IMPACT OF MATHEMATICS ANXIETY ON STUDENTS' ACADEMIC ACHIEVEMENT IN UNDERGRADUATE CLASSES: A STUDY OF BALOCHISTAN, PAKISTAN

SYED MUHAMMAD JAMIL

Ph.D. Scholar, Department of Education, The University of Haripur, Khyber Pakhtunkhwa, Pakistan.
Email: aghahmz@gmail.com

Dr. SYED AFZAL SHAH

Assistant Professor, Department of Education, The University of Haripur, Khyber Pakhtunkhwa, Pakistan.
Email: afzal_kakakhel@yahoo.com

FAZAL-UR-REHMAN

Ph.D. Scholar, Department of Education, The University of Haripur, Khyber Pakhtunkhwa, Pakistan.
Email: fazaljan.9394@gmail.com

Abstract

This research explores the influence of mathematical anxiety on undergraduate students' academic achievement, as evaluated by their total mathematics grade point averages. This research did not examine the link between students' math apprehension, the independent variable, and their academic achievement, the dependent variable. Out of 10000 students, the study sample includes 640 individuals, 320 men and 320 females from different postgraduate institutions in Balochistan. First, the investigators assessed students' overall mathematical grade norms based on the final report cards provided by the administrations. The researchers then applied a current five-point Likert survey form to self-test math fear as a study tool. Using a quantitative technique, the researchers conducted a multiple regression model to assess the association between math anxiety and academic accomplishment as indicated by students' total mathematical grade point averages. The research stated that worry greatly influences the aggregate mathematics score averages of the study's undergraduate students. The researchers advise that instructors detect if math anxiety impairs students' academic performance and implement a student-centered strategy that promotes extremely anxious kids' intellectual development and accomplishment. In addition, future studies should evaluate the influence of math test anxiety in primary and intermediate math courses and identify the arithmetic chapters that worry students the most.

Keywords: Mathematics Anxiety, Academic Achievement, Grade Point Average, Undergraduate Students, Multiple Regression Model

1. INTRODUCTION

1.1 Background of the Study

Anxiety has emerged as a primary focus in human studies in recent decades. Numerous research (Charpentier et al., 2021, 1057-1057) have investigated and inferred the presence of a link between pressure and the "short-term achievements" (test scores) of students' academic performance (stress). These findings are based on the assumption of a connection between the two. The detrimental effect of anxiety on the academic performance of pupils, as assessed by their grades, continues to increase year after year (Plante et al., 2022). Because mathematics is a multi-systemic activity, anxiety associated with mathematics originates from the subject matter itself (Zelaya, 2020). According to

Tarcinski et al. (2022), there are times when the general public's conception of mathematics as a challenging field of study may have a significant and adverse effect on classroom activities, especially scheduled examinations. While some researchers discovered that poor math abilities had a detrimental influence on students' anxiety levels during timed tests, other researchers found that greater levels of math anxiety are primarily connected with lower academic achievement. In addition, excessive anxiety levels may lead to apprehensive memory, which has been shown to directly and negatively influence students' long-term and short-term academic outcomes in mathematics and other subjects (Daker et al., 2021).

1.2 Theoretical Framework

After many years of study, it is still unclear which comes first: bad performance in mathematics leads to math anxiety, or math anxiety leads to poor performance in mathematics. A bad mathematical experience, poor performance at an early age, or a lack of relevant mathematical information may all contribute to the development of math anxiety in many students, particularly those enrolled in upper-level math classes. Math anxiety may have a detrimental influence on students' engagement and attitude toward mathematical activities, acquisition of mathematical information, and strategies for solving problems, understanding of definitions and ideas, and knowledge production, according to the Debilitating Anxiety Theory proposed by Ray Hembree in 1990. In addition, those with more excellent rates of math anxiety are more likely to answer questions fast and try to finish their tests as soon as possible without examining the accuracy of their answers, which leads to poor exam performance. (Choi et al., 2020) This shows that those with high rates of math anxiety cannot understand and grasp the principles and meanings of mathematics appropriately.

1.3 Research Questions

What is the impact of mathematics anxiety on undergraduate students' academic achievement, as indicated by their overall mathematical grade point averages?

1.4 Research Hypothesis

There is a significant impact of math anxiety on students' academic achievement.

1.5 Rational of the Study

Examining students' anxiety during timed mathematics examinations at all levels is necessary to minimize it as significantly as possible and address it during the beginning of classes.

1.6 Significance of the Study

The present study aims to expand the current scholarly discourse by examining the impact between math anxiety and students' academic achievement, as assessed by their cumulative grade point averages. The results obtained from this investigation make a valuable addition to the existing pool of information.

1.7 Delimitations of the Study

The researcher has restricted the study to encompass undergraduate students from Balochistan solely.

2. LITERATURE REVIEW

The study by Kumar and Karimi (2010) aimed to examine the relationship between math anxiety and academic achievement in students. The study elicited responses from 424 students who participated in a survey on apprehension towards mathematics. The researchers analyzed the variations in math anxiety levels among male and female individuals. Kumar and Karimi's (2010) research findings suggest a negative correlation exists between math anxiety and mathematical performance among students, regardless of gender.

The study conducted by Burte et al. (2020) revealed that a correlation exists between anxiety and suboptimal performance in math grades and standardized test scores. However, it is noteworthy that not all individuals experiencing math anxiety exhibit poor academic performance. Despite the indispensability of fundamental mathematical abilities in everyday existence, many individuals encounter feelings of unease and apprehension when confronted with the prospect of performing mathematical operations regularly. Furthermore, Li and colleagues (2022) have found that individuals with high math anxiety exhibit significantly lower performance in mathematics than in non-mathematical subjects.

Zhou (2020) posited that exploring factors, including anxiety, that impact students' academic performance in mathematics and their subsequent effective resolution could enhance the prospects of students pursuing higher education and careers in scientific fields.

Furthermore, as per Buckley's (2013) observation, it is a common belief that students with a high IQ can only acquire exceptional mathematical skills. The researcher revealed that a sequence of experiments in the United States evinced that anxiety may reduce mathematical performance during an examination by hindering the individual's ability to access the resources essential for completing a mathematical test. Furthermore, Hussein and Cskos (2023) discovered that students might develop an unfavorable disposition toward mathematics due to anxiety. Individuals who experience anxiety may avoid academic disciplines, educational programs, and professional trajectories involving mathematics, potentially constraining their prospects and vocational courses.

According to Mnguni's (2022) findings, the experience of math anxiety during problem-solving can potentially diminish individuals' working memory capacity, thereby leading to suboptimal performance outcomes. According to Mnguni (2022), educators can potentially mitigate students' math anxiety.

3. METHODOLOGY

3.1 Sample of the Study

The study centered on the mean mathematical scores of students aged 17 to 22 across all levels of tertiary education. Mathematics is a compulsory subject in the academic program of any tertiary institution. As students advance through their mathematical studies, the content becomes progressively more abstract, potentially impacting their academic achievement.

3.2 Research Design

The present study is based on a non-experimental research design; survey methods were used to collect the data. This study analyzed the impact of graduate students' anxiety, and their total mathematical score averages were analyzed.

3.3 Research Instruments

The investigators employed a self-constructed, standardized questionnaire based on the Five-Point-Likert scale. The survey consisted of twenty-two items that were evaluated using a scoring system ranging from one to five in a specific manner. The scale used in this context ranges from 1 to 5, where 1 represents a strong disagreement, 2 represents a disagreement, 3 represents uncertainty, 4 represents an agreement, and 5 represents a firm agreement.

3.4 Validity and Reliability Test

To uphold the integrity of the survey instrument, the investigators employed identical standardized items and refrained from making any alterations to the articles. To evaluate the reliability and consistency of the survey questionnaire, a sample of 640 students was asked to complete the survey twice, with a two-week interval between each administration. Subsequently, the scholars juxtaposed the answers provided by each pupil in both iterations and computed the aggregate score for each individual. Upon finding that each participant responded with near-identical answers on two separate occasions and that their overall scores did not exhibit significant variation between the initial and subsequent iterations of the survey, the investigators concluded that the questionnaire possessed a high degree of reliability.

4. DATA COLLECTION PROCEDURE

The researcher visited colleges and universities in person to collect information from students. The researcher delivered printed versions of the survey questionnaire to all undergraduate students, and all undergraduates completed the survey. Following the implementation, the researchers organized the collected data for analysis.

4.1 Data Analysis

The researchers utilized Excel and Statistical Software. Social Science Research (SPSS) was used to analyze the gathered data. Descriptive statistics and a multiple regression model were used in the study.

4.2 Regression

A multiple regression model was used to determine the effect of variables on the mathematical grade averages of undergraduate students and their anxiety levels.

Table 4.1: Level of Anxiety among College Students

	N	Minimum	Maximum	Mean	Std. Deviation
Learning Maths Anxiety	644	1.17	3.00	2.3458	.49590
Maths Evaluation Anxiety	644	1.17	3.00	2.3825	.50733
Environmental Anxiety	644	1.17	3.00	2.5908	.32875
Valid N (list-wise)	644				

Table 4.1 represents the study's results that aimed to measure the level of anxiety among college students for three different types of anxiety: Learning Math anxiety, Mathematics Evaluation anxiety, and Environmental Anxiety. The data in the table suggest that, on average, the level of anxiety among college students for all three types of anxiety measured is moderate to high. The mean values for Learning Math anxiety, Math Evaluation anxiety, and Environmental Anxiety are 2.3458, 2.3825, and 2.5908, respectively. The minimum values are 1.17 for all three types of anxiety, indicating that even the least anxious students experience some degree of anxiety. The maximum values are also the same for all three types of anxiety, meaning that some students experience high anxiety levels. The standard deviation values for the three types of anxiety range from 0.32875 to 0.50733, indicating that the responses are not tightly clustered around the mean. The standard deviation for Environmental Anxiety is the lowest, indicating that the reactions are less variable than the other two anxiety types.

The results of this study suggest that anxiety among undergraduate college students is a significant issue and that efforts should be made to identify and address the root causes of anxiety. Additionally, the study results could be used to develop interventions that target specific types of anxiety experienced by college students, such as Learning Math anxiety and Mathematics Evaluation anxiety.

Table 4.2: Impact of Math Anxiety on Academic Achievement of Undergraduate Students

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	108.089	1.134		95.296	0.000
	Learning Maths Anxiety	-6.293	.915	-0.353	-6.880	0.000
	Maths Evaluation Anxiety	-1.977	.736	-0.120	-2.685	0.007
	Environmental anxiety	-6.950	.997	-0.369	-6.968	0.000
R=0.804[a] R^2=0.646 Adj. R^2= 0.645 F=387.51 Alpha=0.000						
a. Dependent Variable: Marks						

The impact of mathematics anxiety on students' academic achievement is presented in Table 4.2. The table shows several noteworthy observations that can be made.

The coefficients column in the regression model presents the unstandardized coefficients (B), the standard error of the coefficients, and the standardized coefficients (Beta) for

each independent variable. The independent variables include learning math anxiety, math evaluation anxiety, and environmental anxiety. The dependent variable is academic achievement. Standardized coefficients: The Beta coefficients, which are standardized, demonstrate the relative significance of each independent variable in forecasting the dependent variable while accounting for the impacts of the remaining independent variables. Higher levels of math apprehension are associated with lower academic achievement, as indicated by the negative Beta values for all three independent variables. Significance: The T-test and significance (Sig.) column show the statistical value of each independent variable in predicting academic achievement. All three independent variables significantly affect academic achievement, as indicated by the low p-values (i.e., less than 0.05).

Model fit: The R, R2, and Adj. R2 values indicate the independent variables' predictive capacity concerning the dependent variable. The correlation coefficient (0.804) suggests a moderately robust positive association between the predictor and response variables. The obtained R2 value of 0.646 indicates that the independent variables incorporated in the model have the potential to account for 64.6% of the variability in academic achievement—moreover, the Adj. The R2 value of 0.646 suggests that the model exhibits a satisfactory fit, given its proximity to the R2 value. The F-test indicates the statistical significance of the model as a whole (F=387.51, Alpha=0.000). The table indicates a significant negative impact of math anxiety on academic achievement. The findings suggest that increased levels of math anxiety, mathematics evaluation anxiety, and environmental anxiety are linked to decreased levels of academic performance. Consequently, it is imperative to tackle the issue of math anxiety among students in order to facilitate improved academic performance.

5. CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

This study examined math anxiety's influence on undergraduate students' academic achievement in Balochistan, Pakistan. The researchers utilized descriptive statistics and regression analysis to evaluate the extent of this phenomenon. The present study's results exhibited similarities to prior research in numerous aspects. Zhou (2020) posits that math anxiety impacts student behavior. Kumar and Karimi (2010) have reported a significant inverse association between anxiety and performance. The correlation between anxiety and performance has been explored in various studies, including Anouti's (2018) investigation into the impact of heightened math anxiety on overall performance. Anouti's findings suggest that a significant number of students exhibit suboptimal performance in mathematics as a result of elevated anxiety levels. According to Anouti's (2018) findings, confident students who experience high anxiety levels may perform well on math assessments due to their advanced abilities. However, these individuals may eventually encounter a situation where their anxiety surpasses their skills, leading to a detrimental effect on their task performance and hindering their ability to acquire new skills in future lessons. According to Karababa's (2020) research, anxiety can lead to hindrances and decreased performance on mathematical assessments.

According to the findings of Beilock and Willingham (2014), math anxiety has a negative impact on working memory and hinders problem-solving abilities. This assertion is supported by Lubienski's (2020) research. The present study has directed its attention toward examining the relationship between anxiety and students' academic performance in mathematics. This research has been motivated by the recommendations of previous literature, which have highlighted the importance of exploring the impact of math anxiety on students across all levels and classes. Additionally, a necessity exists to conduct further investigations into students' anxiety levels when faced with mathematical tasks (Rozgonjuk, 2020). The findings indicate a statistically significant inverse relationship between anxiety levels and mathematics students' mean grade point averages.

5.2 Recommendations

For Teachers

- The identification of math anxiety is critical in determining a student's task performance and should be regularly assessed. The research above indicates that math anxiety has a discernible effect on students' mathematical proficiency, as evidenced by their cumulative grade point averages. Hence, mathematics educators must assess whether students' math-related apprehension impedes academic achievement.

- As per the outcomes of this investigation, students who experience anxiety in mathematics exhibit inferior performance compared to their non-anxious peers. In order to achieve this objective, educators must relinquish their traditional teacher-focused methodology and instead prioritize the placement of students at the core of the pedagogical and learning experience.

For Future Researchers

- It is recommended that researchers identify the specific mathematics chapters that evoke the highest levels of math apprehension among middle and high school students.

- The present study reveals that anxiety has a detrimental effect on numerous undergraduate students' mathematical grade point averages. Hence, it is imperative to conduct further research to investigate the prevalence of math anxiety among students at primary, secondary, and intermediate levels to mitigate the occurrence of it in subsequent academic pursuits.

References

1. Anouti, M., Shehayeb, S., & Mchiek, M. (2018). The Effect of Math Anxiety on Students' Performance in the Intermediate and Secondary Classes. *International Journal of Science and Research (IJSR)*, pp. *8*, 739–745.

2. Burte, H., Gardony, A. L., Hutton, A., & Taylor, H. A. (2020). Elementary teachers' attitudes and beliefs about spatial thinking and mathematics. *Cognitive research: principles and implications, 5(1),* 1–18.

3. Charpentier, C. J., Faulkner, P., Pool, E. R., Ly, V., Tollenaar, M. S., Kluen, L. M., ... & O'Doherty, J. P. (2021). How are representative neuroimaging samples? Large-scale evidence for trait anxiety

differences between fMRI and behavior-only research participants. *Social cognitive and affective neuroscience*, *16*(10), 1057–1070.

4. Choi, S. S., Taber, J. M., Thompson, C. A., & Sidney, P. G. (2020). Math anxiety, but not induced stress, is associated with objective numeracy. *Journal of Experimental Psychology: Applied, 26(4),* 604.

5. Daker, R. J., Gattas, S. U., Sokolowski, H. M., Green, A. E., & Lyons, I. M. (2021). First-year students' math anxiety predicts STEM avoidance and underperformance throughout the university, independently of math ability. *npj Science of Learning, 6(1),* 17.

6. Hembree, R. (1990). The nature, effects, and relief of mathematics anxiety. *Journal for Research in mathematics education, 21(1),* 33–46.

7. Hussein, Y. F., & Csíkos, C. (2023). The effect of teaching conceptual knowledge on students' achievement, anxiety about, and attitude toward mathematics*. Eurasia Journal of Mathematics, Science and Technology Education, 19(2),* em2226.

8. Karababa, A. (2020). The moderating role of hope in the relationship between maladaptive perfectionism and anxiety among early adolescents. *The Journal of Genetic Psychology, 181(2-3),* pp. 159–170.

9. Kumar, V., & Karimi, A. (2010). Mathematics Anxiety, Mathematics Performance, and Mathematics Anxiety, Mathematics Performance. *Journal of the Indian Academy of Applied Psychology. 36(1),* 147-150.

10. Li, T., Quintero, M., Galvan, M., Shanafelt, S., Hasty, L. M., Spangler, D. P. ... & Wang, Z. (2022). The mediating role of attention in the association between math anxiety and math performance: *An eye-tracking study. Journal of Educational Psychology.*

11. Lubienski, S. T., Ganley, C. M., Makowski, M. B., Miller, E. K., & Timmer, J. D. (2021). "Bold problem solving": A new construct for understanding gender differences in mathematics. *Journal for Research in Mathematics Education, 52(1),* 12-61.

12. Mnguni, M. T. (2022). The relationship between anxiety, working memory and achievement in mathematics in grade 5 learners: *a case study of Tshepisong schools (Doctoral dissertation).*

13. Plante, I., Lecours, V., Lapointe, R., Chaffee, K. E., & Fréchette-Simard, C. (2022). Relations between prior school performance and later test anxiety during the transition to secondary school. *British Journal of Educational Psychology*, *92*(3), 1068-1085.

14. Tarchinski, N. A., Rypkema, H., Finzell, T., Popov, Y. O., & McKay, T. A. (2022, April). Extended Exam Time Has a Minimal Impact on Disparities in Student Outcomes in Introductory Physics. *In Frontiers in Education (Vol. 7, p. 247). Frontiers.*

15. Zelaya, A. M. (2020). *A Review of Common Treatments and Their Effectiveness to Reduce Juvenile Recidivism* (Doctoral dissertation, The Chicago School of Professional Psychology).

16. Zhou, D., Du, X., Hau, K. T., Luo, H., Feng, P., & Liu, J. (2020). Teacher-student relationship and mathematical problem-solving ability: mediating roles of self-efficacy and mathematical anxiety. *Educational Psychology, 40(4),* 473–489.