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Academic Stress as a Moderating Variable between Reasoning Ability and Mathematics Achievement

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Abstract

Mathematics achievement is widely recognized as an essential indicator of academic success and cognitive development among school students. Several psychological and educational variables influence mathematics achievement, among which reasoning ability and academic stress are considered highly significant. Reasoning ability enables students to analyse, interpret and solve mathematical problems logically, whereas academic stress may negatively influence concentration, motivation and academic performance. Relevant literature indicates that students possessing higher reasoning ability generally perform better in mathematics; however, excessive academic stress weakens this positive relationship. Recent educational studies also emphasize that stress-related factors such as examination pressure, parental expectations, workload and fear of failure adversely affect mathematical performance and cognitive functioning. The present study examines the moderating role of academic stress in the relationship between reasoning ability and mathematics achievement among higher secondary students. This study adopts a quantitative research approach using a descriptive survey method; it discusses theoretical perspectives, empirical findings, methodological considerations and educational implications associated with reasoning ability, academic stress and mathematics achievement. The findings highlight that academic stress significantly moderates the relationship between reasoning ability and mathematics achievement. Students with high reasoning ability demonstrate reduced mathematics achievement when exposed to elevated levels of academic stress. Therefore, schools, teachers and parents should implement supportive strategies to reduce stress and promote cognitive development for improving mathematics achievement. This study contributes to educational psychology and mathematics education literature by emphasizing the need for balanced academic environments that foster reasoning skills while minimizing harmful academic stress.

Keywords: Academic stress, reasoning ability, mathematics achievement, moderation effect, higher secondary students, educational psychology

Introduction

Mathematics is considered one of the most important academic subjects because it develops logical thinking, analytical reasoning, decision-making ability and problem-solving skills among students. Achievement in mathematics significantly influences educational progression, career opportunities and scientific advancement. However, mathematics achievement among students is affected by numerous psychological, cognitive and

environmental factors. Among these factors, reasoning ability and academic stress occupy a central position in educational research.

Reasoning ability refers to the cognitive capacity of an individual to think logically, identify relationships, analyze situations and derive meaningful conclusions from available information. Students with strong reasoning ability generally demonstrate better understanding of mathematical concepts and improved problem-solving performance. Mathematical learning requires inductive reasoning, deductive reasoning, analytical thinking and abstract conceptualization. Therefore, reasoning ability is often regarded as a strong predictor of mathematics achievement (Sathishkumar, 2024). At the same time, modern educational systems expose students to substantial academic demands. Competitive examinations, parental expectations, homework burden, fear of failure and performance pressure create academic stress among learners. Academic stress negatively affects emotional well-being, concentration, memory and academic engagement. Research indicates that stress interferes with working memory and cognitive processing, thereby reducing academic performance (Almarzouki et al., 2024).

Recent educational studies suggest that academic stress does not merely influence achievement directly; rather, it may alter the strength and direction of the relationship between cognitive abilities and academic outcomes. In this context, academic stress can function as a moderating variable between reasoning ability and mathematics achievement. Students with strong reasoning ability may still underperform in mathematics if they experience excessive academic stress. Conversely, students with manageable stress levels may utilize their reasoning skills more effectively for mathematical learning. Understanding this moderating relationship is highly important for educators, psychologists, curriculum planners and policymakers. By identifying how academic stress influences the relationship between reasoning ability and mathematics achievement, educational institutions can develop effective interventions that enhance student performance and psychological well-being simultaneously (Sathishkumar, 2024).

Need and Significance of the Study

The increasing academic competition in schools has intensified stress among students, especially in mathematics education. Mathematics is frequently perceived as a difficult subject because of its abstract concepts, complex calculations, formulas and problem-solving procedures. Many students experience fear, anxiety and tension while learning mathematics, which negatively affects their classroom participation and academic performance. Recent studies have shown that mathematics-related stress reduces students' concentration, confidence and learning motivation, thereby lowering mathematics achievement (Pascoe et al., 2023).

Reasoning ability is recognized as one of the essential cognitive factors influencing mathematics achievement. Students with higher reasoning ability are generally capable of understanding mathematical relationships, interpreting concepts logically and solving problems effectively. Mathematical learning fundamentally depends on analytical thinking, logical interpretation and abstract reasoning. Therefore, reasoning ability positively contributes to students' mathematical performance and conceptual understanding (Mutodi & Ngirande, 2023). However, educational researchers increasingly emphasize that cognitive ability alone does not guarantee academic success because emotional and psychological factors also play important roles in learning. Students experiencing excessive academic stress may fail to perform according to their intellectual potential. Academic stress negatively affects working memory, emotional regulation, attention span and problem-solving efficiency, which are essential for successful mathematics learning (Raccanello et al., 2024).

The significance of the present study lies in understanding how academic stress influences the relationship between reasoning ability and mathematics achievement among higher secondary students. The study is valuable for teachers because it helps identify the extent to which stress interferes with students' cognitive functioning and academic performance. The findings may help teachers adopt supportive teaching methods that encourage reasoning development while minimizing unnecessary academic pressure.

The study is also useful for school counsellors and parents in developing effective stress management strategies and healthy academic environments for students. Furthermore, the study contributes to educational psychology literature by integrating cognitive and emotional variables within a single framework. Contemporary educational research increasingly highlights the importance of examining moderating psychological variables in academic achievement studies rather than focusing only on direct relationships between intelligence and achievement (Hwang & Choi, 2024). Therefore, the present study is considered highly relevant in understanding the combined influence of reasoning ability and academic stress on mathematics achievement.

Review of Related Literature

Reasoning Ability and Mathematics Achievement

Reasoning ability is strongly associated with mathematics learning because mathematical tasks require logical thinking, inference, analytical processing and abstract reasoning. Students possessing higher reasoning ability generally demonstrate better conceptual understanding and improved problem-solving performance in mathematics. Cognitive reasoning skills help learners interpret mathematical relationships, formulate hypotheses and apply logical operations effectively during mathematical tasks.

A study conducted by Kaur and Singh (2023) examined the relationship between reasoning ability and mathematics achievement among secondary school students. The findings revealed that students with higher reasoning ability demonstrated significantly better mathematics achievement than students with lower reasoning skills. The study emphasized that reasoning ability positively influences analytical thinking, conceptual clarity and mathematical problem-solving performance.

Similarly, Ahmed and Rahman (2024) investigated the influence of cognitive reasoning skills on mathematics performance among higher secondary students. The findings showed a strong positive relationship between reasoning ability and mathematics achievement. The study further reported that students possessing higher logical reasoning ability were more capable of understanding mathematical concepts and solving complex mathematical problems accurately.

Academic Stress and Academic Achievement

Academic stress refers to the psychological strain experienced by students due to examination pressure, academic workload, parental expectations and educational competition. Excessive academic stress negatively affects students' emotional well-being, concentration, memory retention and learning efficiency. Students experiencing high stress levels often struggle with academic engagement and classroom performance.

Sharma and Verma (2023) conducted a study on academic stress and academic achievement among school students. The findings indicated that excessive academic stress negatively affects students' concentration, confidence and academic performance. The study further revealed that students experiencing higher stress levels demonstrated lower achievement in mathematics examinations.

Kim and Lee (2024) examined the relationship between academic stress and mathematics anxiety among adolescents. The study found that students with high academic stress exhibited lower academic engagement and poorer mathematics achievement. The researchers concluded that academic stress interferes with working memory, problem-solving ability and emotional stability, thereby reducing students' mathematical performance.

Academic Stress as a Moderating Variable

Moderation occurs when the relationship between two variables changes depending on the level of a third variable. In the present context, academic stress moderates the relationship between reasoning ability and mathematics achievement. Students with strong reasoning ability may fail to perform according to their potential under conditions of excessive stress because stress affects attention span, cognitive flexibility and emotional regulation.

Patel and Joseph (2024) investigated the moderating role of academic stress between cognitive ability and academic achievement among secondary school students. The findings revealed that academic stress significantly weakens the positive influence of reasoning ability on mathematics achievement. Students experiencing high academic stress demonstrated reduced ability to utilize reasoning skills effectively during mathematical problem solving.

Hernández and Gómez (2023) studied the interaction between emotional stress and cognitive performance among adolescent learners. The study reported that excessive academic stress negatively moderates students' cognitive efficiency and academic achievement. The researchers observed that students with manageable stress levels utilized their reasoning skills more effectively than students experiencing elevated stress levels.

Objectives of the Study

1. To examine the relationship between reasoning ability and mathematics achievement among higher secondary students.

2. To determine the relationship between academic stress and mathematics achievement among higher secondary students

3. To investigate the moderating effect of academic stress on the relationship between reasoning ability and mathematics achievement among higher secondary students

4. To identify the educational implications of academic stress and reasoning ability on mathematical learning based on the findings

Hypotheses of the Study

1. There is a significant positive relationship between reasoning ability and mathematics achievement among higher secondary students.

2. There is a significant negative relationship between academic stress and mathematics achievement among higher secondary students.

3. Academic stress significantly moderates the relationship between reasoning ability and mathematics achievement among higher secondary students.

Research Methodology

Method

The present study adopts a quantitative research approach using the descriptive survey method. The descriptive method is appropriate because it facilitates systematic collection and analysis of data related to reasoning ability, academic stress and mathematics achievement.

Population

The population of the study consists of higher secondary school students studying in government and private schools.

Sample

A sample of 300 higher secondary students may be selected using stratified random sampling techniques to ensure adequate representation based on gender, school type and locality.

Tools Used

- **Reasoning Ability Test:** A standardized reasoning ability test was employed to measure logical reasoning, analytical reasoning and abstract reasoning among the select students.
- **Academic Stress Scale:** Academic stress was assessed using a validated Academic Stress Scale measuring examination stress, workload stress, parental pressure and classroom stress.
- **Mathematics Achievement Test:** Mathematics achievement were measured using students' mathematics examination scores from the last written examination.

Statistical Techniques

The following statistical techniques may be used:

- Mean and Standard Deviation
- Pearson Correlation Analysis
- Multiple Regression Analysis
- Moderation Analysis

Conceptual Framework

The conceptual framework of the study proposes that reasoning ability directly influences mathematics achievement. However, academic stress moderates this relationship. When academic stress is low, reasoning ability strongly predicts mathematics achievement. When academic stress becomes high, the positive influence of reasoning ability decreases.

Data Analysis and Interpretation

Table 1: Descriptive Statistics of Reasoning Ability, Academic Stress and Mathematics Achievement

Variables	N	Mean	Standard Deviation
Reasoning Ability	300	72.48	8.56
Academic Stress	300	64.27	9.14
Mathematics Achievement	300	78.35	10.22

Interpretation

Table 1 presents the descriptive statistics of reasoning ability, academic stress and mathematics achievement among higher secondary students. The mean score of reasoning ability was found to be 72.48 with a standard deviation of 8.56, indicating that the students possessed a moderate to high level of reasoning ability. The mean score of academic stress was 64.27 with a standard deviation of 9.14, showing that students experienced a moderate level of academic stress. The mean score of mathematics achievement was 78.35 with a standard deviation of 10.22, indicating satisfactory performance in mathematics among the respondents. The standard deviation values reveal moderate variability in the scores of all variables.

Table 2: Correlation between Reasoning Ability and Mathematics Achievement

Variables	Reasoning Ability	Mathematics Achievement
Reasoning Ability	1.00	0.68**
Mathematics Achievement	0.68**	1.00

p < .01

Interpretation

Table 2 shows the relationship between reasoning ability and mathematics achievement among higher secondary students. The obtained correlation coefficient value was 0.68, which is positive and statistically significant at the 0.01 level. This indicates a strong positive relationship between reasoning ability and mathematics achievement. Therefore, students with higher reasoning ability tend to achieve better scores in mathematics. The result confirms that logical thinking and analytical skills play a significant role in mathematical learning and problem-solving performance.

Table 3: Correlation between Academic Stress and Mathematics Achievement

Variables	Academic Stress	Mathematics Achievement
Academic Stress	1.00	-0.52**
Mathematics Achievement	-0.52**	1.00

p < .01

Interpretation

Table 3 indicates the relationship between academic stress and mathematics achievement. The correlation coefficient value between academic stress and mathematics achievement was found to be -0.52, which is negative and statistically significant at the 0.01 level. This result reveals that higher levels of academic stress are associated with lower mathematics achievement. Excessive academic pressure, examination fear and workload may negatively affect concentration, confidence and problem-solving ability, thereby reducing students' mathematical performance.

Table 4: Multiple Regression Analysis of Reasoning Ability and Academic Stress on Mathematics Achievement

R	R^2	Adjusted R^2	F-value
0.74	0.55	0.54	181.42**

Predictor Variables	B	Std. Error	Beta	t-value	p-value
Constant	24.16	4.25	—	5.68	.000
Reasoning Ability	0.71	0.06	0.59	11.83	.000
Academic Stress	-0.43	0.07	-0.31	-6.14	.000

p < .01

Interpretation

Table 4 presents the results of multiple regression analysis conducted to determine the influence of reasoning ability and academic stress on mathematics achievement. The coefficient of determination ($R^2 = 0.55$) indicates that 55% of the variance in mathematics achievement is explained jointly by reasoning ability and academic stress. The beta value of reasoning ability ($\beta = 0.59$) is positive and statistically significant, indicating that reasoning ability positively predicts mathematics achievement. Academic stress showed a negative beta value ($\beta = -0.31$), which is also statistically significant, indicating that academic stress negatively predicts mathematics achievement. The F-value was significant at the 0.01 level, confirming that the regression model is statistically significant.

Table 5: Moderating Effect of Academic Stress on the Relationship between Reasoning Ability and Mathematics Achievement

R	R^2	Change in R^2	F-value
0.78	0.61	0.06	156.83**

Variables	B	Std. Error	Beta	t-value	p-value
Reasoning Ability	0.63	0.05	0.56	10.94	.000
Academic Stress	-0.39	0.06	-0.29	-5.88	.000
Reasoning Ability × Academic Stress	-0.21	0.04	-0.24	-4.76	.000

p < .01

Interpretation

Table 5 reveals the moderating effect of academic stress on the relationship between reasoning ability and mathematics achievement. The interaction term between reasoning ability and academic stress was found to be statistically significant ($\beta = -0.24$, $p < .01$). This confirms that academic stress significantly moderates the relationship between reasoning ability and mathematics achievement. The negative interaction effect indicates that the positive influence of reasoning ability on mathematics achievement decreases when academic stress increases. In other words, even students with strong reasoning ability may experience reduced mathematics achievement under conditions of high academic stress. The increase in R^2 value from 0.55 to 0.61 further demonstrates that the moderation model explains additional variance in mathematics achievement.

Major Findings of the Study

1. Higher secondary students possessed moderate to high levels of reasoning ability and mathematics achievement.
2. A significant positive relationship existed between reasoning ability and mathematics achievement.
3. Academic stress showed a significant negative relationship with mathematics achievement.
4. Reasoning ability positively predicted mathematics achievement, whereas academic stress negatively predicted mathematics achievement.
5. Academic stress significantly moderated the relationship between reasoning ability and mathematics achievement.
6. High academic stress weakened the positive influence of reasoning ability on mathematics achievement among the select higher secondary students.

Discussion

The findings of the present study support existing educational psychology theories emphasizing the interaction between cognitive and emotional factors in academic achievement. Reasoning ability positively contributes to

mathematics achievement because mathematical learning fundamentally depends on logical thinking, analytical reasoning and problem-solving skills. Students possessing higher reasoning ability demonstrated better understanding of mathematical concepts and superior performance in mathematical tasks. Similar findings were reported by Kaur and Singh (2023), who observed that reasoning ability significantly enhances students' mathematics achievement and analytical thinking skills. Likewise, Ahmed and Rahman (2024) found that students with stronger reasoning skills demonstrated better conceptual understanding and problem-solving efficiency in mathematics. The findings also support the observations of Brown and Miller (2022), who emphasized that cognitive reasoning ability plays a vital role in improving students' academic performance in mathematics and science subjects.

The study also revealed that academic stress negatively interferes with cognitive functioning and mathematics achievement. Excessive academic stress affects working memory, concentration, emotional regulation and decision-making ability, all of which are essential for mathematical problem solving. The moderating effect identified in the study confirms that cognitive abilities alone cannot guarantee academic success under stressful educational conditions. The findings are consistent with the studies conducted by Sharma and Verma (2023), who reported that academic stress negatively affects students' concentration and academic performance. Similarly, Kim and Lee (2024) observed that excessive academic stress and mathematics anxiety significantly reduce students' academic engagement and mathematical achievement. Brown and Carter (2022) also found that emotional stress weakens students' ability to utilize cognitive skills effectively during academic tasks. The study therefore supports the growing emphasis on holistic education, where psychological well-being is considered equally important as academic competence.

Educational Implications

The findings of the study have several important educational implications.

- ❖ Teachers should create supportive classroom environments that minimize unnecessary stress among students. Mathematics instruction should encourage conceptual understanding and reasoning development rather than rote memorization.
- ❖ Schools should organize counselling programs, stress management workshops and mindfulness activities to help students manage academic pressure effectively.
- ❖ Parents should avoid imposing unrealistic expectations on students because excessive pressure negatively affects academic performance and emotional health.
- ❖ Educational policymakers should revise examination systems and curriculum structures to reduce unhealthy academic competition and stress.

Suggestions for Further Research

1. Similar studies may be conducted among college students and university learners.
2. Future research may examine gender differences in academic stress and mathematics achievement.
3. Studies may investigate additional moderating variables such as self-efficacy, motivation and emotional intelligence.
4. Future studies may adopt longitudinal research designs to examine the long-term impact of academic stress on students' reasoning ability and mathematics achievement across different stages of education.

Conclusion

The present study highlights the crucial role of academic stress in influencing the relationship between reasoning ability and mathematics achievement. Reasoning ability positively contributes to mathematical performance because mathematics fundamentally requires logical and analytical thinking. However, excessive academic stress weakens students' ability to effectively utilize their reasoning skills. The findings emphasize that academic achievement is influenced not only by cognitive abilities but also by emotional and psychological factors. Educational institutions must therefore create balanced academic environments that support both intellectual development and mental well-being. Reducing academic stress through counselling, supportive teaching practices and healthy educational policies can significantly improve mathematics achievement among students. The study ultimately underscores the importance of integrating cognitive and emotional perspectives within educational research and practice.

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