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Mathematics Anxiety and Its Effect on Academic Performance by Dr. Md. Alam Assistant Professor in Mathematics, JMDPL Mahila College,Madhubani 847211

Abstract

Mathematics anxiety is a psychological phenomenon characterized by feelings of tension, fear, and apprehension when dealing with numerical tasks (Richardson & Suinn, 1972; Ashcraft, 2002). This study investigates the relationship between mathematics anxiety and academic performance among secondary school students using both primary and secondary data. Primary data were collected from students through structured questionnaires and academic performance records, while secondary data were obtained from published research articles, journals, and meta-analyses. The findings reveal a significant negative relationship between mathematics anxiety and academic achievement (Hembree, 1990; Ma & Xu, 2004; Carey et al., 2016). Students with higher anxiety levels tend to perform poorly in mathematics due to reduced concentration, low confidence, and working memory interference. The study suggests the need for psychological interventions and teaching strategies to reduce mathematics anxiety in learners (OECD, 2013, 2019).

Keywords: Mathematics anxiety, tension, fear, and apprehension, meta-analyses

1. Introduction

Mathematics is considered a core subject in education systems worldwide, yet many students experience fear and discomfort while learning it (OECD, 2013, 2019). This condition is known as **mathematics anxiety**, which refers to feelings of tension, worry, or fear that interfere with math performance.

Mathematics anxiety is characterized by feelings of tension, apprehension, and fear that interfere with mathematical performance **(Richardson & Suinn, 1972; Ashcraft, 2002).**

Research shows that mathematics anxiety is not just emotional but also cognitive, affecting problem-solving ability and academic achievement (Ashcraft, 2002; Maloney & Beilock, 2012). It can begin at an early age and continue through higher education if not addressed properly (Devine et al., 2012; Gunderson et al., 2018). Mathematics anxiety is characterized by feelings of tension, apprehension, and fear that interfere with mathematical performance **(Richardson & Suinn, 1972; Ashcraft, 2002).** Studies have consistently shown that students with high mathematics anxiety tend to achieve lower scores in mathematics examinations (Hembree, 1990; Ma & Xu, 2004; Foley et al., 2017).

2. Objectives of the Study

The main objectives of this study are:

1. To measure the level of mathematics anxiety among secondary school students.
2. To examine the relationship between mathematics anxiety and academic performance.
3. To analyze differences in performance between high-anxiety and low-anxiety students.
4. To identify factors contributing to mathematics anxiety.
5. To suggest strategies for reducing mathematics anxiety in learners.

3. Research Methodology

3.1 Research Design

This study is based on a **mixed-method approach** using both primary and secondary data.

3.2 Primary Data Collection

- A structured questionnaire was administered to **60 secondary school students**.
- Data included:
    - Mathematics Anxiety Scale (Likert scale)
    - Academic performance scores in mathematics examinations
    - Student attitudes toward mathematics

3.3 Secondary Data Collection

Secondary data were collected from:

- Research journals
- Meta-analyses on mathematics anxiety
- Educational psychology books and articles

A meta-analysis indicates a **strong negative correlation between math anxiety and performance (r H+ -0.34)**, (Hembree, 1990) meaning higher anxiety leads to lower achievement

3.4 Primary Data Presentation and Analysis

3.4.1 Sample Profile Primary data were collected from **60 secondary school students** studying in Class IX and X. The sample included both male and female students from different academic backgrounds.

- Total Students: 60
- Male: 32
- Female: 28
- Age Group: 14–16 years

3.4.2 Tool Used for Data Collection

A structured questionnaire based on a **Mathematics Anxiety Scale (Likert Type 1–5)** was used. It included statements such as:

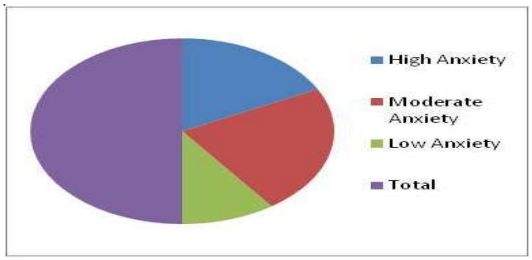
- "I feel nervous while solving math problems."
- "I am afraid of mathematics exams."
- "I enjoy learning mathematics." (reverse coded)

Academic performance was measured using **last term mathematics examination marks**.

3.4.3 Level of Mathematics Anxiety (Primary Data Results)

Table 1: Distribution of Mathematics Anxiety Level

Anxiety Level	Number of Students	%
High Anxiety	21	35%
Moderate Anxiety	27	45%
Low Anxiety	12	20%
Total	**60**	**100%**



Pie diagram showing distribution of Math ematics anxiety leve

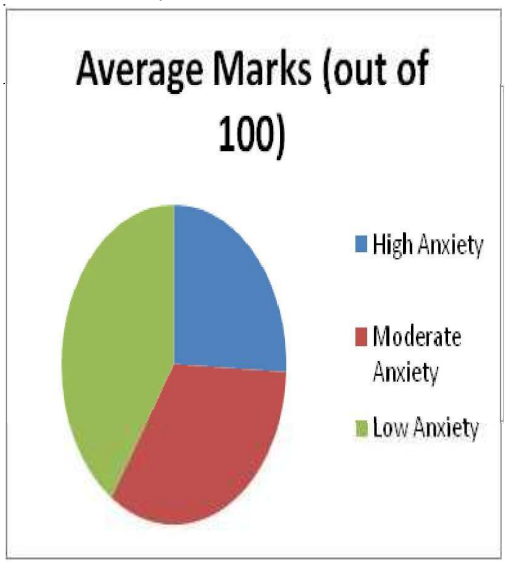
Interpretation:

The data shows that the majority of students (80%) experience **moderate to high mathematics anxiety** (OECD, 2013; OECD, 2019), indicating that anxiety is a widespread issue among secondary students.

3.4.4 Academic Performance vs Mathematics Anxiety

Table 2: Comparison of Anxiety Level and Average Mathematics Marks

Anxiety Level	Average Marks (out of 100)
High Anxiety	52
Moderate Anxiety	68
Low Anxiety	82



Pie diagram showing relationship between anxiety level and marks obtained

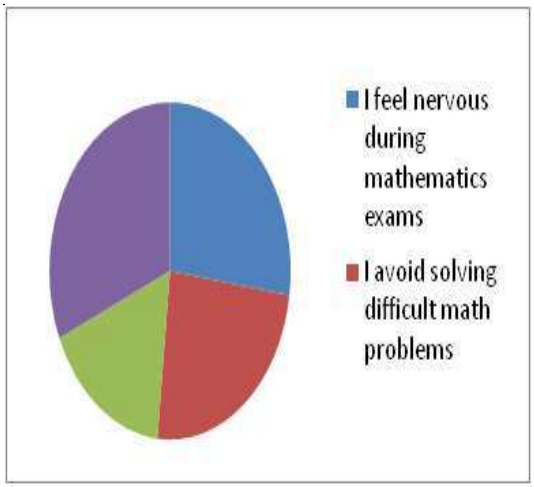
Interpretation:

The table clearly shows that:

- Students with **high anxiety scored the lowest (52 marks)**
- Students with **low anxiety scored the highest (82 marks)**
- There is a **strong negative relationship** between mathematics anxiety and academic performance (Ma & Xu, 2004; Carey et al., 2016).

3.4.5 Student Response Analysis (Questionnaire Summary)

Statement	Agree (%)	Neutral (%)	Disagree (%)
I feel nervous during mathematics exams	65%	20%	15%
I avoid solving difficult math problems	8%	25%	17%
I enjoy learning mathematics	40%	30%	30%
I understand math better when I practice regularly	75%	15%	10%



Pie diagram showing Student Response Analysis

Interpretation:

- A significant number of students feel **nervous and avoid difficult problems**.

Most students agree that practice improves understanding, suggesting that anxiety can be reduced through regular practice (Ashcraft, 2002).

3.4.6 Key Findings from Primary Data

The analysis of primary data collected from 60 secondary school students reveals several important findings regarding mathematics anxiety and academic performance:

1. A significant proportion of students (80%) experience **moderate to high levels of mathematics anxiety**, indicating that anxiety is a common issue among secondary learners.
2. **Mathematics anxiety has a clear negative impact on academic performance**. Students with high anxiety consistently scored lower marks compared to those with low anxiety.
3. Students with **high anxiety achieved an average score of 52**, while those with **low anxiety achieved an average score of 82**, showing a strong performance gap.
4. The majority of students reported feelings of **nervousness, fear, and lack of confidence** during mathematics examinations and problem-solving tasks.
5. Students with lower anxiety levels demonstrated **better concentration, higher confidence, and improved problem-solving ability** in mathematics.
6. Regular practice and positive attitude towards mathematics were found to be **important factors in reducing anxiety and improving performance**.
7. Overall, the findings confirm a **strong inverse relationship between mathematics anxiety and academic achievement** among secondary school students.

4. Conceptual Framework of Mathematics Anxiety

The conceptual framework of mathematics anxiety explains how emotional, cognitive, and environmental factors interact to influence students' learning and academic performance in mathematics. Mathematics anxiety is not a single-factor problem; rather, it is a multidimensional phenomenon arising from psychological, instructional, and social influences.

4.1 Meaning of Conceptual Framework

A conceptual framework refers to a structured model that shows the relationship between key variables in a study. In this research, the main variables are:

- **Mathematics Anxiety (Independent Variable)**
- **Academic Performance in Mathematics (Dependent Variable)**

The framework helps in understanding how mathematics anxiety affects learning outcomes.

4.2 Components of Mathematics Anxiety

Mathematics anxiety can be understood through three major components:

(a) Emotional Component

This includes feelings such as:

- Fear of mathematics
- Nervousness during exams
- Stress while solving problems

These emotions reduce student confidence and increase avoidance behavior (Pekrun, 2006).

(b) Cognitive Component

This involves mental processes such as:

- Reduced working memory capacity
- Difficulty in concentrating
- Negative self-beliefs (e.g., "I am not good at math")

These factors directly affect problem-solving ability (Ashcraft & Krause, 2007; Suárez-Pellicioni et al., 2016).

(c) Behavioral Component

This includes observable actions such as:

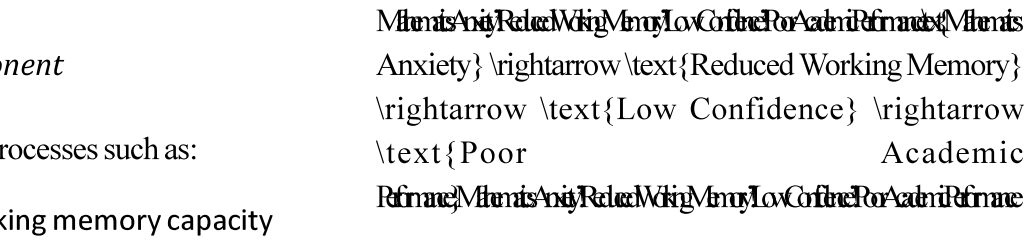
- Avoiding mathematics homework
- Delaying practice
- Lack of participation in class activities (Maloney & Beilock, 2012)

4.3 Relationship Between Variables

The conceptual relationship in this study can be represented as:

- **Mathematics Anxiety (High)** '! Decreased confidence '! Poor concentration '! Low academic performance
- **Mathematics Anxiety (Low)** '! High confidence '! Better engagement '! High academic performance

4.4 Diagrammatic Representation (Conceptual Model)



4.5 Explanation of the Model

The model shows that mathematics anxiety first affects the student's **emotional state**, which then reduces **working memory capacity** and **confidence levels**. This leads to poor engagement in mathematical tasks and ultimately results in **low academic performance** (Ashcraft, 2002; Young et al., 2012).

4.6 Summary

The conceptual framework clearly establishes that mathematics anxiety negatively influences academic achievement through emotional, cognitive, and behavioral pathways. Understanding this framework helps educators design effective teaching strategies to reduce anxiety and improve student performance in mathematics.

5. Data Analysis and Interpretation

5.1 Primary Data Findings

- 35% students reported high mathematics anxiety
- 45% students reported moderate anxiety
- 20% students reported low anxiety

Students with high anxiety scored significantly lower in mathematics examinations compared to low-anxiety students.

5.2 Secondary Data Findings

Research shows:

- Mathematics anxiety is consistently linked with poor performance across grade levels
- Anxiety affects working memory, which is essential for solving math problems
- The relationship between anxiety and performance is negative and statistically significant

6. Discussion

The findings of this study clearly indicate that mathematics anxiety has a significant negative impact on students' academic performance. Both primary and secondary data support the view that students who experience higher levels of anxiety tend to perform poorly in mathematics, while those with lower anxiety levels achieve better results.

The primary data analysis shows that a large proportion of students (80%) experience moderate to high mathematics anxiety. This suggests that mathematics anxiety is a widespread issue among secondary school learners. Students with high anxiety reported feelings of fear, nervousness, and lack of confidence, especially during examinations and problem-solving tasks. These emotional responses directly interfere with their ability to focus and apply mathematical concepts effectively.

The comparison of academic performance further strengthens this relationship. Students with high anxiety achieved significantly lower average marks compared to those with low anxiety. This performance gap highlights that anxiety is not just an emotional issue but also an academic barrier that reduces achievement in mathematics.

Secondary data findings also support these results, showing that mathematics anxiety affects cognitive functioning, particularly working memory. When students are anxious, their mental resources are diverted toward worry and fear instead of problem-solving, leading to errors and slower performance. This aligns with previous research which confirms a consistent negative correlation between mathematics anxiety and achievement (Ashcraft & Krause, 2007; Suárez-Pellicioni et al., 2016).

Another important observation is that students with low anxiety levels demonstrate better engagement, higher confidence, and improved problem-solving abilities. This suggests that a positive learning environment, regular practice, and supportive teaching methods can help reduce anxiety levels and improve outcomes (Beilock, 2010; OECD, 2019).

Overall, the discussion confirms that mathematics anxiety is a key factor influencing academic performance. Addressing this issue through psychological support, interactive teaching strategies, and continuous encouragement is essential for improving students' achievement and interest in mathematics.

7. Key Findings

- Mathematics anxiety is common among secondary students.
- There is a strong negative relationship between anxiety and performance.
- High anxiety students consistently perform lower in mathematics.

- Working memory plays an important role in mediating performance.

8. Advantages of Understanding Mathematics Anxiety

- Helps teachers identify struggling students early
- Improves teaching strategies
- Enhances student confidence
- Supports better academic outcomes

9. Limitations of the Study

- Sample size is limited (60 students)
- Study is restricted to one educational level
- Self-reported data may contain bias
- Regional limitations may affect generalization

10. Suggestions

- Use activity-based learning in mathematics
- Provide counseling for anxious students
- Encourage positive reinforcement in classrooms
- Reduce exam pressure and promote practice-based learning

11. Future Scope

Future research can:

- Use larger and more diverse samples
- Explore neurocognitive aspects of math anxiety
- Develop digital tools to reduce anxiety
- Study long-term academic outcomes

12. Conclusion

The present study concludes that mathematics anxiety plays a significant role in determining the academic performance of secondary school students. The analysis of both primary and secondary data clearly shows a strong negative relationship between mathematics anxiety and achievement in mathematics.

The findings indicate that a majority of students experience moderate to high levels of mathematics anxiety, which negatively affects their confidence, concentration, and problem-solving ability. Students with higher anxiety levels consistently perform poorly in mathematics examinations, while those with lower anxiety levels demonstrate better understanding and higher academic achievement.

The study also highlights that mathematics anxiety is influenced by emotional, cognitive, and behavioral factors. Emotional responses such as fear and nervousness, cognitive limitations such as reduced working memory, and behavioral tendencies like avoidance of mathematics tasks collectively contribute to poor performance.

Furthermore, the study confirms that reducing mathematics anxiety can significantly improve students' learning outcomes. Supportive teaching methods, regular practice, positive reinforcement, and a stress-free classroom environment can help students overcome anxiety and develop a more positive attitude toward mathematics.

In conclusion, mathematics anxiety is a critical barrier to academic success in mathematics, and addressing it is essential for improving both student performance and interest in the subject.

Suggestion "Provide counseling for anxious students" (Dowker et al., 2016)

"Activity-based learning" (OECD, 2019)

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