, 33% reported feeling nervous, 47% reported feeling calm, 41% reported having faster heartbeats due to stress and tension, 38% reported worrying about the test long before the test date, 21% reported not feeling confident regarding the test, 47% reported not thinking about the test before the test date, and 62% reported feeling sufficiently confident during the test. These data provide insights into the different ways in which stress is experienced by students during mathematics tests and can be used to identify areas for interventions to reduce anxiety levels and improve performance.

 doi:10.20944/preprints202412.1702.v2

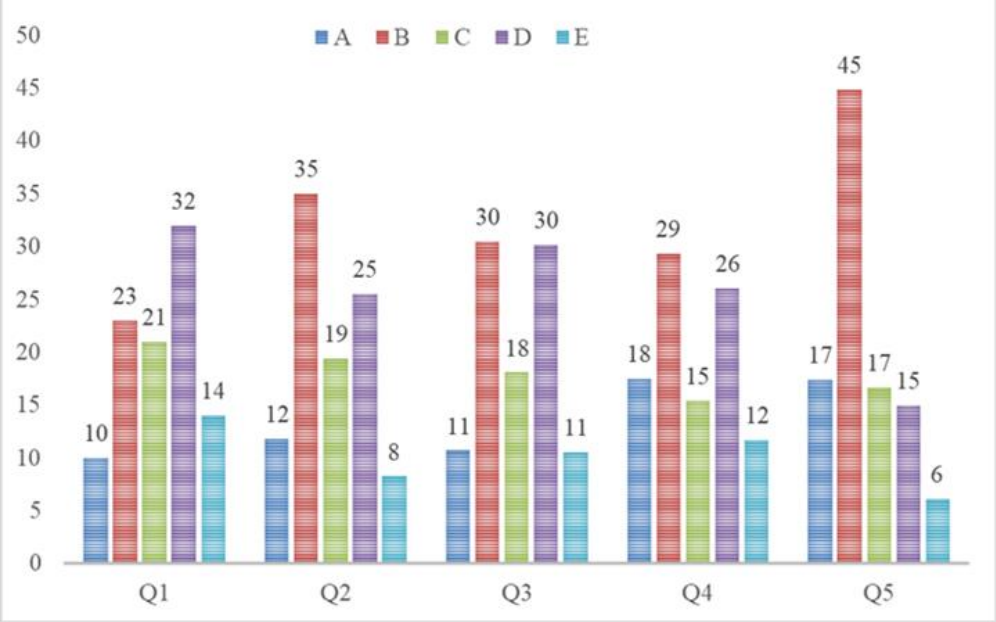

Figure 1. Students' responses in percentage for Q1 to Q5.

Figure 2 illustrates the results of a test, with various percentages representing the respondents' confidence levels and performance. Fifty percent of the students said that test stress caused them difficulty in remembering the correct answers, and 36% of the students thought that most of the answers were wrong. Also, 48% of students reported low confidence in obtaining good grades, 38% of students lack confidence in their expected performances and 36% of students are afraid that their parents may not accept their poor achievement. In contrast, 45% of students reported being confident in their performance and believed they would get a good grade. And, 42% of students reported that they do not worry about their parents' anxiety regarding their achievements.

Figure 2. Students' responses in percentage for Q6 to Q10.

Table 1 shows that there is no significant difference between male and female test anxiety labels. However, it is observed that female students feel tenser than male students during the test and they complain of higher heart bit than males. There is some evidence to suggest that there may be a relationship between test anxiety and gender. Studies have found that, on average, females tend to

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experience higher levels of test anxiety than males. This difference in anxiety levels may be due to a number of factors, including societal and cultural expectations, differences in the way males and females process and approach tests, and the way that test anxiety is perceived and responded to in males and females. Research also suggests that test anxiety can have a greater negative impact on females than males, as it can lead to lower self-esteem and self-confidence, which can negatively impact academic performance. Female students with high test anxiety tend to underperform in exams as compared to their male counterparts. It's also important to note that test anxiety can affect anyone and is not limited to a particular gender. It can affect students of all genders and ages, and can have a negative impact on their academic and overall well-being.

Table 1. Statistical comparison between male and female anxiety levels.

	Male		Female		*df* = 700
	N = 482		N = 220		
Items	**Mean**	**SD**	**Mean**	**SD**	**p-value**
1	3.122	1.222	3.282	1.202	0.1062
2	2.811	1.161	2.882	1.211	0.4587
3	2.929	1.197	3.136	1.220	0.0350*
4	2.803	1.304	2.955	1.303	0.1523
5	2.465	1.122	2.500	1.133	0.7024
6	3.384	1.132	3.305	1.087	0.3855
7	3.210	1.142	3.323	1.094	0.2183
8	3.012	1.187	3.105	1.206	0.3383
9	2.954	1.276	2.836	1.224	0.2501
10	2.944	1.182	2.905	1.116	0.6800

*p<0.05, **p<0.01, ***p<0.001.

Table 2 shows that 5 out of 10 items have statistically significant differences while comparing the test anxiety level between Mathematics major and minor students. Here, 3 items show a significant correlation at 0.1% level, 1 item at 1% level, and 1 other item at 5% level. Findings demonstrate students who study mathematics as a major have higher stress and anxiety about tests than those who study mathematics as a minor subject. Mathematics major students complain more about stomach sickness, nervousness, faster heartbeats, and worrying before and during the tests compared to mathematics minor students. However, studies have found that students who major in mathematics or related fields tend to have lower levels of test anxiety than students who are not in math-related majors. This may be due to the fact that students in math-related majors have had more exposure to and practice with mathematical concepts, which can lead to greater confidence and comfort with taking math tests. On the other hand, students who minor in math or have taken math classes as part of their general education requirements may have higher levels of test anxiety, as they may have had less exposure to and practice with mathematical concepts. Additionally, students who feel they are not "good at math" may also experience higher levels of test anxiety when taking math tests. It's also important to note that test anxiety is a multidimensional construct and may be influenced by a variety of factors including personality, learning style, past experiences, and individual differences. Also, other factors such as teaching style, classroom atmosphere, and test format may also play a role in the level of test anxiety experienced by math students [25].

Table 2. Statistical comparison between Mathematics major and minor students.

	Major		Minor		*df* = 700
	N = 384		N = 318		
Items	**Mean**	**SD**	**Mean**	**SD**	**p-value**
1	3.335	1.205	2.997	1.214	0.0002***
2	2.963	1.176	2.695	1.167	0.0027**
3	3.170	1.199	2.802	1.195	0.0001***

 doi:10.20944/preprints202412.1702.v2

4	3.068	1.327	2.607	1.241	<0.0001***
5	2.581	1.134	2.365	1.109	0.0111*
6	3.419	1.099	3.308	1.143	0.1913
7	3.322	1.117	3.173	1.142	0.0823
8	3.105	1.198	2.984	1.190	0.1819
9	2.963	1.303	2.881	1.212	0.3920
10	2.961	1.141	2.915	1.190	0.6022

*p<0.05, **p<0.01, ***p<0.001.

3.2. Qualitative Approach

The following questions were asked to five participants to draw learner voices and in-depth anxiety data:

i. What are the factors that cause anxiety during exams?
ii. How do you feel during your exam?
iii. In your opinion, when does anxiety level increase during exams? Before the exam, during the exam, or after the exam?
iv. What suggestions and recommendations do you have for alleviating your test anxiety?

Table 3. Participant's details.

pseudonym	Gender	Year of Study	Family Income
Anamika	Female	2nd	High
Choiti	Female	3rd	Medium
Rahul	Male	4th	Medium
Sujit	Male	3rd	Low
Susmita	Female	4th	High

In response to the first qualitative research question, Anamika reports a variety of factors that contribute to test anxiety, including forgetting answers, feeling unprepared, fear of failure, physical symptoms such as hypertension and panic, slow writing speed, and time constraints. These factors may all contribute to a sense of stress and uncertainty during test-taking, making it more difficult for Anamika to perform at their best. Choiti on the other hand, states:

> *My anxiety arises from lack of preparation. But sometimes good preparation is not enough and I get anxious thinking about whether I will be able to remember everything or not.*

Rahul identifies lack of confidence as a key factor in generating test anxiety. Specifically, he notes that a lack of confidence in understanding and properly answering the questions on the test can lead to feelings of stress and uncertainty during the test-taking process. Also, Sujit states:

> *I worry about question patterns and if I will be able to answer the questions in time.*

According to Susmita, time constraints, irregular study habits, last-minute studying, and insufficient practice are all factors that contribute to test anxiety. These factors may lead to feelings of unpreparedness and a lack of confidence in one's abilities, which can in turn contribute to feelings of stress and uncertainty during the test-taking process.

In response to the second qualitative question, Anamika reports:

> *It depends on the question paper; if all the questions are common, I feel confident. However, if things are reversed I often get panicked in the exam hall.*

The other participants agree; common questions calm them since they can anticipate the possible right or wrong answers and marks to be deduced or obtained. As Rahul states:

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I always try to remain relax as much as possible; however, it depends on the course, preparation, and confidence level.

According to Sujit and Susmita, feeling exhausted, tensed and having little confidence are factors that contribute to test anxiety. These feelings can be caused by factors such as lack of sleep, overwork, or feeling unprepared for the test, and can make it more difficult for the test-taker to perform at their best.

In response to "when does anxiety level increase during exams? Before, during, or after the exam?" Anamika states:

My anxiety remains high before the exam and reduces gradually during and after the exams.

Choiti has high pre-test anxiety and Rahul clarifies:

When my preparation is bad, I am much more anxious before the exam. If my exam does not go well, I am more anxious after the exam.

Sujit may be experiencing a phenomenon known as "tip-of-the-tongue" (TOT) state. This occurs when a person knows that they know something, but are temporarily unable to retrieve the information from memory. This can be caused by a variety of factors, such as stress or fatigue, and is a common experience for many people. If Sujit is experiencing TOT frequently or it is affecting her daily life, she should consult with a healthcare professional. Susmita states:

At the beginning of the exams, I feel very nervous. But gradually I get use to this circumstances.

In response to the last question regarding suggestions about anxiety management, Anamika 1exerts:

We should study consistently throughout the year rather than cramming before exams. We should practice regularly to build confidence and fight anxiety. Eating healthy food and keeping away from social media might reduce stress.

Having exam strategies in place can help reduce anxiety during the test-taking process. Responding to the questions that you are most confident in first can help build momentum and increase your sense of control over the situation. Careful time management can also help you stay on track and avoid feeling overwhelmed. Additionally, having a positive attitude towards post-test anxiety can help you focus on learning from the experience and moving forward, rather than dwelling on the outcome. Engaging in self-care activities such as exercise, meditation, or spending time with friends can also help alleviate stress and anxiety after taking a test:

It is better to realize that what is gone is gone; we cannot bring it back. We need to learn from the mistakes made in the previous exam and start preparing with a fresh mind for the next exam.

Choiti is anxious before exam and suggests:

Always remember that a single paper or exam marks really cannot define one's life. There will be many more opportunities to do better in our life if we try hard. That is how I reduce my anxiety.

Thus, having confidence in oneself, being well prepared, and not giving up are all strategies that can help reduce anxiety and improve performance on tests. Being confident in one's abilities and knowledge can help reduce the fear of failure and increase the likelihood of success. Proper preparation, such as studying and reviewing material beforehand, can also help reduce anxiety by increasing one's level of familiarity with the material. It's also important not to give up and keep trying even if you are facing difficulties, because it's a way to show resilience, this will help you to

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overcome the challenges, and to develop the ability to adapt to new situations. Additionally, having a positive attitude and a growth mindset can help you to see challenges as opportunities for learning and development, rather than as failures.

Sujit mentioned, focusing on practice and repetition can be an effective strategy for improving performance on tests. By repeatedly reviewing and practicing the material, you can increase your familiarity and understanding of the material, which can help reduce anxiety and increase confidence. Believing in your own capabilities and trying to maintain a steady mindset can also be helpful. By having faith in your abilities and not getting discouraged or overwhelmed by setbacks, you can increase your resilience and the ability to handle the pressure of tests. Susmita's suggestion of keeping a steady mindset can also help you to avoid getting too excited or too disappointed by the outcome of the test, which can help you stay focused and maintain your composure. It's important to note that every person have their own way to cope with anxiety and stress, so it's good to find what works best for you and stick to it. A combination of different strategies may be the best approach:

Don't panic. Study properly and do not memorize without understanding.

They emphasize on keeping practicing and taking sample tests to check preparation.

They mentioned, keeping practicing and taking sample tests can be an effective way to check your preparation and improve your performance on tests. Practicing and reviewing the material on a regular basis can help you become more familiar with it, increase your understanding, and develop better retention of the information. This can help reduce anxiety and increase confidence. Taking sample tests can also be a useful tool for preparing for exams. Sample tests can help you identify areas of weakness and focus your study efforts. They also allow you to get a sense of the format and structure of the exam, which can help reduce anxiety on the day of the test. Furthermore, taking sample tests can help you to evaluate your progress over time and adjust your study strategy accordingly, which is an important step to achieve success.

Conclusion

This study suggests that university mathematics students in Bangladesh tend to experience test anxiety, and that gender has little or no impact on this. This finding is supported by previous research, which suggests that test anxiety among university students is a common phenomenon. The study also suggests that the type of course, whether mathematics is a major or minor, has a significant impact on test anxiety. Specifically, it suggests that students who are majoring in mathematics experience more tension, nervousness, and physical symptoms during tests than students who are studying mathematics as a minor. It's important to note that test anxiety is a complex phenomenon that can be influenced by a variety of factors such as personal characteristics, study habits, and the academic environment. Therefore, it's important to consider the unique context of the study and how it applies to other settings and populations. Also, it's important to find ways to manage test anxiety, such as developing effective study habits, practicing relaxation techniques, and seeking professional help if necessary.

The following points are highlighted from the findings of this study:

- Test anxiety is common among Bangladeshi Mathematics students and is not correlated with gender.
- Those who study maths as a major subject at universities experience higher maths test anxiety than others.

Appendix

Questionnaire for Quantitative Section:

1. My stomach gets upset and/or I get very nervous before the tests.

   a. Strongly disagree, b. Disagree, c. Neutral, d. Agree, e. Strongly agree

2. I have an uncomfortable feeling during the math tests.

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a. Strongly disagree, b. Disagree, c. Neutral, d. Agree, e. Strongly agree

3. My heartbeat gets faster during math tests.
   a. Strongly disagree, b. Disagree, c. Neutral, d. Agree, e. Strongly agree
4. I could not sleep properly before math tests.
   a. Strongly disagree, b. Disagree, c. Neutral, d. Agree, e. Strongly agree
5. I could not concentrate during math tests.
   a. Strongly disagree, b. Disagree, c. Neutral, d. Agree, e. Strongly agree
6. I have a good understanding in math but do badly on math tests.
   a. Strongly disagree, b. Disagree, c. Neutral, d. Agree, e. Strongly agree
7. During the tests, I think that I will not get good grades.
   a. Strongly disagree, b. Disagree, c. Neutral, d. Agree, e. Strongly agree
8. During the tests, I forget everything that I know.
   a. Strongly disagree, b. Disagree, c. Neutral, d. Agree, e. Strongly agree
9. I don't want to tell others about my math test scores.
   a. Strongly disagree, b. Disagree, c. Neutral, d. Agree, e. Strongly agree
10. I could not pick right questions to answer that is easy for me.
    a. Strongly disagree, b. Disagree, c. Neutral, d. Agree, e. Strongly agree

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