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Article

Factors Affecting Success and Failure in Higher Education Mathematics: Students and Teachers' Perspectives

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Abstract: *Background:* Bangladeshi students from science, technology, engineering, and mathematics (STEM) often struggle with solving many mathematical problems in different pedagogic contexts. They mostly lack the considerable prior learning or strong basics required to cope with the teaching and learning materials used at the undergraduate levels, which leads many students to take readmissions every year. *Objective:* This research aims at investigating the factors affecting the success and deficit of university undergraduate mathematics students in Bangladesh. The mixed-method research incorporates quantitative and qualitative data analysis on the students' and teachers' perspectives regarding the issues. The authors focus more on categorizing the reasons influencing effective mathematics pedagogies than on identifying new or unknown causes. *Methodology:* This study is outlined in three phases. The phases include i. Exploratory qualitative survey ii. Quantitative triangulation survey, iii. Explanatory semi-structured interviews. *Findings:* First, the qualitative survey exposes the important factors that highlight the student's success and failure in mathematics. Next, the quantitative data confirm that there are some similarities and dissimilarities between students' and teachers' perceptions. Also, the coefficient correlation analysis shows male students lack consistency and passion for study resulting in poor performances. Conversely, female students emphasize the inability to connect mathematical theories to real-life usages, curriculum loads, and unavailable resources as the reasons for underperformance. Finally, the interview data demonstrate the students attribute their failure to inadequate practices, memorizing habits, poor teaching, low motivation, and external distractions. Also, students acknowledge the necessity of steady practice, clear understanding, regular study, and working strategies for successful mathematics education. Teachers emphasize students' clear concepts, aptitude, motivation, and curiosity for successful learning. *Conclusion:* This conclusion proposes a fresh start with the local mathematics pedagogic practices by analyzing teacher-student feedback on the success and failure factors impacted by varied individual and contextual elements. The study offers inclusive feedback on the part of both stakeholders. However, an open discussion or interaction between students and teachers might be needed to enhance mutual trust and understanding between them.

Keywords: Mathematics; Factors; Success; Failure; Students; Teachers;

Introduction:

Students' pre-tertiary (Secondary and Higher Secondary) education significantly contributes to a successful transition to their higher education (Hourigan & O'Donoghue, 2007; Rylands & Coady, 2009). However, both secondary and higher secondary levels fail to provide Bangladeshi students with inadequate previous learning at the secondary and higher secondary levels often obstructing a robust basic framework needed for higher education (Monem & Baniamin, 2010). Even the better prepared pre-tertiary students demonstrate distressingly low performance in their first-year mathematics courses (Kizito, Munyakazi, & Basuayi, 2015). Alam (2009) indicates the quality and precedence of university STEM education have diminished over the last few years, making it difficult for the country to attain sustainable education goals. Extended mathematics anxiety

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among the students is likely to generate negative attitudes toward mathematics, discouraging them to do their best in academia (Ramirez, Shaw, & Maloney, 2018). Moreover, many students who pass mathematics-related courses cannot utilize their full academic potential for many internal and external distraction factors (Wood, 2001).

A considerable amount of research has been conducted worldwide examining the determinants behind students' academic performance. But little research prevails that has provided a comprehensive picture depicting the relative importance of numerous factors responsible for students' success and underperformance in mathematics education at the tertiary level addressed by both students and teachers, especially in the context of Bangladesh. Since the holistic academic performance of students is not only associated with students' approach to learning but also with the teaching quality and methods (Anthony, 2000), we take into account both students' and teachers' perceptions in this regard.

Factors Affecting University Mathematics Education:

A study investigating first-year students' success and failure in mathematics report that self-motivation is the best influencing factor of attainment, as the teacher and student participants believe (Anthony, 2000). Other success factors include students' passion and interest in mathematical elements, satisfaction in achieving the desired outcome, completion of assignments, and accessibility to adequate supportive materials. Teachers attribute students' failure to unproductive study techniques, weak poor subject knowledge, non-adjusting conditions, and individual issues. Nevertheless, students identify uninteresting lecture mode and inappropriate course design as accountable for their failure in first-year mathematics courses. Later, Brazilian students mark self-effort as the crucial most causal factor affecting students' success and failures (Boruchovitch, 2004). Furthermore, deficient teachers, impatience, task difficulty, nervousness, and misfortune are considered the common causes of success and failure in Mathematics tests. Older male students who regularly attend the classes are more optimistic about succeeding in Mathematics education. Also, the low-ranked teachers allocate higher grades to these learners since they enrol in higher education with increased readiness and determination facilitating learning. Low-ranked young teachers, being aware of the learners' needs, have prodigious abilities to raise a supportive classroom environment leading the students to achieve better grades (Gupta et al., 2006). Another broad range of variables, namely prior subject knowledge, extreme workload, discrete assessment system, inappropriate teaching quality, scarcity of resources etc. impact first-year mathematics students' performances in a course. However, the workload is the most impactful one which is followed by students' previous academic knowledge (Kizito *et al.,* 2015). A four-element conceptual framework, comprising students' self-efficacies, motivation types, study habits, and mathematics perceptions affecting the transition to universities is proposed by Bengmark *et al.,* (2017). Students' self-efficacy and motivation outweigh the two other driving forces, such as study habits and views on mathematics at universities. However, the framework discards a clear insight into teacher perceptions and roles in providing creative motivation to university mathematics students. University students' poor performance in mathematics classes correlates more with poor fundamental knowledge than the difficulty in assimilating new concepts in Australia. This indicates students acquire limited and inflexible conceptual Mathematical understanding at the pre-tertiary levels (Vincent, Pierce, & Bardini, 2017).

A positive relationship between mathematics achievement and three intrinsic student factors, namely previous knowledge, self-efficacy, and learning strategies is examined in Sun, Xie, and Anderman (2018). In addition, math anxiety provokes students' self-consciousness leading to underperformance in math-intensive subjects and the female students demonstrate a higher level of math anxiety than their male counterparts. Many students experience math anxiety because of lower grades achieved earlier, which generates their negative attitude toward mathematics and related subjects (Ramirez *et al.*, 2018). Portuguese engineering university students' high attendance leads to higher passing rates, which demonstrates teachers should upgrade the pedagogical approaches reflecting

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student needs and conveniences to connect and involve students in the procedures (Bigotte de Almeida *et al.*, 2020). Students' unawareness regarding readiness and inability to plan study unswervingly correlates with failure in mathematics learning. Hence, the government and higher education institutions must take necessary measures to encourage students and ensure equal opportunities to accomplish their degrees in the due time (Van der Merwe *et al.*, 2020).

University students' mathematical achievement is impacted by their conception of mathematics in the Saudi Arabian context. Students' fragmented concepts of mathematics produce little self-directed learning skills and hence, they demonstrate low performances. On the other hand, students' high holistic perceptions of mathematics facilitate high Mathematical attainment through engendering greater self-directed learning skills (Alotaibi & Alanazi, 2021). Australian students' attitudes toward participating in various mathematics-related workshops as peer-leader help them better understand the teachable course materials and boost their confidence. Serving as a peer leader enhances students' communication skills and peer connections resulting in a more interactive classroom environment (Johnston, 2021). Teachers' personalized emails providing quiz results, recommendations, feedback, and reminders have favourable impacts on the students' academic performance. These engaged students in learning using a conversational approach and improved their math proficiencies (Dart & Spratt, 2021). Implementing AL (Active Learning) techniques, consisting of interactive presentation, pair work, discussions, group presentations, recommendations, expanding curiosity, mathematical experiments, and projects have a beneficial effect on students' mathematics achievement (Lugosi & Uribe, 2022).

Students' pre-tertiary mathematics learning experiences are directly connected to making a successful transition to tertiary-level mathematics intensive courses. The reasons for demonstrating poor performances and under-preparedness in university mathematics courses are mostly linked to the defective learning process at the pre-tertiary or secondary levels. Mainly exam-oriented assessment systems create significant gaps in students' knowledge and preparation based on passive, non-interactive, and rote learning. (Hourigan & O'Donoghue, 2007). Besides, students' secondary-level mathematics skills significantly shape their tertiary mathematics performances. A short preparatory mathematics course is required for the first-year mathematics major and minor students so the weaker ones can cope with their tertiary-level mathematics studies (Rylands & Coady, 2009). Applying an edification approach enabling students to take learning ownership and actively engage with mathematical solutions can change their perspectives. Involving students in developing instructional resources and sharing responsibilities make them feel exhilarated to learn mathematics and overcome the fear of failure (Prabhu, 2020).

The proposed cross-sectional mixed-method research aims at analyzing the influencing factors of Bangladeshi students' achievement and underperformance in mathematics intensive courses at tertiary level education from both the students' and teachers' perspectives. The methods used in this work primarily relied on prior empirical works. The research addresses the following questions:

1. What are the perceived factors facilitating students learning in university mathematics courses?
2. What factors cause these students' failure in these courses?

Methodology:

Participants:

The research participants comprise 194 and 401 university students and 40 and 56 teachers for phases 1 and 2 respectively. The student participants consist of 151 and 41 for phase 1 and 272 and 129 for phase 2 as the mathematics major and minor students enrolled in different public and private universities in Bangladesh. The teacher participants consist of 28 and 11 for phase 1 and 47 and 9 for phase 2 are the mathematics faculty at different public and private universities. A total of 10 students, including 7 females and 3 males participated in semi-structured interviews via Zoom Applications. All of the student respondents study mathematics at the undergraduate level. Five teachers, including 3 males and 2 females, attended interviews to provide further insights into the factors influencing students' success and failure. The teacher respondents hold higher degrees in mathematics as pre-service education, although none of them has received specialized training in teaching mathematics.

Higher education students' academic performance is generally measured by the GPA or course completion (Killen, 1994) at the Bangladeshi university. The current research defines students' success as obtaining a CGPA (Cumulative Grade Point Average) of 3.00 or above on a 4.00 scale without retaking any courses while failure is securing a CGPA less than 3.00 on the same scale.

Instruments:

In the first phase, a survey questionnaire consisting of two open-ended questions and six demography questions adapted directly from Anthony (2000) has been used to collect qualitative data on the potential factors affecting success and failure in mathematics education. In the next phase, a quantitative survey questionnaire consisting of thirty Likert scales with five items is used to gather data on students' and teacher perceptions regarding success and failure in mathematics. Finally, a semi-structured interview questionnaire including around twelve is used to elicit in-depth data on understanding the clear picture of our research questions. The medium of discussion was Bangla and necessary probing questions are used to generate complex concepts and critical understanding. The interview meetings are video-recorded to transcribe verbatim. The coding is done thematically.

Data Collection:

The data collection process was completely online. The survey links at two stages were shared with the participants via Facebook, Messenger, WhatsApp, Linked In, E-mail, and other various social media sites. And participants were allowed to share the survey links with their peers and friends studying at different other universities. No additional incentives were offered to motivate participation; instead, the students and teachers responded to the research spontaneous. This indicates the study is essential to report the unheard voices of the population. The snowball sampling method was used to ensure a representative number of participants, which cost little and effectively drew responders from similar disciplines in a short period (Johnson, 2005). The participants are interviewed online via Zoom Applications, and each of the meetings was an hour and a half long.

Online survey research provides the researchers with easy access to a large number of participants with common characteristics and hesitance to communicate problems in person (Wright, 2006). Using web-based survey tools, such as Google Form has increasingly been popular among academic researchers for low cost, short time, and convenient sharing (Raju & Harinarayana, 2016). In addition, Google form appears to be the most appropriate tool for conducting a survey to maintain social distancing and prevent Covid-19 from spreading.

Table 1: Information of students in Phase 1 (N = 194) and Phase 2 (N = 401)

		Phase 1		Phase 2	
Variables	Type	Total	Percentage (%)	Total	Percentage (%)
Gender	Male	127	66	290	72.3
	Female	65	34	111	27.7

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Monthly Family Income	Low	84	43.75	224	55.9
	Medium	64	33.33	122	30.4
	High	44	22.92	55	13.7
Subject	Major	151	78.65	272	67.8
	Minor	41	21.35	129	32.2
Year of Study	First	81	41.8	69	17.2
	Second	47	24.2	144	35.9
	Third	22	11.3	95	23.7
	Fourth	44	22.7	93	23.2
Type of University	Public	171	89	262	65.3
	Private	21	11	139	34.7
Grades (CGPA)	Less than 3.0	-	-	88	21.9
	3.0 to 3.5	-	-	180	44.9
	Higher than 3.5	-	-	133	33.2
Data	Analyzed	192	99	401	100
	Rejected	2	1	0	0

Table 2. Information of teachers in Phase 1 (N = 40) and Phase 2 (N = 56).

		Phase 1		Phase 2	
Variables	Type	Total	Percentage (%)	Total	Percentage (%)
Gender	Male	30	75	43	76.8
	Female	10	25	13	23.2
Type of University	Public	28	70	47	83.9
	Private	11	27.5	9	16.1
Designation	Lecturer	16	40	20	35.7
	Assistant Professor	18	45	23	41.1
	Associate Professor	3	7.5	7	12.5
	Professor	3	7.5	6	10.7
Teaching Experience	1 to 6 years	22	55	26	46.4
	7 to 12 years	10	25	19	33.9
	13 to 18 years	6	15	5	8.9

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	19 years to higher	2	5	6	10.7
Data	Analyzed	40	100	56	100
	Rejected	0	0	0	0

Table 3: Information of students in phase 3 (N = 10)

Pseudonym	Gender	Year of Study	CGPA	University
Student 1	Female	Fourth	Below 3.00	Public
Student 2	Male	Fourth	Below 3.00	Public
Student 3	Female	Third	Above 3.00	Public
Student 4	Female	Third	Above 3.00	Public
Student 5	Male	Second	Above 3.00	Public
Student 6	Female	Second	Below 3.00	Public
Student 7	Male	Second	Above 3.00	Public
Student 8	Female	Second	Above 3.00	Public
Student 9	Female	Third	Below 3.00	Public
Student 10	Female	Third	Above 3.00	Public

Table 4: Information of teachers in phase 3 (N = 5)

Pseudonym	Gender	Designation	Type of University
Teacher 1	Male	Lecturer	Private
Teacher 2	Male	Assistant Professor	Private
Teacher 3	Male	Professor	Public
Teacher 4	Female	Assistant Professor	Public
Teacher 5	Female	Assistant Professor	Private

Procedure:

The entire research was performed in three phases. The first stage was an exploratory survey through open-ended questionnaires. The second stage of the triangulation survey involved a quantitative five-item Likert-scale questionnaire and the final phase was semi-structured interviews with randomly selected student and teacher participants. The authors used Anthony's (2000) framework in the first two phases, while the third phase involved the Participatory Action Research (PAR) methodology analogous to Dube (2020). In every phase, the participants were provided with the ethical protocol and assured that any personal information gathered will be kept entirely confidential and used for this academic research purpose. The mixed-method study was conducted following the authentic research guidance and ethics protocol provided by the University of Dhaka, Bangladesh. The research surveys were approved by the Head of the Mathematics Department. All the participants were included upon their agreement.

In phase one, two separate open-ended questionnaires were created for students and teachers. The student questionnaire asked for the participants' socio-educational demography, comprising gender, study level, course nature, university and department name, university type, and monthly family income. The teacher questionnaire recorded comparable data on gender, teaching experience, designation, and university type. The surveys included cross-questions on the participants' perspectives reading the factors affecting students' success and failure in undergraduate mathematics courses. After collecting data by sharing the surveys on social media for around a month, the authors received responses from 194 students and 40 teachers. Two incomplete student responses were rejected and no teacher responses were discarded.

At the end of the first phase, the authors identified more than 15 factors influencing mathematics students' success and failure, as reported by the respondents. After analyzing the responses the factors were ranked to choose the most reported top 15 factors for success and failure separately. A total of 30 factors were predetermined to use in the second phase triangulation survey. Some of the factors overlapped and then the rank changed accordingly. Finally, the authors fixed 19 unique factors facilitating success and 21 exclusive factors leading to failure. Based on these factors recorded in phase one, the authors developed two other separate quantitative survey questionnaires for the students and teachers. The questionnaire included a 5 point Likert-type scale (1 = Strongly disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly agree) investigating to what extent students and teachers agreed with the statements. The questionnaires' details are added in a supplementary file. The links of the questionnaires were reshared with the participants via different social media platforms. The data collection procedure continued for around one other month. Different phases of participant information are illustrated in Tables 1, 2, 3, and 4. In addition, phase 2 data are analyzed using statistical software named SPSS Statistic 21.0, including a t-test analysis.

In the third phase, a total of 10 students and 5 teachers were selected as the interview participants using purposeful sampling (Palinkas et al, 2013). The authors randomly chose the respondents avoiding any biases and requested their participation. The question details are added in the supplementary file. The Participatory Action Research (PAR) method (Dube, 2020) was used to accumulate data directly from the participants considering its pragmatic values, authenticity, comprehensiveness, and intractability. It offers solutions to complex and multi-dimensional problems by embracing participants and researchers in a collegial procedure (Kindon, Pain, and Kesby, 2008). Due to the ongoing pandemic situation, the interviews were conducted via Zoom Applications to avoid social gatherings. It was convenient, easy-to-use, cost-effective, manageable, secure, and reliable with its audio-video recording and auto-saving options. It was a potential tool to collect in-depth qualitative data from remote or geographically dispersed participants. Also, Zoom allowed the authors to record and store sessions securely without relying on third-party software, which is especially significant in research where every bit of sensitive data, including facial expressions, body language, contact etc. needs to be protected. (Archibald et al., 2019). All the interviews were recorded so the authors can transcribe and analyze the data later to produce accurate results. It took two weeks to conduct all the interviews. The interview period ranged from 30 to 40 minutes. The meetings began informally by explaining the purposes of the study and offering Q/A sessions to make the participants easy and comfortable with the discussions. The respondents were asked altogether twelve structured questions in addition to many relevant probing questions eliciting essential beliefs and opinions. All the authors were present during the interview sessions conducted in Bengali. Later, the transcriptions were summarized in English and translated

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quotations are presented to support the findings. At the end of all interview sessions, the authors transcribed each interview and sent the transcriptions to the corresponding participant via email, asking for any additions or edits they would like to make (Ellington & Frederick, 2010). Then the final drafts of the summarized interviews were developed.

Results:

Phase 1 Analysis:

In phase one, all the factors listed are the responses to open-ended questionnaires. Students' most preferred factor responsible for success is 'doing a lot of practice' (37%) which was followed by a clear understanding of a topic' (18%) and 'studying regularly' (9%). Likewise, 'irregular practice/study' (32%) and memorizing mathematics are the top two most cited factors responsible for failure. Also, 'unclear concepts' (13%) and 'uninteresting lessons' (9%) and 'inadequate lectures' (9%) are the three most student-cited failure factors. On the other hand, teachers emphasize students' 'motivation, passion, and confidence' (24%), clear perceptions about the course materials (15%), and 'increased practice' (12%) to obtain high grades. 'Lack of interest, motivation, confidence, and seriousness among students' (28%), 'poor teaching quality (12%), and 'students' negligence' (8%) are the key factors for students' failure in undergraduate mathematics courses.

In the next phase, all the factors contributing to students' success and failure addressed by both students and teachers are categorized into four broad groups, namely lecturer, courses, students, and external factors, as suggested by Killen (1994) and used by Anthony (2000). The student data reveal most of their success and failure factors involve the students' category characterizing around 73% of their success factors and 47% of their failure issues. Moreover, 13% of students' success factors relate to lecturer quality, 7% to course concepts, and 7% to contextual factors. Besides, the student participants attribute 7% of their failure factors to uninteresting lectures, 20% to unmanageable curricula and inadequate resources, and 27% to external political factors.

Likewise, the teacher data exposes a similar observation. Teachers attribute 60% of students' success and 47% of students' failure factors to the students' category. As the participants report, 13% of students' success factors are associated with lecturers or quality teaching; 7% with course concepts, and 20% with environmental factors. They also assign 7% of students' failure factors to poor quality teaching), 20% to unclear mathematical concepts, and 27% to external distractions.

Summary of the above findings in tabular form:

Type	**Category**	**Success (%)**	**failure (%)**
		Factors: Students View in percentage	
C1	Lecturer	13.33	6.67
C2	Courses	6.67	20
C3	Students	73.33	46.67
C4	External	6.67	26.67
		Factors: Teachers View in percentage	
C1	Lecturer	13.33	6.67
C2	Courses	6.67	20
C3	Students	60	46.67
C4	External	20	26.67

Phase 2: Quantitative Analysis

Comparison between Students' and Teachers' Perception

In the success questionnaire, eight items are statistically correlated ($p < 0.05$) out of 19 items. Among these eight, three (S2, S11, S16) items show significant differences at a 0.1% level, three (S12, S15, S17) at a 1% level, and the other two (S4, S14) at a 5% level. The analysis shows teachers place importance on students' clear understanding, motivation, passion, dedication, determination, self-confidence, patience, interest, and curiosity in mathematics for accomplishing success. Meanwhile, students emphasize the need to learn formulas, use strategies, follow proper guidelines, prior knowledge, and good literacy skills.

In case of failure, eight items are found to be statistically significant ($p < 0.05$) with one (U13) item at 0.1% level, two (U2, U14) at 1% level, and other five (U4, U9, U11, U20, U21) at 5% level, as shown in Table 5. For students' failure, teachers focus on their memorizing tendency, inattention, irregularities, disinterest, avoiding texts, consulting guide books, political involvement, high teacher-student ratio, low literacy skills, and part-time tutoring. Nonetheless, the only item students mention beyond the teacher list is the time constraint to complete the given syllabus.

Table 5: Teacher and Student Perceptions

		Teachers		Students				
Type	Item	Mean	SD	Mean	SD	p-value	t-value	95% CI
C2	S2	4.8393	0.3706	4.2618	0.8359	< 0.0001***	-5.097	(-0.8002, -0.3548)
C3	S4	4.5357	0.5709	4.3392	0.7033	0.0461*	-2.000	(-0.3896, -0.0034)
C3	S11	3.9286	0.8281	4.3541	0.6552	< 0.0001***	4.396	(0.2353, 0.6157)
C1	S12	4.3929	0.5618	4.6234	0.5660	0.0045**	2.857	(0.0720, 0.3890)
C3	S14	4.4464	0.6301	4.1870	0.7599	0.0151*	-2.439	(-0.4684, -0.0504)
C4	S15	3.8214	0.8551	4.1571	0.6912	0.0010**	3.300	(0.1358, 0.5356)
C3	S16	3.9464	0.7241	4.7107	1.0256	< 0.0001***	5.390	(0.4856, 1.0430)
C3	S17	4.5179	0.5391	4.2319	0.7026	0.0036**	-2.927	(-0.4780, -0.0940)
C3	U2	4.1250	1.0798	3.6259	1.2113	0.0036**	-2.925	(-0.8344, -0.1638)
C3	U4	4.0179	1.0356	3.6060	1.1914	0.0143*	-2.460	(-0.7409, -0.0829)
C3	U9	3.8571	1.0167	3.4389	1.4226	0.0342*	-2.124	(-0.8050, -0.0314)
C3	U11	4.0179	1.0701	3.6608	1.1224	0.0254*	-2.243	(-0.6700, -0.0442)
C4	U13	3.7500	1.1322	3.0973	1.2684	0.0003***	-3.652	(-1.0039, -0.3015)
C2	U14	3.3214	1.0972	3.7357	1.0816	0.0076**	2.680	(0.1105, 0.7181)
C4	U20	3.9107	1.0140	3.5411	1.0950	0.0174*	-2.387	(-0.6739, -0.0653)
C3	U21	3.4286	0.8709	3.1072	1.1140	0.0389*	-2.072	(-0.6263, -0.0165)

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

Comparison between the male and female student perspectives

Gender has no significant influence on the student perceptions since the male and female students differ only in two items (S7, S16) showing significance at a 1% level. The male students weigh more on imagination and literacy skills than the females. As for failure, one item (U15) is significantly different at a 1% level and two others (U12, U14) at a 5% level. Details are stated in Table 6. Female students attribute their low performance more to inadequate resources than their male counterparts. Furthermore, they are more

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likely to fail in connecting mathematical theories to real-life problem-solving and feel greater pressure with the large curricula than the male students.

Table 6: Male vs. Female Student Perceptions

		Male (N = 290)		Female (N = 111)				
Type	Items	Mean	SD	Mean	SD	p-value	t-value	95% CI
C3	S7	4.2448	0.7478	3.9910	0.6674	0.0019**	-3.130	(-0.4132,-0.0944)
C3	S16	4.1000	0.7717	3.8739	0.7276	0.0080**	-2.666	(-0.3928, -0.0594)
C2	U12	3.7966	1.1838	4.0811	0.8542	0.0213*	2.311	(0.0425, 0.5265)
C2	U14	3.6621	1.1113	3.9279	0.9790	0.0275*	2.212	(0.0296, 0.5020)
C4	U15	3.5448	1.1252	3.8649	0.9389	0.0081**	2.663	(0.0838, 0.5564)

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

Comparison between the high and low-grade achievers

To analyze the *high and low-grade achievers'* perspectives about success and failure, two different groups of students, namely higher grade students holding CGPA higher than 3.50 and lower grade students with CGPA less than 3.00. While comparing, one item in the success factors (S2) shows a significant difference at a 0.1% level, one (S5) at a 1% level, and three (S8, S14, S17) at a 5% level, as shown in Table 7. The analysis demonstrates that higher grade achievers tend to ascribe more importance to having a clear understanding of the subject and focusing on studies than the lower grade achievers'. Other highly attributed success factors by the higher grade students include regular class attendance, subject interests, and question-answers or reflections. Whereas, only three failure items emerge to be statistically significant ($p < 0.05$) with one (U9) at a 0.1% level and the other two (U7, U11) at a 5% level, as shown in Table 7. Observations show that for low performance, the lower grade students put less emphasis on disinterest, fear of mathematics, avoiding texts, and consulting guide books.

Table 7 Perceptions of High vs. Low grades students

		High (N = 133)		Low (N = 88)				
Type	Items	Mean	SD	Mean	SD	p-value	t-value	95% CI
C2	S2	4.4060	0.7691	4.0000	0.9469	0.0006***	-3.500	(-0.6346, -0.1774)
C3	S5	4.4737	0.6695	4.2045	0.8327	0.0086**	-2.652	(-0.4692, -0.0692)
C3	S8	4.4662	0.6803	4.2614	0.7950	0.0418*	-2.047	(-0.4020, -0.0076)
C3	S14	4.3158	0.6894	4.0682	0.8276	0.0167*	-2.411	(-0.4500, -0.0452)
C3	S17	4.3083	0.6417	4.0909	0.7825	0.0250*	-2.257	(-0.4073, -0.0275)
C3	U7	3.8722	1.0900	3.5341	1.1239	0.0268*	-2.230	(-0.6370, -0.0392)
C3	U9	3.4436	1.2335	2.8295	1.2705	0.0004***	-3.580	(-0.9522, -0.2760)
C3	U11	3.8647	1.0995	3.4773	1.1344	0.0120*	-2.532	(-0.6890, -0.0858)

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

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Comparison between public and private university students' perspectives

The analysis between the public and private university students' perspectives shows four success items (S5, S8, S16, S17) are significantly different at a 0.1% level, one (S7) at a 1% level, and the other three (S13, S14, S15) at 5% level, as shown in Table 8. Private university students put greater emphasis on regular class attendance, good literacy skills, interactions, and attentiveness than their counterparts. Other success items referred by the private university students are imaginative ability, resource availability, conducive classroom environment, patience and curiosity, and prior knowledge.

In contrast, two failure items (U12, U18) show a significant difference at a 0.1% level, one (U17) at a 1% level, and the other five (U3, U5, U8, U13, U15) at a 5% level, as shown in Table 8. The majority of public university students find applying mathematical theories and understanding abstract concepts difficult. Also, they accuse the poor academic system of failure and highlight teachers' failure to make lessons interesting and deliver deficient lectures more than the private university students. Students' failure to understand the course content, involvement in politics, excessive tuition, and insufficient resource use are also responsible. Conversely, private university students mention a weak background as a stumbling blockage against successful mathematics learning.

Table 8: Perceptions of public vs. private university students

		Public (N = 262)		Private (N = 139)				
Type	Items	Mean	SD	Mean	SD	p-value	t-value	95% CI
C3	S5	4.2710	0.7675	4.5324	0.6405	0.0007***	3.431	(0.1116, 0.4112)
C3	S7	4.1031	0.7277	4.3094	0.7308	0.0073**	2.698	(0.0560, 0.3566)
C3	S8	4.2824	0.7609	4.6043	0.6093	<0.0001***	4.308	(0.1750, 0.4688)
C4	S13	4.3092	0.7427	4.4676	0.6290	0.0330*	2.140	(0.0129, 0.3039)
C3	S14	4.1183	0.7764	4.3165	0.7126	0.0128*	2.502	(0.0425, 0.3539)
C4	S15	4.1031	0.7009	4.2590	0.6631	0.0314*	2.159	(0.0140, 0.2978)
C3	S16	3.9237	0.7491	4.2518	0.7527	<0.0001***	4.167	(0.1733, 0.4829)
C3	S17	4.1336	0.7012	4.4173	0.6692	0.0001***	3.917	(0.1413, 0.4261)
C1	U3	3.7977	1.0473	3.5036	1.2648	0.0133*	-2.486	(-0.5266, -0.0616)
C2	U5	3.8015	1.0928	3.5540	1.2863	0.0433*	-2.027	(-0.4875, -0.0075)
C4	U8	3.0840	1.1550	3.3741	1.2527	0.0206*	2.324	(0.0447, 0.5355)
C2	U12	4.0153	1.0430	3.6115	1.1827	0.0005***	-3.520	(-0.6293, -0.1783)
C4	U13	3.5687	1.1683	3.2878	1.2754	0.0271*	-2.219	(-0.5298, -0.0320)
C4	U15	3.7214	1.0370	3.4676	1.1566	0.0257*	-2.240	(-0.4766, -0.0310)
C2	U17	3.8626	0.9161	3.5612	1.1864	0.005**	-2.822	(-0.5114, -0.0914)
C4	U18	3.9771	1.0647	3.5396	1.2756	0.0003***	-3.651	(-0.6731, -0.2019)

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

Comparison between junior and senior students' perspectives

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The authors regroup all the study student participants according to their level of study, namely Junior (1st and 2nd year students), Senior (3rd and 4th year students). Most public and private universities offer four years Bachelor degrees. However, no significant impact ($p < 0.05$) of study levels on the students' perceptions regarding the success and failure factors in mathematics courses.

Comparison between high and low family income students' perspectives

To further expand the understanding of diverse student perspectives, the authors compare the success and failure factors data based on the student participants' monthly family income. Students with a monthly family income above 40000 BDT (around 471 USD) comprise the high-income group while those who have a monthly family income less than 20000 BDT (235 USD) consist of the low-income group. Seven success items in total are statistically significant ($p < 0.05$) out of which one item (S4) differs significantly at a 1% level, and the other six items (S1, S3, S9, S15, S17, S18) vary at 5% level, as presented in Table 9. Regarding the success factors, low-income students endorse additional significance on showing interest, passion, dedication, determination, and self-confidence for success than the high-income students. Other highly recommended success factors by the high-income group, include applicational skills, regular study, group activities, teacher-peer interactions, and prior knowledge.

In contrast, one item (U9) is significantly different at a 1% level whereas the other three (U7, U8, U21) is at a 5% level out of the four statistically significant ($p < 0.05$) failure items, as presented in Table 9. High family income students attribute disinterest as a reason for their failure in mathematics. Besides, fear of mathematics, weak basics, and low literacy skills are responsible for poor performances.

Table 9: Perceptions of low vs. high monthly family income students

		Low family income (N = 224)		High family income (N = 55)				
Type	Items	Mean	SD	Mean	SD	p-value	t-value	95% CI
C3	S1	4.7054	0.5296	4.5091	0.7667	0.0262*	-2.236	(-0.3691, -0.0235)
C3	S3	4.3929	0.6941	4.1818	0.7224	0.0460*	-2.005	(-0.4184, -0.0038)
C3	S4	4.4196	0.6442	4.1091	0.8750	0.0033**	-2.968	(-0.5165, -0.1045)
C3	S9	4.3214	0.6725	4.0364	0.9421	0.0173*	-2.584	(-0.5021, -0.0679)
C4	S15	4.2098	0.6668	3.9818	0.8049	0.0303*	-2.177	(-0.4341, -0.0219)
C3	S17	4.2455	0.6680	4.0182	0.8922	0.0361*	-2.106	(-0.4398, -0.0148)
C1	S18	4.5446	0.5665	4.3273	0.7711	0.0190*	-2.360	(-0.3985, -0.0361)
C3	U7	3.5893	1.1756	4.0182	1.0970	0.0147*	2.456	(0.0851, 0.7727)
C4	U8	3.0446	1.2230	3.4364	1.1982	0.0335*	2.137	(0.0309, 0.7527)
C3	U9	3.0446	1.3519	3.6182	1.2246	0.0044**	2.870	(0.1802, 0.9670)
C3	U21	3.0134	1.1579	3.4000	1.0470	0.0246*	2.259*	(0.0497, 0.7235)

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

Comparison between mathematics major and minor students' perspectives

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Considering the nature of the courses, mathematics major and minor students' perspectives are analyzed, which shows no statistically significant difference ($p < 0.05$) between these two groups except for one success item (S16) at a 5% level, and two failure items with one (U8) at 0.1% level, and the other (U21) at 5% level, as presented in Table 10. Students majoring in mathematics consider good literacy skills essential for success whereas mathematics minor students attribute low literacy skills and weak basics to underperformances.

Table 10: Perceptions of mathematics major vs. minor students

		Major (N = 272)		Minor (N = 129)				
Type	Item	Mean	SD	Mean	SD	p-value	t-value	95% CI
C3	S16	4.1838	0.6895	4.0078	0.8883	0.0307*	-2.169	(-0.3355,-0.0165)
C4	U8	3.0331	1.2068	3.5039	1.1119	0.0002***	3.741	(0.2234, 0.7182)
C3	U21	3.0294	1.1164	3.2713	1.0951	0.0421*	2.039	(0.0087, 0.4751)

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

Phase 3: Qualitative Analysis

Students' Interview

Factors Influencing Students' Academic Success

Students' interview responses demonstrate a wide range of factors contributing to their success and failure. 8 of the respondents report following lectures and class notes is very helpful to them. Student 1 states:

> *I try to go through the lectures of the previous class very carefully before attending a new lecture since this helps me to understand and grab the new information easily. Otherwise, I feel like a fish out of the water in a class discussing a new topic.*

However, three students believe a mere lecture is not enough for outstanding performance. Student 4 explains:

> *Apart from lectures, internet resources are of great help. Sometimes it is difficult to understand everything from a lecture, which is often delivered too fast to focus on every single word. There are many good YouTube videos to reduce these perception gaps.*

Seven students think a strong foundation and prior knowledge on the subject is vital. 90% of them agree that regular practice is very effective to get a good outcome in the tests. Student 2 asserts:

> *The first and foremost thing is having a clear concept about a topic. It's not about only remembering formulas and techniques, instead, it is about knowing how to derive these formulas. Simultaneously, one has to invest time to solve exercises and practice as much as possible.*

Moreover, student 3 states:

> *Prior knowledge is important; it helps to cope with the course material instantly. For instance, if a student does not understand Linear Algebra I in the first year, he/she will confront challenges to adopt the concepts of Linear Algebra II in the next year.*

Four of the students highlight the significance of imagination to profoundly learn some complex topics. Student 4 says:

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> *I feel that imagination is quite significant in mathematics learning, especially to understand abstract ideas. When I try to imagine the underlying concepts, I perceive the problems much better than the other ways. One of our Calculus tutors would try to make things visual to us and I truly enjoyed studying that course.*

Two of the respondents acknowledge the roles of studying regularly and timely completing all homework and assignments in successful learning. Student 5 states:

> *Consistency is the key. If someone studies constantly throughout the year, obviously he/she will secure good grades at the end.*

Also, student 6 asserts:

> *One of my teachers used to assign us Partial Differential Equation tasks and problems to solve. I would complete those all and I was happy and confident with that course before the final exams.*

Two more students also shared their personal experiences of successfully handling academic pressure and mathematics anxiety which facilitated their success.

Student 7 states:

> *When I feel pressured, I simply take a break and try refreshing myself before restarting. I make a routine which I try to follow strictly before the exams.*

While student 8 states:

> *I keep enough time in hand for preparation to avoid nervousness. I divide the complete syllabus into small parts and save some extra time for revision. Staying relaxed and preplanning help me to overcome fear and anxiety before the exam.*

Three students also mention the family members' contribution to successful mathematics learning. Student 2 clarifies:

> *I receive much support and reinforcement from my family and relatives, including my father about studying mathematics.*

Student 9 states:

> *A mathematics major student has many career options both at home and abroad. My family did not complain about my rejection of Engineering subjects only because I secured outstanding results. They realized my passion and potential for this subject and helped me to get out of depression.*

8 students put stress on the significance of group study. They strongly support peer assistance as one of the best contributors to success. Student 1 and 10 state:

> *Group study and online peer discussion have helped me to achieve good grades. Most often I do not understand teachers' lectures which is easy if a friend explains. I am very much dependent on group study. I understand 50% of the class lectures and I rely on group studies for the rest. Group study is very effective; if I explain a topic to my friends, it becomes clearer to me as well and permanent learning happens. Whenever I am stuck with a problem, first I approach my friends, then seniors, and finally the teachers. Hence, I always get a solution to my problems somehow.*

Factors Influencing Students' failure

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Six students accuse the teaching quality and hold the teachers responsible for their failure. Students 1, 6, 8, 9 state:

> *I often do not understand the lectures delivered by the teachers. I think the lectures should have been more intelligible. The majority of the teachers seem to teach as part of their job and do it anyway. Some lectures are quite hurried just to complete the syllabus at the earliest possible time. Some teachers do not take class regularly, which demotivates the students and creates information gaps since they hardly remember the previous lesson. Also, many teachers do not teach efficiently, they just keep writing on the board without explaining. Teachers need to bring variations in lectures; making things more visible to us would help.*

Four student respondents blame themselves for their failure. Student 2 and 3 state:

> *Most of the local students believe university education does not involve study pressure and hence, become a bit careless and do not study hard initially, which results in grade fall. Some good students fail to reach their full potential at university because of easy distractions. They spend much more time hanging out with friends or enjoying things than studying. They study only a few days before the exam.*

The majority of students (7) also talk about inconsistent study habits and inadequate practices. The interview data exposes (40%) of students blame the habit of memorizing mathematical theorems instead of understanding, which was also evident in the phase one response. Student 5 states:

> *Students tend to memorize theorems without properly understanding how they were derived because they always look for a shortcut to pass the exam, which weakens their basics.*

Two students also talk about weak mathematical basics, unmanageable curricula, etc. Student 4 and 7 state:

> *A good number of students skip getting admitted in mathematics; either they study it for family pressure or for not qualifying in the other desired subjects at the same or different universities. My parents wanted me to be a doctor, although I had no other choice except to study mathematics after failing Medical admission tests. Most mathematics students, either major or minor, only to complete graduation and receive certificates.*

Being unaware of mathematics-related careers, many of them neither have any career plan nor aspire for government administrative jobs. It is also evident that residential students are not satisfied with the overall academic environment on the campus. Student 3, 8 and 10 complain:

> *New students do not have proper accommodation during their first year of study; they have to share rooms with more than conceivable students. The environment is neither conducive nor friendly enough to concentrate on studies. Most of the residential halls have no suitable conditions for studying. From the first year, students engage themselves with politics, either willingly or forcefully, even before the exam night. Neither the academic structure is research-oriented; undergraduate students hardly get research opportunities.*

Teachers' Interview

Influencing Factors for Success

The teacher respondents discuss their roles regarding students' success. Teacher 1, 2, and 3 assert:

> *Teachers have many responsibilities, such as presenting interesting lectures, discussing real-life applications, continuing research, communicating learning objectives, course's career prospects etc. The 3D concepts should be taught using animation and graphs.*

This will increase students' enthusiasm for learning the topics. Young lecturers also talk about the importance of organized class lectures. Teacher 1 states:

> *Students have to follow lectures accurately; they have to understand any topic very well and try to apply to learn into different fields.*

Four teachers believe they need to share their own learning experiences during lectures and consider the students' learning needs in preparing lecture notes. Teacher 3 states:

> *Since the majority of the students only focus on lecture notes, preparing the next lecture with good care is essential. While preparing my lectures, first I make sure that everyone understands the topic clearly; I focus on my understanding to ensure students' comprehension. I spend a good amount of time designing lecture notes and the way of presentation. Generally, I look into internet resources, read books, and watch YouTube videos to prepare for lectures. Well, this is not a fixed pattern, I should say.*

While preparing for lectures, teachers should focus on topics that may not be easy for the students to understand. They have to spend 2 to 4 hours designing a lecture. However, teacher 4 and 5 put importance on reading books rather than only going through class lectures.

> *There are a few students who solely depend on class notes, which is never enough. To get good results in mathematics, students need to follow three things: understanding the concepts, practising regularly, and learning some tricks and techniques.*

Students should read books along with lectures to minimize the knowledge gaps. They should also consult additional relevant resources from the internet. Students' high achievement in academia is shaped by the teachers' presentation of lectures to some extent. Teacher 1 claims:

> *During a lecture, I generally start with a problem that is not much difficult even for a weak student. Subsequently, I moved forward to the harder ones. I always discuss the hardest one in detail so that the rest of the mathematics is easy for them.*

Lectures should be engaging students directly with course content. Teachers can share relevant research papers with the students, encouraging them to know the relevant findings. Properly explaining the theories and how these theories can be implemented will be effective. Teachers also justify the necessity of regular study and practice. Teacher 3 says:

> *Mathematics is a practice-based subject. It is impossible to perform well without adequate practice. Knowing how to implement a theorem rather than only knowing the statement and proof of that theorem is crucial.*

To ensure this, students have to work out as many problems as possible and solve the exercises given at the end of each chapter. Another concern regarding the relationship between lectures and students' academic performance is students' feedback and evaluation process. Three teachers respond positively to teachers' feedback while two other

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teachers mentioned its drawback. They admit that they do not have to attain students' feedback. Teacher 5 clarifies:

> *We don't have to follow this system, although it is certainly helpful for the teachers to improve the teaching quality. This system is not yet implemented on a large scale at our university except for a few courses. This system might not produce the expected results because of student and teacher politics prevailing at the universities. Instead, the method might be detrimental to start before banning politics in the university ambiences.*

However, those who follow the system in a department expect the authority should send this student feedback to the teachers after publishing test results so the students' negative feedback does not impact their results. Three teachers also address the issues related to the university's environmental or contextual factors and students' academic performances. Teacher 5 explains:

> *The environment of the department and the teacher-student relationships are always good and friendly. Wi-Fi is available too; students can receive counselling from the teachers and discuss any topic with them.*

Teachers always make sure that students feel comfortable and do not hesitate to ask questions.

Influencing Factors for Failure

While responding about the major causes of students' failure, four teachers mention both teachers' and students' irresponsibility. Teacher 1 describes:

> *I observe students do not study mathematics meticulously. Lack of awareness is the key. Sometimes topics are difficult to understand for them. Some teachers present the subject interestingly. Some teachers use old notes prepared during their student life!*

Hence, these teachers never improve the teaching styles or teachable materials over time. Thus, the issues about boring lectures leading to academic regression emerge from the interview data. Teacher 3 explains:

> *Teachers should not directly drive into formulas and mathematical problems; they should first discuss the subject and why students need to study it. The course's applications and implications should be explained too.*

To bring variations in lectures, teachers should make them linked to practical usages, assign shared tasks, and include question-answer sessions. Teachers 3 and 4 believe long-term mathematics anxiety from childhood can be a root cause of student failure.

> *From the primary level of education, we notice two groups of students, including some who like mathematics and who fear it. Unfortunately, most of the students belong to the latter group. The early fear about mathematics continues to prevail up to the university level.*

To reduce such fear, teachers should instruct the students on how to learn mathematics, instead of merely teaching it so students get help from self-study. Teachers 2 and 5 indicate that students' insincerity about effective learning causes low academic performance.

> *Students are not sincere; although they attend lectures, they do not study well at home. Students only practice before the exams, instead of studying throughout the year. Neither do they practice regularly! Most often students memorize theorems without understanding the basic concepts.*

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Moreover, the students occupy themselves with tuition or hangouts, which decreases their study time and concentration. ...of the responding teachers highlight the problem of teaching a course declining with the teachers' research interests. Teacher 2 complains:

> *Some teachers teach courses that are neither their research interests nor their field of expertise. Consequently, the lectures are not enriched enough and the teachers are more concerned about their research than teaching.*

These teachers do not exploit adequate preparation time. While discussing technology integration and online facilities in mathematics teaching, teacher 3 and 5 are reluctant to use technical or online options despite their availability. They did this only during the pandemic when they were bound to teach virtually.

> *Some teachers do not like to use technology, although currently, they are doing it due to the pandemic. However, technology has been essential to ensure effective learning. I am afraid, almost none of us use all the existing facilities.*

Techno-phobia is a kind of common nature which is hard to change. However, any kind of incentive or appreciation offered to the teachers can improve the practices. Students' overall academic performance is largely connected to the assessment systems. Most teacher respondents have some dissatisfaction regarding the existing exams-based evaluation. Teacher 4 reacts:

> *The assessment system is not a standard one here, especially at the public universities. We should incorporate assignments or projects requiring the implementation of the course content. Only the written examinations are not enough.*

The prevailing assessment systems reinforce the students to run after good grades and a decent job, instead of encouraging them to learn something new in a true sense. Apart from these, teachers 1, 2, and 5 also attribute students' inadequate prior knowledge and indifference to learning mathematics to students' failure.

Discussion:

The current study investigates the teacher and students' perspectives on the variables influencing Bangladeshi university students' success and failure in mathematics. The research findings infer that a wide range of multidimensional factors influences students' Mathematical achievement and failure, regardless of gender, family income, university type, study level, and grades.

Students' perceptions of their failure factors primarily include irregular practices, which is also the third most frequently teacher-stated factor in phase one. The finding coincides with that of Mazana et al. (2020), who found that teachers reproved students for passively studying mathematics like history and practising inadequately. Both teachers and students report one common cause of the students' poor performance, which is more rote learning than conceptual development. Teachers share a similar viewpoint regarding exam-based assessment systems and obsession with better grades, which encourage students to remember the content instead of acquiring an intuitive grasp of it. This has congruence with Basturk's (2016) findings of student respondents' criticism about teaching and learning mathematics through memorization.

Students' low performance is also exacerbated by poor teaching quality and deficient lectures. This finding is consistent with Basturka and Yavuzb's (2010), who stated ineffective teaching approaches and monotonous presentations lead to students' underperformance. Both students and teachers express their concerns about both public and private university lecturers' teaching merit. Teachers' involvement in academic activities, research projects, and career development can reduce their preparation time for ensuring quality lecture notes for students. This might result in students' dissatisfaction with the course, as teachers stated. However, Casinillo (2019) found no correlation between the factors affecting students' failure and their perceptions of mathematics teachers.

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Another cause of failure is the mathematics phobia developed in childhood. Mazana et al. (2020) report a similar conclusion in their study; teachers discover most students nurture a pre-existing view that mathematics is a difficult subject leading to low self-confidence and poor performance. Students' underperformance is also attributed to the stress of covering large curricula in the time constraint. Teachers' perceptions of student failure are impacted by their low motivation, curiosity, and confidence. In phase one, it is the most frequently identified failure factor by teachers. This justifies Tachie & Chireshe's (2013) and Anthony's (2000) findings about little enthusiasm for mathematics as one of the most significant impediments to Turkish students' success. Besides, Teachers believe university students' difficulties with abstract mathematical concepts lead to low performance. Unfortunately, school students view math as a routine subject comprising mostly of calculations based on logic and formulas, while university math is theoretical consisting mainly of definitions and theorems (Gregorio et al., 2019).

Bangladeshi public university students are more apprehensive about the uncreative pedagogical structure discouraging experiments, which has been confirmed in Alam (2009). The research states about the deteriorating features of the overall public university education system in Bangladesh over time, with unwanted session jams causing delayed graduation. Students become frustrated with family pressure and unemployed conditions in such circumstances. On the other hand, private university and mathematics minor students are concerned about their weak mathematical background, which might block further higher study options.

Students need to invest adequate practice time to achieve high academic success, which is one of the most frequently mentioned success factors by both students and teachers. However, the findings contrast with that of Anthony (2000), who finds regular practices as a low-ranked success criterion. Students also identify understanding the course materials as a crucial success criterion. High-achievers put greater emphasis on this aspect of success. It is the teacher reported second most important component in students' success. Students' clear concepts of the subject are also significant in attaining desired learning objectives. Students believe regular study increases their succeeding chances in mathematics. This is in line with Shibanda et al.'s (2015) findings that study regularity is the most frequently stated student success factor. High achievers acknowledge focus and attention in addition to effective exam strategies and tactics contribute to achieving better test scores. This aligns with Casinillo' (2019) findings about poor study habits as the main obstacle to succeeding in mathematics.

Good and quality teachers play a crucial role in moulding student's academic aspirations. Both students and teachers agree access to quality teaching is key to a student's academic achievement. Garca y Garca (2021) observe a similar condition where the variable 'excellent professors' predicts good marks for both male and female mathematics students. According to Alibraheim (2021), Students' attitudes toward mathematics are influenced by some internal and external factors, the latter of which include instructor traits. However, the availability of resources, appropriate classroom settings, and interests in mathematics form students' perceptions of achievement. The first phase of the research explores the majority of teachers and students who believe that determination, enthusiasm, and confidence are essential for mathematics success. Anthony (2000) and Bengmark et al. (2017) corroborate this view of teachers. Students' self-motivation and self-efficacy are the two most meaningful elements of success, followed by passion and interest in tertiary-level mathematics.

Teachers also recognized the importance of having prior knowledge of the subject to attain satisfactory results. Similar findings were observed in a study conducted in South Africa by Kizito et al (2015), who discovered that students' prior academic knowledge was the second most important factor, behind workload, in explaining their success in first-year mathematics courses. Furthermore, Rylands & Coady (2009) found that students' secondary mathematics skills have a significant impact on their tertiary level performance. Teachers, on the other hand, believe that regularly attending lectures, having a decent study atmosphere, and having a good examination system are less important criteria in achieving success, contrary to the findings of Gupta et al. (2006) which say that a supportive learning system is mandatory for students' high accomplishments. We found no gender differences in success perceptions, except that male students believe visualization is very important in mathematics. Anthony (2000) also found no statistically significant difference in male and female students' perceptions of achievement, however, Gupta et al (2006) reported that male students have a more favourable attitude toward mathematics.

Conclusion:

Overall, it is evident from the data that both students and teachers hold students responsible for their success and failure in undergraduate math courses. Findings conclude students' perceived factors for failure include inconsistent study, wrong pedagogies, and negative attitudes. Teachers consider students' little self-confidence, low motivation, and short foresight are the major obstacle to students' success. Students report success factors comprising regular exercises, clear concepts, responsiveness, and strategy adaption. On the other hand, teachers commend enthusiasm, prior knowledge, and strong basics in mathematics for achieving success in the subjects. The study demonstrates female students are equally competent as male students in their academic mathematics achievement.

The results presented in this paper might vary depending on time, territory, and perspective. Hence this dynamic research with expansion potential needs further attention into improving mathematics pedagogies and the impact of these individual variables on the students' success and failure. A strategic limitation of this study includes recording success and failure factors for all types of students, while more acceptable findings would be drawn about the success factors from only the high achievers and the failure factors from the counter group. Also, research conducted in some other contexts would produce comparative results ensuring generalizability at the global level. Small student and teacher sample sizes are other constraints of the research.

Future researchers might focus on how the research findings can be used to confirm a profoundly supportive academic environment for effective mathematics instruction. More sophisticated techniques and statistical analysis in addition to the p-test can be utilized to extend the results and analysis. Further study can be expanded beyond mathematics into the other relevant fields. The specific perspectives of the Bangladeshi indigenous groups should be studied since they undergo extreme language barriers in studying science and mathematics like the English medium instruction (EMI) student groups.

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Appendix

Phase 2: Questionnaire

Factors for Success (S):

S1: Need lots of practice.

A. Strongly agree, B. Agree, C. Neutral, D. Disagree, E. Strongly disagree

S2: Have a clear understanding of the subject.

A. Strongly agree, B. Agree, C. Neutral, D. Disagree, E. Strongly disagree

S3: Should study regularly.

A. Strongly agree, B. Agree, C. Neutral, D. Disagree, E. Strongly disagree

S4: Show interest, passion, dedication, determination, and have self-confidence.

A. Strongly agree, B. Agree, C. Neutral, D. Disagree, E. Strongly disagree

S5: Stay focused and be attentive in the classroom.

A. Strongly agree, B. Agree, C. Neutral, D. Disagree, E. Strongly disagree

S6: Good teaching and quality teachers are essential.

A. Strongly agree, B. Agree, C. Neutral, D. Disagree, E. Strongly disagree

S7: Be imaginative.

A. Strongly agree, B. Agree, C. Neutral, D. Disagree, E. Strongly disagree

S8: Attend classes regularly.

A. Strongly agree, B. Agree, C. Neutral, D. Disagree, E. Strongly disagree

S9: Do group study and discuss with each other.

A. Strongly agree, B. Agree, C. Neutral, D. Disagree, E. Strongly disagree

S10: Take notes during classes and follow lectures and books.

A. Strongly agree, B. Agree, C. Neutral, D. Disagree, E. Strongly disagree

S11: Need to memorize some formulas and follow strategy.

A. Strongly agree, B. Agree, C. Neutral, D. Disagree, E. Strongly disagree

S12: Need proper guidelines from teachers and departments.

A. Strongly agree, B. Agree, C. Neutral, D. Disagree, E. Strongly disagree

S13: Availability of resources and proper classroom environment.

A. Strongly agree, B. Agree, C. Neutral, D. Disagree, E. Strongly disagree

S14: Don't panic and enjoy mathematics.

A. Strongly agree, B. Agree, C. Neutral, D. Disagree, E. Strongly disagree

S15: Have prior knowledge to understand new information.

A. Strongly agree, B. Agree, C. Neutral, D. Disagree, E. Strongly disagree

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S16: Have a good reading and writing ability.

A. *Strongly agree, B. Agree, C. Neutral, D. Disagree, E. Strongly disagree*

S17: Ask questions to teachers and yourselves.

A. *Strongly agree, B. Agree, C. Neutral, D. Disagree, E. Strongly disagree*

S18: Teachers need to show more real-life applications in the classroom.

A. *Strongly agree, B. Agree, C. Neutral, D. Disagree, E. Strongly disagree*

S19: A good examination system is necessary.

A. *Strongly agree, B. Agree, C. Neutral, D. Disagree, E. Strongly disagree*

Factors for Underperformance (U):

U1: Lack of regular practice/study.

A. *Strongly agree, B. Agree, C. Neutral, D. Disagree, E. Strongly disagree*

U2: Memorizing mathematics rather than understanding the subject.

A. *Strongly agree, B. Agree, C. Neutral, D. Disagree, E. Strongly disagree*

U3: Teachers failed to make the lesson interesting and insufficient lectures.

A. *Strongly agree, B. Agree, C. Neutral, D. Disagree, E. Strongly disagree*

U4: Inattentive and irregularities in the classroom.

A. *Strongly agree, B. Agree, C. Neutral, D. Disagree, E. Strongly disagree*

U5: Failed to understand the subject.

A. *Strongly agree, B. Agree, C. Neutral, D. Disagree, E. Strongly disagree*

U6: Lack of interest, motivation, confidence, seriousness, patience, and guidance.

A. *Strongly agree, B. Agree, C. Neutral, D. Disagree, E. Strongly disagree*

U7: Fear about mathematics.

A. *Strongly agree, B. Agree, C. Neutral, D. Disagree, E. Strongly disagree*

U8: Don't have a good mathematics background.

A. *Strongly agree, B. Agree, C. Neutral, D. Disagree, E. Strongly disagree*

U9: Not interested in mathematics.

A. *Strongly agree, B. Agree, C. Neutral, D. Disagree, E. Strongly disagree*

U10: Examination-oriented education.

A. *Strongly agree, B. Agree, C. Neutral, D. Disagree, E. Strongly disagree*

U11: Reading fewer books but reading solution materials and guide books.

A. *Strongly agree, B. Agree, C. Neutral, D. Disagree, E. Strongly disagree*

U12: Failed to connect mathematical theory in real life.

A. Strongly agree, B. Agree, C. Neutral, D. Disagree, E. Strongly disagree

U13: Involvement in student's politics and doing lots of tuition.

A. Strongly agree, B. Agree, C. Neutral, D. Disagree, E. Strongly disagree

U14: Huge syllabus with limited time available.

A. Strongly agree, B. Agree, C. Neutral, D. Disagree, E. Strongly disagree

U15: Insufficient resources to study.

A. Strongly agree, B. Agree, C. Neutral, D. Disagree, E. Strongly disagree

U16: Lack of prior knowledge on the subject.

A. Strongly agree, B. Agree, C. Neutral, D. Disagree, E. Strongly disagree

U17: Failure to understand abstract ideas.

A. Strongly agree, B. Agree, C. Neutral, D. Disagree, E. Strongly disagree

U18: Poor education system.

A. Strongly agree, B. Agree, C. Neutral, D. Disagree, E. Strongly disagree

U19: External distraction in the university.

A. Strongly agree, B. Agree, C. Neutral, D. Disagree, E. Strongly disagree

U20: The teacher-student ratio is too high.

A. Strongly agree, B. Agree, C. Neutral, D. Disagree, E. Strongly disagree

U21: Bad reading and writing ability.

A. Strongly agree, B. Agree, C. Neutral, D. Disagree, E. Strongly disagree

Phase 3: Qualitative analysis questionnaires for students and Teachers

1. What duties should students perform to do better in mathematics courses?
2. What are the reasons for the underperformance in mathematics courses?
3. What should students do to control their fear, anxiety, pressure, and stressful situation in the process of learning mathematics?
4. Do you get support and motivation from your parents for studying mathematics? Do you think that parental care helps someone to do better in mathematics? Why?
5. Are you satisfied with the holistic educational environment at your department? If not, how can the educational environment be improved?
6. If you don't understand any topic, do you ask your teachers to explain the topic again? If not, what restricts you from doing so?
7. Are you satisfied enough with the teaching process of your teachers? If not, how can instructors make the teaching process more interesting?
8. What steps should the instructors take to make the abstract mathematical concepts more clear and understandable to students?

9. Do you need support from your teachers outside of classrooms? What are those?
10. Do you think you have enough technologies in school and at home to do well in Mathematics?
11. Do you think peer support/group study is effective in achieving success in Mathematics? Why? How are you influenced by your peers personally?
12. What do you think about the role of assessment systems (exam-based) in producing bad results?