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Test Anxiety Among STEM Students: The Case of Higher Education in Bangladesh

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Abstract: Tests or examinations are an essential part of education, creating test anxiety among students. Several studies identified a negative correlation between test anxiety and Science, Technology, Engineering, and Mathematics (STEM) students' academic performance in higher education, and female students in STEM subjects showed more test anxiety before and during an examination. Studies also identified that STEM students could pay less attention to their examinations due to test anxiety. Such evidence in the context of Bangladeshi universities is yet to be understood. This study investigated the level of test anxiety among Bangladeshi university students of STEM subjects, including gender differences and the relationship between test anxiety and academic performance. We considered the quantitative research design to understand the status of test anxiety among undergraduate STEM students. A survey was conducted online from two STEM departments of a private university in Bangladesh using the shorter version of the CAEX test anxiety instrument, and a total of 246 undergraduate students participated. The findings show that Bangladeshi undergraduate STEM students generally felt slight anxiety during or before the examination. Female students were more anxious before or during a test than male students, and no significant relationship was found between test anxiety and academic achievement. The study reflects the need to conduct further research to understand the physiological, cognitive, and psychological factors leading to test anxiety among university students, as well as establishes a demand to identify the reasons behind having no relationship between test anxiety and students' academic performance.

Keywords: test anxiety, anxiety and achievement, STEM students, gender difference, higher education, Bangladesh

1. Introduction

Test anxiety becomes a considerable concern among students, as it negatively affects students' academic achievement, lifestyle, inner motivation, and attention toward the study process [1, 2]. Studies reported that university students obtain lower academic results in achieving a grade point average (GPA) due to test anxiety [3–6]. The negative correlation between test anxiety and students' academic performance is observed worldwide, from developed [4, 5] to developing countries [7], particularly in Science, Technology, Engineering, and Mathematics (STEM) subjects [8, 9]; however, lower test anxiety is also evident [10], which might have a relationship with the STEM learning process.

Several studies have already identified the adverse association between test anxiety or examination stress and academic performance among STEM students in higher education. From large-scale studies or meta-analyses, Hembree [11] and von der Embse et al. [12] established that higher levels of text anxiety among STEM students directly affected their lower academic performance. For instance, test anxiety is found common among STEM students in the US, which also has an effect on their academic performance [13]. Researchers also identified that female students in STEM subjects showed more test anxiety than male students [14–16], which impacted their academic performance [17]. One of the major roles of higher educational institutions is to reduce students' test anxiety so that they can perform better in their academic journey [18]. Therefore, understanding test anxiety situation among students in relation to their academic performance is important.

From the perspective of Bangladesh, we carefully searched for evidence-based literature to understand the test anxiety situation among university students; however, we found limited articles concerning this issue [19, 20]. These articles did not focus on gender differences, were not conducted with the STEM group students, or provided limited discussions of test anxiety on academic performance. Therefore, we aim to understand the test anxiety situation among university students from STEM subjects in Bangladesh by formulating two specific research questions: (1) Is there any gender difference in terms of test anxiety in STEM subjects in higher education? and (2) Is there any

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association between test anxiety among STEM students and their academic performance?

2. Literature Review

2.1. Test anxiety

Sawka-Miller [21] defined test anxiety as "the subjective experience of intense physiological, cognitive, and/or behavioral symptoms of anxiety before or during test-taking situations that interferes with test performance". Test anxiety indicates a set of cognitive, affective, and behavioral adverse reactions of the students. These reactions create possible negative consequences in an evaluation process [6]. In other words, test anxiety is a set of responses of students in examination situations such as agitation, excessive body movements, sleeplessness, muscle spasms, focusing problems, abdominal pain, and tremors that harm a student's academic life and career [22]. In academic life, such internal changes among students make them anxious, fearful, or nervous, particularly during and before different assessment procedures such as quizzes, midterms, or final examinations [4]. Students try to obtain higher exam scores; thus, test events create anxiety among students [23]. While an expected range of anxiety can inspire pupils to work hard [24], anxiety disorder is deliberate [25]. A higher level of anxiety negatively impacts people's mental and physical health and decreases performance at all levels, such as personal, social, occupational, and educational [26].

There are two types of anxiety: trait and state anxiety [27]. The first one is considered as a more stable personality feature, while state anxiety temporarily reacts to an unfavorable event. Trait anxiety can be associated with constant high arousal and various psychopathological conditions, while state anxiety is related to the transient intense emotional state through nervous system activity [28]. Several studies discussed the effect of both trait and state anxieties in terms of students' cognitive and behavioral approaches (such as students' higher mindfulness), which are also aligned with STEM students' test anxiety. For instance, Carsley and Heath [29] discussed that "it is important to also consider students' dispositional and states of mindfulness, which may be contributing to students' test anxiety and state mindfulness response when participating in a mindfulness-based intervention for test anxiety".

Test anxiety might not always be negative, and, in some instances, low-level test anxiety could help students focus on achieving success in examinations [30, 31]. Test anxiety is a worldwide concern as university students hold moderate to high-level test anxiety [3, 32]. Studies also found that female students faced more stress or anxiety before the examination [33], while male students obtained a lower score due to anxiety [3, 34]. Considering the context of Bangladesh, it is found that more than 70 percent of university students felt anxious during exams [19]; however, an inverse association between anxiety and undergraduate students' academic achievement was also evident [20]. Studies argued that poor academic performance was linked to increased anxiety levels [19, 20].

2.2. Factors and components of test anxiety

Test anxiety is composed of a complex component process such as cognitive components (e.g., worry about possible failure), affective components (e.g., uneasy and nervous feelings or increasing heart rate), motivational components (e.g., escape from the situation), and behavioral components (e.g., facial and postural expression of anxiety) [35]. The cognitive components indicate the rise of negative thoughts during a test that impact performance (e.g., if I fail, my whole life will be destroyed). The affective-physiological components designate autonomic arousal (e.g., tension, tight muscles, and trembling) in a test situation. In contrast, behavioral components, such as poor study skills, avoidance, and work procrastination, point to academic work hesitation or lack of study skills [36]. Figure 1 provides a summary of the components of test anxiety.

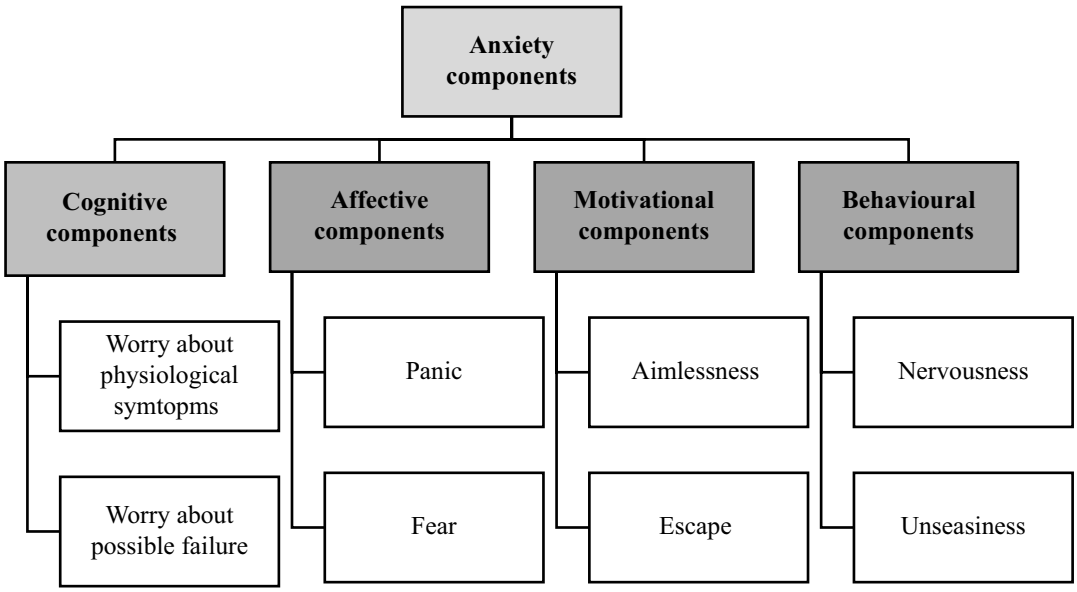
Several factors are responsible for test anxiety, in which students' insufficient content knowledge, insufficient time to prepare for exams, financial concerns, health problems, academic pressure, and adjustments to educational institutions are most common [37]. For example, students could forget the key contents of the subject during an examination or be unable to focus on the content because of the unfamiliarity of the examination room. Students also can be affected by some perceived factors: they could hold a fear of making mistakes during an examination though they know the content, they could think that they had insufficient study background for examination, or they could even be worried about the negative attitude of their teachers and family members [38]. In addition, teachers' teaching and evaluative methods, competition between students, and fear of failure lead to students experiencing test anxiety and impact their academic performance [37].

On the one hand, several factors and components discussed above created test anxiety among students; on the other hand, due to test anxiety, students face a higher level of lower motivation for their examination, which could reduce their concentration before and during an examination [39]. Therefore, test anxiety during and after an examination and the factors and components of test anxiety are reciprocal.

2.3. Measuring test anxiety

The association between test anxiety and students' academic performance was first examined in 1960 [40], in which a test anxiety scale was used to identify the test anxiety among Children, and this study found positive correlations [40]. Later on, researchers provided another model to measure test anxiety considering worry and emotionality [41]. They suggested that worry is a better predictor of weakened test performance, pointing out that maladaptive cognitions have a more significant adverse effect on a test than physiological distress. However, according to Zeidner and Matthews [36], self-referential executive processing model and negative self-beliefs caused by metacognitive strategies (e.g., heightened attention) cause short-term distress, whereas maladaptive situation interaction (e.g., negative feedback) causes long-term distress. Zeidner and Matthews [36] proposed a self-referent executive processing model focusing on emotional discomfort that might link trait and state test anxiety assessment. Aguayo [42] developed a test anxiety questionnaire titled Cuestionario de Ansiedad ante los Exámenes para ESO y Bachillerato – Adaptado [Test Anxiety Questionnaire for ESO and Bachillerato – Adapted] (CAEX-A) in Spanish [5]. This questionnaire has two parts. The first part consists of 39 items to assess the intensity of the test anxiety, and the second part contains 11 items to evaluate the level of anxiety. The instrument is based on Lang's three-dimensional theory of anxiety: physiological responses, cognitive responses, and motor responses. Núñez-Peña et al. [5] adapted this CAEX tool, and we used this shorter version for our study.

Figure 1
Components of test anxiety



3. Hypotheses

For this research, we hypothesize that:

$H_0$1. There is no significant difference between male and female undergraduate students in terms of their test anxiety.

$H_0$2. There is no significant difference regarding test anxiety between Computer Science and Electrical Engineering undergraduate students.

$H_0$3. There is no significant relationship between undergraduate students' academic performance (GPA) and test anxiety scales.

4. Research Methodology

4.1. Research design

The study is quantitative in nature, as this form of research design allows for the measurement, description, and explanation of phenomena of interest and the opportunity to make generalizations about the investigated topic [43]. We attempted to measure the test anxiety levels of the students of two STEM departments of a university. Based on the test anxiety measurement questionnaire developed by Aguayo [42] and shortened and simplified by Núñez-Peña et al. [5], this study intended to understand the status of test anxiety, including gender differences, of two groups of STEM students. We collected data from undergraduate STEM students at a private university located in the capital city, Dhaka, Bangladesh. The second author worked for this university earlier. During her job period in the sampled university, she conducted several training sessions with the students and observed that the students from the STEM departments showed more anxiety about their examinations than those from non-STEM departments. She validated her observations through informal discussions with her colleagues in both STEM and non-STEM departments and found similar observations. Therefore, we considered two STEM subjects from this university and chose the quantitative study design as this research design establishes the relationship among variables and provides a general tendency of responses with an unbiased approach [44].

4.2. Participants

The participants were selected from two departments, Computer Science (CS) and Electrical Engineering (EE), of the sampled university. We planned to collect at least 40 responses from each department, ensuring equal gender group representation, assuming getting no outlier as such sample size allows running group comparison and *t*-tests to understand the differences between two groups [45, 46]. Among a total of 2078 students of CS and 1584 from the EE departments, 139 and 107, respectively, completed the survey, and the response rate was 6.72%. While we expected a higher response rate, limited access to the Internet among Bangladeshi students might be the reason for lower responses [47]. However, the response rate is usually lower in online surveys [48], and such a lower response rate is observed in several studies on education [49]. This lower participation could be considered because it might not create any resulting bias [50]. The undergraduate students at the selected university participated in the survey; of them, 178 were male, and 68 were female. The mean age of the CS students was 22.47 ($SD = 1.89$, range = 18–29), and for EE, it was 22.23 ($SD = 2.29$, range = 17–29).

4.3. Instruments

The original instrument was published in Spanish, containing 50 items [5]; however, a shorter English version which also could measure the test anxiety is available [5]. We used this shorter version to understand Bangladeshi university students' test anxiety status. The first part of the shorter version consists of 14 items that assessed the students' anxiety levels in different situations (Appendix A). Participants were asked to rate how repeatedly they felt each circumstance on a six-point Likert-type scale (0 = almost never, 1 = seldom, 2 = sometimes, 3 = often, 4 = usually, and 5 = almost always). The score of an individual for this part can be from 0 to 70. The second part consists of four items: an oral presentation, a multiple-choice test, an open-question test, and a test involving calculations (Appendix B), and each item is

independent. For each item, a similar scale was also employed (0 = not anxious, 1 = slightly anxious, 2 = fairly anxious, 3 = very anxious, 4 = highly anxious, and 5 = extremely anxious). The score for each item of this part for an individual can be from 0 to 5. We also gathered students' demographic and study-related information such as age, gender, academic year, and academic performance. The sampled participants used the Bengali language for their day-to-day communication, the first author translated the shorter version of the CAEX instrument into this language, and the co-authors reviewed it several times. We requested a bilingual researcher with expertise in educational assessment to check the translations, and she provided some suggestions to ensure the content validity and clarity of the instrument. Based on her suggestions, the authors collectively made it final.

The original instrument was validated and had high internal consistency in terms of measuring test anxiety [42]. To understand the reliability of the instrument, we performed a reliability analysis on the first part of the instrument. Cronbach's alpha showed that the questionnaire is highly reliable ($\alpha = 0.900$). Except for one, all the questionnaire items decreased the alpha if deleted. The exception is item 6; however, this increases the alpha very slightly (from $\alpha = 0.900$ to $\alpha = 0.903$); therefore, keeping this item is considerable. Núñez-Peña et al. [5] also reported the similar reliability ($\alpha = 0.94$) of the instrument.

4.4. Data collection and analysis

We created a Google Form to conduct the survey online. Collecting data using an online platform is efficient, convenient, time- and cost-saving [51, 52]. Besides, online data collection helps the researchers to transfer data from one format to another without losing any data [53]. The survey link was circulated to all the students of these two departments through their respective department's social networking groups. We requested the teachers of these departments to appeal to their students so that they felt encouraged to participate. The duration of data collection was three weeks, and it took, on average, approximately 20 min to complete the survey. We downloaded the responses as an Excel file and then converted into Statistical Package for Social Sciences (SPSS) format. We used the SPSS 21.0 for data analysis. A Pearson product-moment correlation was calculated to establish the relationships between the study variables, and independent-samples t-tests were also used to determine group differences. The tests of normality were checked, and both the Kolmogorov-Smirnov test ($p > 0.05$) and the Shapiro-Wilk test ($p > 0.05$) showed that the data was normally distributed, which led the authors to use the independent-samples *t*-test to compare the group differences. Mean and standard deviation were also two main statistical tools. The variables used in this study were gender, departments, GPA, and test anxiety items (Appendix A and B).

4.5. Ethical considerations

We followed the necessary ethical considerations throughout the study. The study protocol was approved by the Bangladesh Bioethics Society (reference number: ERC/BBS/022). The study objectives, data collection procedure, and ethical issues were presented at the beginning of the Google Form, and the participants were requested to provide their consent before starting the survey. Participation in the study was voluntary, and the consent form stated that participants could withdraw themselves from the data collection process at any stage. Anonymity and confidentiality were maintained in all stages.

5. Results

Descriptive statistics show that before or during an examination, the test anxiety of the sampled students was "seldom" ($M = 22.79$, $SD = 14.01$), as shown in Table 1. Their anxiety level was slightly more than "fairly anxious" for oral presentations ($M = 2.12$, $SD = 1.47$) and "slightly anxious" for the remaining three kinds of tests, such as the multiple-choice test ($M = 1.03$, $SD = 1.08$), open-question test ($M = 1.18$, $SD = 1.20$) and test involving calculations ($M = 1.60$, $SD = 1.50$). Regarding gender differences, Table 1 reports higher levels of test anxiety among female students ($M = 25.88$, $SD = 15.88$) than their male peers ($M = 21.61$, $SD = 13.08$) in 14-item CAEX test anxiety ($t(244) = -1.98$, $p = 0.050$) and multiple-choice tests ($t(244) = -2.22$, $p = 0.027$). No significant gender differences were found for the oral presentations, open-question test, and test involving calculations.

An independent-samples *t*-test was performed in order to determine the significant differences between the students of the CS and EE departments, if any. Table 2 shows that while CS students showed high anxiety at some points in 14-item CAEX test anxiety and open-question text and low anxiety in other tests compared to their EE counterparts, the differences between the performance of two group students were not statistically significant.

To obtain a deeper understanding of test anxiety, we ran separate t-test for each of the CAEX items and found significant gender differences in four items, such as items no 2, 8, 9, and 13. For all these four items, female students were significantly more anxious than male students ($t(244) = -3.29$, $p = 0.001$; $t(244) = -3.19$, $p = 0.002$; $t(244) = -2.79$, $p = 0.006$, and $t(244) = -2.69$, $p = 0.007$, respectively) (Table 3). We did not find any significant difference for other items.

To evaluate the size and direction of the relationship between academic performance (GPA) and test anxiety scales, a bivariate Pearson's correlation coefficient (r) was calculated. Table 4 reports that there was a weak negative correlation between GPA and the three test anxiety scales such as 14-item CAEX scale ($r(244) = -0.323$, $p = 0.000$), oral presentations ($r(244) = -0.124$, $p = 0.050$), open-question test ($r(244) = -0.154$, $p = 0.016$) and test involving calculation ($r(244) = -0.193$, $p = 0.002$), except multiple-choice test scale. However, the 14-item CAEX test anxiety scale had a weak positive correlation with oral presentations ($r(244) = 0.348$, $p = 0.000$), multiple-choice test ($r(244) = 0.233$, $p = 0.000$), open-question test ($r(244) = 0.250$, $p = 0.000$), and test involving calculation items ($r(244) = 0.302$, $p = 0.000$). Besides, oral presentations scale had a weak but positive correlation with the multiple-choice test ($r(244) = 0.224$, $p = 0.000$), open-question test ($r(244) = 0.337$, $p = 0.000$), and test involving calculations ($r(244) = 0.345$, $p = 0.000$). Similarly, the multiple-choice test had a weak and positive correlation with the open-question test ($r(244) = 0.462$, $p = 0.000$) and test involving calculation ($r(244) = 0.404$, $p = 0.000$). At the same time, the open-question test also had a weak and positive correlation with the test involving calculations ($r(244) = 0.363$, $p = 0.000$). Therefore, the result of Table 4 established that there was no strong relationship between GPA and any of the scales.

6. Discussion

Test anxiety is a psychological state that might potentially become a barrier that can compel students to show less academic performance than their capacity [11, 12]. To develop students' academic potential, it is necessary to understand the scenario of test anxiety bothering them while exhibiting academic performance. As

Table 1
The test anxiety level of the students by gender

	All		Male students		Female students			
Anxiety measures	Mean	SD	Mean	SD	Mean	SD	*t*-test	*p*
14-item CAEX test anxiety	22.79	14.01	21.61	13.08	25.88	15.88	−1.98	0.050
Oral presentations	2.12	1.47	2.12	1.42	2.12	1.60	0.028	0.977
Multiple-choice test	1.03	1.08	0.94	1.07	1.28	1.08	−2.22	0.027
Open-question test	1.18	1.20	1.13	1.18	1.31	1.23	−1.05	0.293
Test involving calculations	1.60	1.50	1.54	1.53	1.76	1.42	−1.05	0.294

Table 2
The test anxiety level of the students by department

	Computer Science		Electrical Engineering			
Anxiety measures	Mean	SD	Mean	SD	*t*-test	*p*
14-item CAEX test anxiety	23.66	14.28	21.66	13.63	1.11	0.268
Oral presentations	2.11	1.53	2.14	1.39	−0.17	0.863
Multiple-choice test	0.99	1.13	1.08	1.03	−0.65	0.509
Open-question test	1.21	1.20	1.14	1.19	0.44	0.657
Test involving calculations	1.60	1.49	1.61	1.53	−0.05	0.957

Table 3
Mean, standard deviation, and *t*-test for four items by gender

	Male students		Female students			
CAEX items	Mean	SD	Mean	SD	*t*-test	*p*
Item 2	0.88	1.21	1.56	1.54	−3.29	0.001
Item 8	1.36	1.56	2.09	1.72	−3.19	0.002
Item 9	1.93	1.58	2.57	1.73	−2.79	0.006
Item 13	1.60	1.56	2.21	1.62	−2.69	0.007

modern educational practices focus on student-centered education [54], understanding this test anxiety scenario among university STEM students could help administrators update the assessment procedure to explore their potential and competencies at a higher level. This present study investigated this point, particularly regarding gender among university students from STEM subjects in Bangladesh. It explored the relationship between their test anxiety and academic performance with empirical evidence based on the shorter version of the CAEX questionnaire, which focused on cognitive responses.

The study results revealed that most sampled students slightly felt anxiety before or during the examination. This result was consistent with other studies [26, 55], which showed that the students' test anxiety was mild or low. A different situation is also evident, in which most students had high [30] or moderate test anxiety [31]. Therefore, test anxiety before or during the examination could vary from context to context. While it was assumed that students' academic performance might be highly triggered by test anxiety, this study did not find such a relationship among Bangladeshi university STEM students. This study found that Bangladeshi STEM students experienced "fairly anxious" on oral presentations and "slightly anxious" on the other three tests, such as multiple-choice tests, open-question tests, and tests involving calculations. These findings are also not aligned with the informal observation of the faculty members of the sampled university, which we discussed in the participation section. There might be several reasons for such low test anxiety. Bangladeshi students are familiar with formal tests or examinations from the beginning of their school life [56]. This familiarity with examinations starting from primary education might be a cause for having a lower anxiety level that does not affect their final score.

The study findings reported a higher level of test anxiety among female students than males. Therefore, our first hypothesis H01stated that there is no significant difference between male and female undergraduate students in terms of their test anxiety, is rejected. This result corroborated the previous study results [5, 14–16, 57]. Situations such as teachers watching or standing beside them for a long time, feeling nervous, or worrying about forgetting everything or failing the tests or getting limited time, crying after a test or overthinking about the marks after tests significantly created test anxiety among female students, whereas sitting in front of the class in a test made the male students more anxious. It was also noticed that female students exhibited test anxiety in multiple-choice tests only at a higher level than male students. There was no gender difference in anxiety levels concerning the oral presentations, open-question test, and test involving calculations. However, Núñez-Peña et al. [5] found that the open-question test, oral presentations, and test involving calculation stirred up more anxiety in female students than males, and no gender difference emerged between male and female students in the multiple-choice test. Several explanations could be proposed for the gender differences in the level of test anxiety found in this study, in line with previous studies [5, 57, 58]. These studies noted that gender differences in the social approval system about the study, gender-linked social roles, females' lower self-efficacy or motivation or self-confidence, specific anxiety toward mathematics or excessive pressure to be successful academically against social constraints, and biases in response to the worth of male and female could accelerate test anxiety in female students. Another possible explanation in terms of gender difference in STEM test anxiety might be that males considered it a threat to their masculinity trait to admit the feelings of test anxiety and unexpected reactions from them in terms of the conventional societal context [5]. To reduce test anxiety among female students, studies suggested considering less focus on examination [14], promoting female participation in STEM subjects [59], and considering the context-specific causes to understand the association between test anxiety and lower performance among female students in STEM subjects [60].

However, no statistically significant difference in test anxiety was noticed between the students of the two STEM departments on any of

Table 4
Pearson's correlation coefficient for GPA and all test anxiety scales

	1	2	3	4	5	6
1. GPA	–	−0.323 (0.000)**	−0.124 (0.050)*	−0.056 (0.382)	−0.154 (0.016)*	−0.193 (0.002)**
2. 14-item CAEX test anxiety		–	0.348 (0.000)**	0.233 (0.000)**	0.250 (0.000)**	0.302 (0.000)**
3. Oral presentations			–	0.224 (0.000)**	0.337 (0.000)**	0.345 (0.000)**
4. Multiple-choice test				–	0.462 (0.000)**	0.404 (0.000)**
5. Open-question test					–	0.363 (0.000)**
6. Test involving calculations						–

Note: *Correlation is significant at the 0.01 level (2-tailed).
** Correlation is significant at the 0.05 level (2-tailed).

the scales. Students from both computer science and electrical engineering subjects hold a similar level of lower test anxiety. Hence, the second hypothesis of the study, $H_0$2, which stated that there is no significant difference regarding test anxiety between Computer Science and Electrical Engineering undergraduate students, is failing to reject. The students of both subjects had to study similar STEM subjects (such as physics, chemistry, and mathematics) in secondary and higher secondary education as a prerequisite for their university admission. Having a similar educational background could be the reason for this similar result.

Students' perceptions regarding course knowledge or fear of any specific course, a lack of enough time for exam preparation, financial concerns, health problems, academic pressure, adjustment to the educational institution, teachers' teaching and evaluative methods, competition between students and unhealthy relations, fear of failure, family expectations and responsibilities and other personal factors might lead to students' test anxiety and impact their academic performance [37]. Even with an excessive academic workload, an oversized academic curriculum with colossal content and frequent or ceaseless test schedules lead to mental health problems such as anxiety, depression, and stress among Bangladeshi undergraduate university students [61]. In contrast to our study, it is also evident that high anxiety was found in university STEM students in Bangladesh when they lived separately from their families and did not regularly contact their family members during examinations [62]. Moreover, they showed that insufficient sleep and not maintaining healthy food habits were also anxiety creators in examinations among students. Since controlling test anxiety levels can help increase students' academic motivation and performance [63], improving parent-student communication and maintaining balanced food and sleeping habits during tests might be considered some ways to alleviate students' excessive anxiety [62]. While we did not investigate the reasons behind the lower test anxiety in STEM subjects, the present findings align with another study [10], which identified that test anxiety among students is lower during a pandemic. During the COVID-19 lockdown, students stayed with their family members with improved communication with parents and good food and sleeping habits [62]. Therefore, along with academic factors, test anxiety among students could be associated with students' personal and family environment aspects. Further investigation is needed to identify what specific factors are the causes of test anxiety among Bangladeshi STEM students.

Furthermore, the current study revealed a weak relationship between test anxiety and university student's academic performance (GPA). Therefore, our third hypothesis, $H_0$3, which stated that there is no significant relationship between undergraduate students' academic performance (GPA) and test anxiety scales, is rejected. This study only considered the students' GPA in the last semester, not the performance of the previous semesters. This finding was in harmony with the study that reported no meaningful relationship between test anxiety and academic performance [55]. However, several studies contended that students with higher test anxiety showed low academic achievements, contrasting with this study's result [26, 64]. Cassady and Johnson [65] also indicated a negative relationship between test anxiety and academic performance in their study, which is not factual for this case. However, it can be assumed from the study result that it is not necessarily academic performance that can be influenced by test anxiety only; there might also be factors such as teaching methods, faulty assessment procedures, imperfect question construction, classroom or learning environment, and lack of academic motivation. A recent study identified teachers' STEM anxiety in their teaching practices [66], which might influence students' test anxiety. Besides, if the students' performance of all semesters was considered in this study, the situation might have been different. Studies also identified that low-level test anxiety could help university students in focusing their academic studies [30, 31], which might have a positive consequence on their academic achievements. The university authorities could investigate more if there is any association between students' low anxiety and their performance.

A more detailed look into the present study's findings demonstrated that university STEM students' test anxiety levels differed in the four types of tests. The 14-item CAEX test anxiety scale had a weak relationship with other scales. These findings conferred the fact that oral presentations aroused slightly more anxiety than the other types of tests. A possible explanation for the findings could be that STEM students fear executing their academic knowledge in oral presentations. The reasons could be insufficient subjective knowledge, lack of preparations or confidence or communication skills, shyness, or trouble accumulating or averring thoughts in front of peers or teachers within a short presentation time, inability to use modern equipment such as laptops or projectors or intimidated by teachers' authoritarian personality or appearance while giving oral presentations. Preparing well for course contents or math problems and getting more time to think, justify, or write the answers might be the causes of feeling less anxious than oral presentations. It could be noticed from the study findings that different test types could cause test anxiety among university students of STEM subjects and that the levels of test anxiety generated from different test types would be different. It is also important to discuss that low-level test anxiety, which is the situation in this case, could help the students for examination success [30, 31]; the university student counselors might be

interested in investigating the issue further in line with the psychological aspects. As it is already evident that test anxiety, whether it is low or high, is associated with lower academic performance, some strategies could be considered to reduce this anxiety, such as reducing or modifying high-stakes testing, performing classroom interventions, ensuring effective study habits and time management skills [67]. Besides, changes in instructional strategies and the positive effect of instructors could also lead to lower test anxiety among STEM students and increase their performance [68, 69].

Test anxiety, either low or high, has an association with STEM students' academic performance. As the university authorities focus on exploring students' potential at a high level, understanding the causes behind test anxiety, including cognitive, affective, and behavioral components [35], is important. This study explores the status of test anxiety among Bangladeshi undergraduate STEM students, which needs further investigation.

7. Study Limitations and Recommendations for Future Research

This study considered only two STEM subjects; a better scenario might be known if more STEM subjects were considered and compared. We recommend considering students from different STEM subjects in future studies to understand if there is any difference in this regard. We also did not design the study method to understand the reasons behind such a lower anxiety level, and future research is recommended to identify whys and wherefores. We considered only the cognitive responses of test anxiety, not the physiological and motor responses, which limited the scope of understanding the whole test anxiety situation of the students. Test anxiety among students is not only related to examination-related factors but several factors could also be associated with this, which was not an issue of investigation for this study. Future studies could fill this gap.

8. Conclusion

The study findings indicate slight test anxiety among university STEM students in Bangladesh. Although mild anxiety does not directly affect students' academic performance, test anxiety can adversely affect their mental health. Despite some limitations related to the participant selection, the present study has its own applicability in Bangladeshi higher educational settings and creates new scopes for further research. This study reflects the need to conduct further research with a larger sample size and from diverse groups to understand the physiological, cognitive, and psychological factors leading to test anxiety among university students. Along with considering an experimental design in future studies, the study also demands future research considering various internal and external factors that might be associated with test anxiety, students' mental well-being, and academic performance, particularly in developing countries like Bangladesh. It is also suggested to understand the level of test anxiety where students are familiar with frequent examinations from school life to understand the association between test anxiety and frequent examination practices.

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Ethical Statement

This study does not contain any studies with human or animal subjects performed by any of the authors.

Conflicts of Interest

The authors declare that they have no conflicts of interest to this work.

Data Availability Statement

The data used to support the findings of this study are available upon request to the corresponding author.

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Appendix

Appendix A

The 14-item test anxiety questionnaire (CAEX)

Please answer the questionnaire by considering how often you experience each of the situations described below. Respond quickly, but make sure you think through the answers. It is very important to answer all the items.

Items	Almost never	Seldom	Sometimes	Often	Usually	Almost always
1. During a test I feel nervous if the teacher stands next to me, and then I can no longer answer the questions.	0	1	2	3	4	5
2. I often cry after a test, thinking about how badly I've done, even if I don't know my mark.	0	1	2	3	4	5
3. While I'm sitting a test, I think about how badly I'm doing.	0	1	2	3	4	5
4. I get nervous if I see that others have finished the test before I have.	0	1	2	3	4	5
5. I think the teacher is constantly watching me.	0	1	2	3	4	5
6. I usually bite my nails or chew my pen during a test.	0	1	2	3	4	5
7. I'm constantly restless throughout a test (moving my feet, playing with my pen, looking around the room, at the clock, etc.,).	0	1	2	3	4	5
8. I think I'm going to fail the test, even if I've studied beforehand.	0	1	2	3	4	5
9. Before taking the test, my thought is that I've forgotten everything and that I'm going to fail.	0	1	2	3	4	5
10. If I sit at the front of the class I feel more nervous.	0	1	2	3	4	5
11. If the test is time-limited I get more nervous and do worse.	0	1	2	3	4	5
12. My feeling as I leave the test room is that I've done badly.	0	1	2	3	4	5
13. I think beforehand that I'll be nervous and that I'll forget everything.	0	1	2	3	4	5
14. It takes me a long time to answer most of the questions or to decide to hand in my test paper.	0	1	2	3	4	5

Note: The original scale was made by Valero [14]; however, this version is excerpted from Núñez-Peña et al. [5].

Appendix B.

Test anxiety statements for specific types of test situations

Please indicate how anxious you would feel when faced with each of the following types of test situations:

	Not anxious	Slightly anxious	Fairly anxious	Very anxious	Highly anxious	Extremely anxious
1. An oral presentation of a given topic in class.	0	1	2	3	4	5
2. A written test with multiple-choice answers.	0	1	2	3	4	5
3. A written test with open questions.	0	1	2	3	4	5
4. A test involving math problems or calculations.	0	1	2	3	4	5

Note: This scale is a part of the test anxiety questionnaire made by Valero [14]; however, this version is excerpted from Núñez-Peña et al. [5].