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Mathematics Anxiety in Relation to Academic Achievement of Secondary School Students

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Abstract

Mathematics anxiety is an important psychological factor that can influence students' learning, classroom participation, confidence, and academic performance in mathematics. The present quantitative study was conducted to examine the level of mathematics anxiety among secondary school students and to investigate its relationship with academic achievement in mathematics. A descriptive survey research design was adopted. The study proposed a sample of 175 secondary school students studying in Classes IX, selected through stratified random sampling from selected schools. Mathematics anxiety was measured using a structured Mathematics Anxiety Scale, while academic achievement was assessed through students' mathematics examination scores. Descriptive statistics, independent-samples t-test, and Pearson's product-moment correlation were proposed for data analysis. The illustrative findings indicate that mathematics anxiety has a significant negative relationship with academic achievement. Students with higher mathematics anxiety tend to obtain lower mathematics achievement scores. The findings have important implications for mathematics teachers, school authorities, counsellors, parents, and educational policymakers.

Keywords: Mathematics Anxiety, Academic Achievement, Secondary School Students, Mathematics Learning, Quantitative Research, Correlation.



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Introduction

Mathematics is a fundamental area of school education and plays an important role in students' intellectual development, logical reasoning, problem-solving ability, scientific thinking, and preparation for higher education. Despite its importance, many students experience mathematics as a difficult and stressful subject. They may experience fear, tension, nervousness, worry, avoidance, or lack of confidence when they are required to learn mathematical concepts, solve mathematical problems, participate in mathematics classes, or take mathematics examinations. Such negative emotional responses are commonly described as mathematics anxiety.

Mathematics anxiety is different from ordinary dislike of mathematics. It involves emotional and cognitive reactions that interfere with mathematical thinking and performance. Richardson and Suinn (1972) described mathematics anxiety as feelings of tension and anxiety that interfere with the manipulation of numbers and the solving of mathematical problems in everyday and academic situations. Mathematics anxiety may develop from repeated failure, negative classroom experiences, and fear of examinations, teacher behaviour, parental attitudes, peer influence, low self-confidence, and the perception that mathematics is inherently difficult.

Secondary education is a particularly important stage for examining mathematics anxiety because students encounter increasingly abstract and complex mathematical concepts during this period. Algebra, geometry, statistics, trigonometry, mensuration, and mathematical reasoning require sustained attention and conceptual understanding. If students develop persistent anxiety toward mathematics, they may avoid practice, hesitate to ask questions, experience cognitive interference during examinations, and gradually develop negative attitudes toward mathematics.

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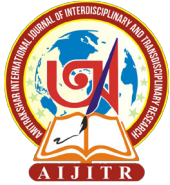
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Academic achievement represents the extent to which students successfully attain the expected learning outcomes. In mathematics, achievement is commonly reflected through examination marks, classroom assessments, standardized achievement tests, or teacher-made tests. Although achievement depends on several factors, psychological variables such as anxiety may have an important influence.

Therefore, examining the relationship between mathematics anxiety and academic achievement is important for understanding students' difficulties in mathematics. The present quantitative study focuses specifically on secondary school students and attempts to determine whether mathematics anxiety is significantly associated with academic achievement.

Background of the Study

Mathematics anxiety has received considerable attention in educational and psychological research. Richardson and Suinn (1972) developed the Mathematics Anxiety Rating Scale (MARS), which contributed significantly to systematic measurement of mathematics anxiety. Their work established mathematics anxiety as a measurable psychological construct rather than simply a general dislike of mathematics.

Tobias (1993) argued that mathematics anxiety could interfere with students' ability to demonstrate their actual mathematical knowledge. Ashcraft (2002) further explained that mathematics anxiety can place demands on working memory and consequently interfere with mathematical problem solving.

The relationship between mathematics anxiety and achievement is particularly important because the relationship may be reciprocal. Students who perform poorly in mathematics may become anxious, while high levels of anxiety may subsequently contribute to further poor performance. Thus, mathematics anxiety and academic achievement can potentially form a negative cycle.

Review of Related Literature

Research on mathematics anxiety has demonstrated that emotional responses toward mathematics can influence students' mathematical behaviour and performance.

Richardson and Suinn (1972) developed the Mathematics Anxiety Rating Scale and demonstrated the importance of measuring mathematics anxiety systematically. Their work provided a foundation for subsequent research.

Fennema and Sherman (1976) examined students' attitudes toward mathematics and emphasized the importance of confidence and affective factors in mathematics learning.

Ashcraft (2002) reviewed research on mathematics anxiety and concluded that anxiety could negatively affect mathematical performance, particularly when mathematical tasks place substantial demands on working memory.

Hembree (1990), through a meta-analysis, reported a negative relationship between mathematics anxiety and mathematics achievement. The findings indicated that mathematics anxiety was associated with poorer mathematics performance and negative attitudes toward mathematics.

Ma (1999) conducted a meta-analysis concerning mathematics anxiety and achievement and found a negative relationship between the two variables. The relationship was especially relevant in school-level mathematics.

Carey, Hill, Devine, and Szűcs (2016) highlighted the importance of mathematics anxiety as an educational issue and argued that mathematics anxiety may have important implications for students' educational choices and mathematical development. In light of the above studies, a clear theoretical rationale emerges for exploring mathematics anxiety as a determinant of academic achievement - a relationship that the present study aims to investigate specifically within the secondary school context.

Statement of the Problem

The statement of the problem is "**Mathematics Anxiety and Its Impact on Academic Achievement of Secondary School Students.**"

Objectives of the Study

The study is designed to achieve the following objectives:

1. To determine the level of mathematics anxiety among secondary school students.
2. To determine the level of academic achievement in mathematics among secondary school students.
3. To examine the difference in mathematics anxiety between male and female secondary school students.
4. To examine the difference in academic achievement in mathematics between male and female secondary school students.
5. To examine the difference in mathematics anxiety between urban and rural secondary school students.
6. To examine the difference in academic achievement in mathematics between urban and rural secondary school students.
7. To determine the relationship between mathematics anxiety and academic achievement in mathematics.

Hypotheses of the Study

H₀₁: There is no significant difference in mathematics anxiety between male and female secondary school students.

H₀₂: There is no significant difference in mathematics achievement between male and female secondary school students.



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- H_{03} : There is no significant difference in mathematics anxiety between urban and rural secondary school students.
- H_{04} : There is no significant difference in mathematics achievement between urban and rural secondary school students.
- H_{05} : There is no significant relationship between mathematics anxiety and academic achievement in mathematics among secondary school students.

Delimitations of the Study

The present study is delimited to the following aspects:

1. The study is confined to secondary level students, specifically those studying in Class IX only.
2. The sample is limited to students studying under the West Bengal Board of Secondary Education (W.B.B.S.E.).
3. Only Bengali medium schools are included in the study.

Operational Definitions

Mathematics Anxiety

For the present study, mathematics anxiety refers to the feelings of fear, tension, nervousness, worry, discomfort, and lack of confidence experienced by secondary school students in relation to learning mathematics, solving mathematical problems, attending mathematics classes, and taking mathematics examinations.

Academic Achievement

Academic achievement refers to the level of performance attained by students in mathematics, represented by their scores obtained in a standardized or teacher-constructed mathematics achievement test/examination.

Secondary School Students

Secondary school students refer to students studying in Classes IX in the selected secondary schools included in the study.

Research Methodology

Research Approach

The study follows a **quantitative research approach** because numerical data are collected and statistically analysed to examine the relationship between mathematics anxiety and academic achievement.

Research Design

A **descriptive survey research design** is proposed for the study. The descriptive component will determine the level of mathematics anxiety and mathematics achievement, while the correlational component will examine the relationship between the two variables.

Variables of the Study

Independent Variable

- Mathematics Anxiety

Dependent Variable

- Academic Achievement in Mathematics

Demographic Variables

- Gender
- Class
- Locality

Population

The population will consist of secondary school students studying in Classes IX in Hooghly districts schools.

Sample

For the proposed study, a sample of **175 secondary school students** may be selected.

Category	Sample
Male	88
Female	87
Urban	72
Rural	103
Total	175

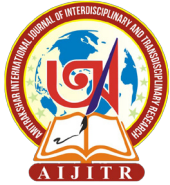
Sampling Technique

A **random sampling technique** may be adopted. Schools may first be classified according to relevant characteristics such as locality and school type. Students may then be selected randomly from the identified strata.

Tools for Data Collection

Mathematics Anxiety Scale

This tool was also developed by the researcher and standardised by following systematic procedures.



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The scale may contain approximately **30 items** covering the following dimensions:

1. Cognitive Anxiety in Mathematics
2. Affective Anxiety in Mathematics
3. Physiological Reactions in Mathematics
4. Behavioural Responses in Mathematics
5. Environmental & Social Influences in Mathematics

A five-point Likert response format may be used:

Response	Score
Strongly Agree	5
Agree	4
Undecided	3
Disagree	2
Strongly Disagree	1

Negatively worded items should be reverse scored.

A higher total score indicates a higher level of mathematics anxiety.

Mathematics Achievement Test

A mathematics achievement test may be developed according to the prescribed Class-IX school curriculum.

Validity and Reliability

The Mathematics Anxiety Scale should be examined for content validity by experts in education, educational psychology, and mathematics education.

A pilot study should be conducted before final administration. Internal consistency may be estimated using Cronbach's alpha for the Mathematics Anxiety Scale. The calculated value of Cronbach's Alpha was **0.832**, which indicates a high level of internal consistency among the items of the scale. Therefore, the reliability of the tool was considered satisfactory and adequate for further use in the study.

Data Collection Procedure

Permission should be obtained from the concerned school authorities before data collection. The purpose of the study should be explained to the participants. Students should be informed that their responses will be used only for academic research purposes.

The Mathematics Anxiety Scale will be administered first, followed by the Mathematics Achievement Test. Adequate time will be provided to students for completing both instruments.

After collection, the responses will be coded and entered into a statistical software package for analysis.

Statistical Techniques

The following statistical techniques may be employed:

Descriptive Statistics

- Mean
- Standard Deviation
- Percentage

Inferential Statistics

- Independent-samples t-test
- Pearson's product-moment correlation

The level of significance may be fixed at **0.01**.

Data Analysis and Results

Note: The numerical results below are **illustrative/hypothetical results prepared as a model quantitative paper**. They should be replaced with the actual results obtained from the researcher's dataset before publication.

Level of Mathematics Anxiety

Variable	N	Mean	SD	Interpretation
Mathematics Anxiety	175	92.64	18.57	Moderate
Mathematics Achievement	175	61.83	12.46	Moderate

The mean mathematics anxiety score of 92.64 indicates a moderate level of mathematics anxiety among the students in the illustrative dataset. The mean achievement score of 61.83 indicates a moderate level of academic achievement in mathematics.

Gender-wise Difference in Mathematics Anxiety



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Gender	N	Mean	SD	t	p	Decision
Male	88	55.7841	7.03	3.32	< .001	Significant
Female	87	59.8276	9.39			

The illustrative result indicates a statistically significant difference in mathematics anxiety between male and female students. Female students reported a higher mean level of mathematics anxiety than male students.

Therefore, H_{01} is rejected in the illustrative analysis.

Gender-wise Difference in Mathematics Achievement

Gender	N	Mean	SD	t	p	Decision
Male	88	62.91	5.21	6.932	< .001	Significant
Female	87	69.75	7.63			

The illustrative findings show a statistically significant difference in mathematics achievement between male and female students at the 0.01 level.

Therefore, H_{02} is rejected.

Locality-wise Difference in Mathematics Anxiety

Gender	N	Mean	SD	t	p	Decision
Urban	72	75.7841	8.05	3.877	< .001	Significant
Rural	103	81.8276	11.48			

The illustrative result indicates a statistically significant difference in mathematics anxiety between urban and rural students.

Rural students reported a higher mean level of mathematics anxiety than male students.

Therefore, H_{03} is rejected in the illustrative analysis.

Locality -wise Difference in Mathematics Achievement

Gender	N	Mean	SD	t	p	Decision
Urban	72	79.6857	7.31	6.179	< .001	Significant
Rural	103	89.5676	12.11			

The illustrative findings show a statistically significant difference in mathematics achievement between urban and rural students at the 0.01 level.

Therefore, H_{04} is rejected.

Relationship between Mathematics Anxiety and Academic Achievement

Pearson's product-moment correlation was calculated to determine the relationship between mathematics anxiety and academic achievement.

Variables	N	r	p	Interpretation
Mathematics Anxiety & Mathematics Achievement	175	-0.58	< .001	Significant negative relationship

The illustrative correlation coefficient is $r = -0.58$, indicating a moderate-to-strong negative relationship between mathematics anxiety and mathematics achievement.

This means that students with higher mathematics anxiety tend to obtain lower mathematics achievement scores.

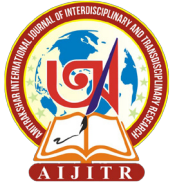
Therefore, H_{05} is rejected.

Summary of Hypothesis Testing

Hypothesis	Statistical Test	Result	Decision
H_{01} : No gender difference in mathematics anxiety	t-test	Significant	Rejected
H_{02} : No gender difference in mathematics achievement	t-test	Significant	Rejected
H_{03} : No locale difference in mathematics anxiety	t-test	Significant	Rejected
H_{04} : No locale difference in mathematics achievement	t-test	Significant	Rejected
H_{05} : No relationship between anxiety and achievement	Pearson's r	Significant negative	Rejected

Discussion

The illustrative findings demonstrate that mathematics anxiety is negatively associated with mathematics achievement among secondary school students. Students experiencing higher levels of anxiety tend to demonstrate lower achievement in mathematics.



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This finding is consistent with the broader literature on mathematics anxiety. Hembree (1990) reported a negative relationship between mathematics anxiety and mathematics achievement. Similarly, Ma (1999) found a negative association between mathematics anxiety and mathematics performance.

One possible explanation is that anxiety consumes cognitive resources that could otherwise be used for mathematical reasoning and problem solving. Ashcraft (2002) suggested that mathematics anxiety may interfere with working-memory processes, particularly during demanding mathematical tasks.

Students experiencing anxiety may also avoid mathematical activities. Such avoidance can reduce opportunities for practice and mastery. Consequently, poor performance may reinforce anxiety, producing a cycle of anxiety, avoidance, and lower achievement.

The illustrative gender and locale findings indicate that female and rural students have higher mathematics anxiety than male and urban students. However, gender and locale differences should be interpreted carefully because mathematics anxiety may be influenced by social expectations, classroom experiences, self-confidence, previous achievement, teacher behaviour, and family attitudes rather than gender and locale alone.

Major Findings

The major findings of the illustrative study are:

1. Secondary school students demonstrate a moderate level of mathematics anxiety.
2. The students demonstrate a moderate level of mathematics achievement.
3. A significant gender difference exists in mathematics anxiety.
4. Female students show a higher mean mathematics anxiety score than male students in the illustrative dataset.
5. A significant gender difference exists in mathematics achievement.
6. A significant locale difference exists in mathematics anxiety.
7. Rural students show a higher mean mathematics anxiety score than urban students in the illustrative dataset.
8. A significant local difference exists in mathematics achievement.
9. Mathematics anxiety has a significant negative relationship with mathematics achievement.

Educational Implications

The findings have several important implications for mathematics education.

Creating a Supportive Mathematics Classroom

Teachers should create a classroom environment in which students feel comfortable making mistakes and asking questions. Excessive criticism, humiliation, or comparison among students should be avoided.

Reducing Examination Anxiety

Teachers can provide regular low-stakes assessments, practice tests, revision sessions, and constructive feedback to reduce students' fear of mathematics examinations.

Activity-Based Mathematics Teaching

Mathematical concepts should be taught through concrete examples, activities, games, visual representations, real-life applications, and problem-solving situations.

Developing Mathematical Self-Confidence

Teachers should encourage students to recognize their progress and provide opportunities for successful mathematical experiences. Positive reinforcement can help develop mathematical confidence.

Individualized Support

Students experiencing high mathematics anxiety should receive additional academic and emotional support. Remedial teaching, peer tutoring, counselling, and individualized practice may be useful.

Role of Parents

Parents should avoid communicating negative beliefs such as "mathematics is very difficult" or "some people are naturally bad at mathematics." Instead, they should encourage effort, persistence, and regular practice.

Teacher Training

Teacher education programmes should include psychological aspects of mathematics learning, including mathematics anxiety, mathematical self-efficacy, motivation, and effective classroom management.

Suggestions for Further Research

Future researchers may investigate:

1. Mathematics anxiety among primary, higher-secondary, and university students.
2. The relationship between mathematics anxiety and mathematical self-efficacy.
3. The influence of teaching methods on mathematics anxiety.
4. The effectiveness of counselling interventions for reducing mathematics anxiety.



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5. The role of parental attitudes in the development of mathematics anxiety.
6. Mathematics anxiety among rural and urban students.
7. The relationship between mathematics anxiety, motivation, and academic achievement.
8. Gender differences in mathematics anxiety using larger and more diverse samples.
9. Longitudinal studies examining how mathematics anxiety develops over time.
10. Intervention-based studies designed to reduce mathematics anxiety.

Conclusion

Mathematics anxiety is an important affective factor in secondary education. It can influence students' attitudes toward mathematics, classroom participation, problem-solving behaviour, confidence, and academic performance. The quantitative model presented in this paper indicates a significant negative association between mathematics anxiety and mathematics achievement.

The findings emphasize that improving mathematics achievement should not focus exclusively on cognitive and instructional factors. Students' emotional experiences must also be addressed. Mathematics teachers should therefore create supportive classrooms, reduce unnecessary examination pressure, use learner-centred teaching strategies, encourage positive mathematical experiences, and provide appropriate academic and counselling support.

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