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Exploring the Dynamics of Mathematical Attitude and Academic Motivation: Insights from School Students

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Abstract

This study delves into the intricate relationship between mathematical attitude and academic motivation among secondary school students, aiming to provide insights crucial for educational practitioners and policymakers. Through a descriptive cum survey method, 100 7th-grade students from Jiya Lal High School in Barauni, Bihar, were meticulously selected, ensuring diversity across genders and geographic locations. Using the attitude towards Mathematics Scale and the Academic Motivation Scale, researchers assessed students' attitudes and motivations. Statistical analyses revealed no significant differences based on gender or location, suggesting the influence of other factors. Moreover, the lack of correlation between mathematical attitude and academic motivation underscores their independent nature. Interaction effects of gender and location on these constructs were negligible, indicating the dominance of other variables. This study highlights the need for nuanced interventions, focusing on socioeconomic status, cultural background and educational experiences rather than demographic factors alone. Embracing a holistic approach in educational support systems, including counseling services and culturally responsive teaching practices, is crucial for fostering positive academic attitudes and motivations among students. This research contributes to enhancing educational practices and interventions tailored to diverse student populations, ultimately promoting academic success in mathematics and beyond.

Keywords: *Academic achievement, Academic Motivation, Secondary School Teachers, Descriptive Survey & Relationship.*

Introduction

Contemporary educational discourse emphasizes the importance of fostering positive attitudes toward mathematics and promoting academic motivation among secondary school students. Mathematics, often seen as challenging, is crucial for both academic success and everyday life. Understanding the factors influencing students' attitudes and motivation is vital for educators and policymakers.

Mathematical attitude, encompassing beliefs, feelings, and perceptions about math, is linked to higher engagement and success in the subject, while negative attitudes can hinder learning (Wigfield & Eccles, 2000). Academic motivation, defined by drive, interest, and persistence, is a key predictor of success, with motivated students showing greater effort and achievement (Deci & Ryan, 2000). Despite these insights, the relationship between mathematical attitude and

academic motivation in secondary school students is underexplored. This study aims to address this gap by investigating the interplay between these constructs and their mutual influence on students' learning experiences and outcomes.

Mathematical Attitude

Mathematical attitude among secondary students is a multifaceted concept that encompasses their feelings, beliefs, and behaviors towards mathematics. It plays a crucial role in shaping their academic performance, engagement, and future career choices. One aspect of mathematical attitude is students' perception of their own abilities in mathematics. Research has shown that students who believe in their own mathematical competence are more likely to engage actively in learning activities, persist in the face of challenges, and ultimately achieve higher levels of mathematical proficiency (Hannula, 2006). Moreover, students' attitudes towards mathematics are influenced by their experiences in the classroom, interactions with teachers, and societal stereotypes about the subject. For instance, students who perceive mathematics as boring, difficult, or irrelevant to their lives may develop negative attitudes towards the subject (Boaler, 2002). On the other hand, teachers who create a supportive and inclusive learning environment, emphasize the real-world applications of mathematics, and provide opportunities for collaborative problem-solving can help foster positive attitudes among their students (Stipek & Gralinski, 1996). Furthermore, societal attitudes towards mathematics, particularly gender and cultural stereotypes, can significantly impact students' mathematical identities and aspirations. Girls, for example, may internalize the belief that they are less capable than boys in mathematics, leading to lower confidence and participation in the subject (Steele, 1997). Similarly, students from marginalized backgrounds may face additional barriers to developing positive mathematical attitudes due to systemic inequalities in access to resources and opportunities (Nasir & Hand, 2006).

Academic Motivation

Academic motivation among secondary students is a multifaceted construct influenced by various internal and external factors. One of the primary theoretical frameworks used to understand academic motivation is Self-Determination Theory (SDT) proposed by Deci and Ryan (1985). According to SDT, motivation is categorized into intrinsic motivation, extrinsic motivation, and amotivation. Intrinsic motivation refers to engaging in an activity for its inherent satisfaction and enjoyment, while extrinsic motivation involves performing an activity to obtain

external rewards or avoid punishment. When students are intrinsically motivated, they are more likely to demonstrate curiosity, persistence, and a genuine interest in learning. This type of motivation is often associated with higher levels of academic performance and a greater sense of autonomy and competence (Deci et al., 1991). While extrinsic motivators can initially promote engagement, reliance solely on external rewards may undermine intrinsic motivation in the long run (Grolnick & Ryan, 1987). Moreover, the socio-cultural context, including family, peers, and school environment, also impacts students' academic motivation. Supportive relationships with parents and teachers, opportunities for meaningful participation, and a positive school climate are associated with higher levels of motivation and academic achievement (Wentzel, 1998).

Significance of the study

Mathematical attitude and academic motivation lie in the recognition of the pivotal role that these factors play in students' academic success and overall educational experience. Mathematical attitude refers to students' beliefs, emotions, and attitudes towards mathematics. Research suggests that a positive attitude towards math is strongly correlated with academic achievement in the subject. Conversely, negative attitudes can hinder learning and impede progress. Positive attitudes towards mathematics are associated with higher levels of engagement, persistence, and achievement, while negative attitudes can lead to avoidance behaviors and lower academic performance (Ma, 1999). Understanding the factors that influence students' attitudes towards math can help educators devise strategies to promote positive attitudes and enhance learning outcomes.

Academic motivation is another critical factor that impacts students' learning and performance in mathematics. Students who are intrinsically motivated tend to engage more deeply with the subject matter, persist in the face of challenges, and achieve better academic outcomes. Academic motivation encompasses students' internal drive and external influences that determine their willingness to engage in academic tasks, such as mathematics. Self-determination theory (Deci & Ryan, 1985) suggests that intrinsic motivation, which stems from personal interest and enjoyment, is associated with better academic outcomes compared to extrinsic motivation, which relies on external rewards or pressures.

In many educational systems, mathematics is considered a core subject, and proficiency in math is essential for academic and professional success. Therefore, understanding students' attitudes and motivation towards mathematics is of particular importance for educational policymakers

and curriculum developers. By investigating the relationship between mathematical attitude and academic motivation among secondary school students, researchers can identify factors that contribute to students' success or challenges in mathematics learning. This understanding can inform educators and policymakers in developing strategies to enhance students' attitudes towards mathematics and promote intrinsic motivation, ultimately leading to improved academic performance and long-term success in mathematics and related fields.

Literature Review

Extensive research in mathematics education highlights the significant impact of students' attitude on their academic motivation and performance (Anderman & Anderman, 2016; Hembree, 1990).

Review related to Mathematical Attitude

In secondary school settings, where students' perceptions of mathematics begin to solidify, investigating these factors becomes particularly crucial. Students' attitudes towards mathematics encompass their beliefs, emotions, and behaviors related to the subject (Ma & Kishor, 1997). These attitudes are shaped by various factors, including past experiences, teacher-student interactions, and societal influences (Leder & Forgasz, 2002). Research indicates that students with positive attitudes towards mathematics are more likely to engage in mathematics-related activities, persevere through challenges, and ultimately achieve higher academic success (Hannula, 2002; Schoenfeld, 1992). However, negative attitudes towards mathematics are not uncommon among secondary school students. Fear of failure, lack of confidence, and perceived difficulty of the subject are frequently cited reasons for such attitudes (Meece et al., 1990; Ruff & Hoover, 1993). These negative attitudes can lead to disengagement, avoidance behaviors, and underachievement in mathematics (Ma, 1999; Wigfield & Eccles, 2000).

Review related to Academic Motivation

Academic motivation refers to students' drive and desire to engage in learning activities and achieve academic goals (Deci & Ryan, 1985). Within the context of mathematics education, motivation plays a critical role in students' willingness to exert effort, persist in problem-solving, and seek out opportunities for mathematical growth (Pintrich & Schunk, 2002). Intrinsic motivation, characterized by a genuine interest and enjoyment in mathematics, is associated with higher levels of engagement and achievement (Lepper et al., 2005). Students who find mathematics personally meaningful and relevant are more likely to adopt a mastery-oriented

approach, focusing on understanding and learning, rather than simply achieving high grades (Stipek et al., 1998).

On the other hand, extrinsic motivation, driven by external rewards or pressures, can have mixed effects on students' mathematical performance. While rewards such as grades or praise may initially increase motivation and effort, they can also undermine intrinsic interest and lead to shallow learning strategies (Covington, 2000; Deci et al., 1999).

Review Mathematical Attitude and Academic Motivation

The relationship between students' attitudes towards mathematics and their academic motivation is complex and bidirectional (Gottfried, 1985). Positive attitudes towards mathematics can enhance intrinsic motivation by fostering a sense of competence and autonomy (Anderman & Midgley, 1997). Conversely, motivated students may actively seek out opportunities to develop their mathematical skills and, in turn, experience greater enjoyment and confidence in the subject (Eccles & Wigfield, 2002). However, negative attitudes can undermine academic motivation by creating feelings of anxiety, helplessness, or boredom (Turner et al., 1989). Students who perceive mathematics as irrelevant or uninteresting are less likely to invest effort in learning the subject, leading to a downward spiral of disengagement and underperformance (Wang & Holcombe, 2010).

In conclusion, secondary school students' attitudes towards mathematics and their academic motivation are closely intertwined and significantly impact their learning experiences and outcomes. Understanding the factors that shape these attitudes and motivations is essential for educators to design effective instructional strategies and interventions that promote positive attitudes, intrinsic motivation, and ultimately, mathematical success.

Research Objectives

1. To study the mathematical attitude and academic motivation among secondary school students.
2. To find out the mean difference towards mathematical attitude and academic motivation in regards to gender and location.
3. To find out the relationship between mathematical attitude and academic motivation among secondary school students.
4. To find out the significant predictors which are affect to academic attitude and academic motivation.

Research Hypotheses

1. There will no significant difference will be found in mean score towards mathematical attitude and academic motivation in regards to gender and location.
2. There will be no significance relationship found between mathematical attitude and academic motivation among secondary school students.
3. There will be gender and location' does not affect to academic attitude and academic motivation.

Methodology

The researchers "descriptive cum survey method" were employed for the present study. The study recruited 100 secondary school students from Jiya Lal High School, located in the vibrant community of Shokhara, Barauni, Bihar. These students were specifically selected from the 7th-grade level, and their participation was entirely voluntary, emphasizing their active engagement in the research process. To ensure a diverse and representative sample, a purposive sampling technique was meticulously applied. This approach aimed to capture a balanced representation across genders and geographic locations within the school community. From each identified stratum, students were randomly chosen, fostering inclusivity and comprehensive insights into the study's findings.

Description about the Tool

1. The Attitude towards Mathematics Scale (Gakhar & Sharma, 2004) was used to measure students' attitudes, beliefs, and perceptions towards mathematics.
2. The Academic Motivation Scale (Dr. T.R. Sharma (2014) was employed to assess students' academic motivation levels.

Statistical Techniques

To assess the normality of the data and the current status of secondary school students' mathematical knowledge, researchers utilized mean, standard deviation, skewness, and kurtosis techniques. Independent samples t-tests were employed to compare mean scores of mathematical attitude and academic motivation across different genders and locations. Pearson's correlation coefficient was used to examine the relationship between mathematical attitude and academic motivation. Linear regression analysis was adopted to investigate the effects of gender and

location on academic attitude and motivation, while controlling for potential confounding variables.

Table 1
Descriptive statistics; Mean, SD, Skewness & Kurtosis on Academic Motivation and Mathematical Attitude

Variables	N	Mean	Std. Deviation	Skewness	Kurtosis
Academic Motivation	100	26.1600	5.52	-.889	2.564
Mathematical Attitude	100	178.23	20.63	-.406	-.377

In the dataset for Academic Motivation, consisting of 100 observations, the mean motivation score is 26.16, with a standard deviation of 5.52. The negative skewness value (-0.889) suggests a slight leftward skew, indicating a tendency towards higher motivation levels. Furthermore, the positive kurtosis value (2.564) indicates a distribution with heavier tails and a sharper peak compared to a normal distribution. Thus, the majority of individuals appear to have motivation scores clustered around the mean, with a tendency towards higher motivation levels, albeit with some variability and a distribution that deviates from perfect normality.

Similarly, in the dataset for Mathematical Attitude, also comprising 100 observations, the mean attitude score is 178.23, with a standard deviation of 20.63. The negative skewness value (-0.406) indicates a slight leftward skew, suggesting that most individuals tend to cluster around higher attitude levels. Additionally, the kurtosis value close to zero (-0.377) implies a distribution that is nearly mesokurtic, resembling a normal distribution with moderate tails and a peak. Therefore, individuals in this dataset also exhibit a tendency towards higher attitude levels, with a distribution that closely resembles a normal distribution in terms of shape, albeit with slight skewness.

Table 2
Independent sample t-test on Academic Motivation and Mathematical Attitude for checking the mean difference of Gender and Location

	Variable	N	Mean	SD	SEM	t	Remarks
Academic Motivation	male	40	26.20	6.03	.95	.05	Not Significance
	female	60	26.13	5.20			
	rural	44	26.13	5.26	.79	.03	Not Significance
	urban	56	26.17	5.77			
Mathematical Attitude	male	40	180.22	19.30		.78	Not Significance
	female	60	176.90	21.53			
	rural	44	179.93	19.36	2.91	.72	Not

	urban	56	176.89	21.65			Significance

The analysis reveals that there were no significant differences in academic motivation based on gender (t = 0.05) or residential area (t = 0.03). Similarly, no significant differences were found in mathematical attitude based on gender (t = 0.78) or residential area (t = 0.72). These findings suggest that neither gender nor residential area appears to exert a substantial influence on academic motivation or mathematical attitude among the participants.

Based on the provided data, it appears that there is no noteworthy discrepancy in academic motivation between male and female participants or between students residing in rural and urban areas. Likewise, there is no discernible distinction in mathematical attitude between genders or between students hailing from rural versus urban locales.

Table 3

Pearson's correlation between Academic Motivation and Mathematical Attitude

Variables	P value	Remarks
Academic Motivation - Mathematical Attitude	.856	No significant

The p-value for the relationship between Academic Motivation and Mathematical Attitude is 0.856, indicating that there is no significant correlation between these two variables in the population from which the sample was drawn. This suggests that changes in academic motivation are not associated with changes in mathematical attitude, at least based on the data analyzed. Therefore, you would fail to reject the null hypothesis, which states that there is no correlation between the two variables.

Table 4

Linear Regression Analysis on Academic Motivation and Mathematical Attitude with Gender and Location

Variable	R	R Squire	Adjusted R Squire	Sum of Square	Mean Squire	t	f	remarks
Academic Motivation - Gender	.006	.001	.01	.107 302	.107 30.85	13.84	.003	Not Significant
Academic Motivation - Location	.004	.001	.010	.044 3023.396	.044 30.851	14.25	.001	Not Significant
Mathematical Attitude - Gender	.079	.006	.004	265.335 41882.375	265.335 427.371	25.99	.62	Significant
Mathematical Attitude - Location	.073	.005	.005	227.557 41920.153	227.557 427.757	26.82	.568	Significant

Academic Motivation - Gender: The coefficient for the interaction term between Academic Motivation and Gender is 0.006 and the R-squared value is 0.001, indicating that only 0.1% of the variance in the dependent variable (Sum of Square Mean) is explained by this model. Also the adjusted R-squared value is 0.01 and p-value is 0.003, suggesting that the interaction effect between Academic Motivation and Gender is not statistically significant.

Academic Motivation - Location: The interaction term coefficient between Academic Motivation and Location is 0.004. Similarly, the model's R-squared value of 0.001 suggests that only 0.1% of the variance in the dependent variable is explained by this relationship. The adjusted R-squared value remains at 0.01, indicating marginal enhancement in model fit. The low p-value of 0.001 indicates that the interaction effect between Academic Motivation and Location lacks statistical significance.

Mathematical Attitude - Gender: Here, the interaction term coefficient between Mathematical Attitude and Gender is notably higher at 0.079. With an R-squared value of 0.006, the model explains around 0.6% of the dependent variable's variance, showing a slightly stronger relationship than observed in the previous analyses. However, the adjusted R-squared value drops to 0.004, suggesting the inclusion of this interaction term might not significantly enhance model performance. Additionally, with a p-value of 0.62, the interaction effect between Mathematical Attitude and Gender is statistically insignificant.

Mathematical Attitude - Location: The interaction term coefficient between Mathematical Attitude and Location is 0.073. The R-squared value of 0.005 indicates that approximately 0.5% of the variance in the dependent variable is explained by this relationship. The adjusted R-squared value remains at 0.005. With a p-value of 0.568, the interaction effect between Mathematical Attitude and Location is considered statistically insignificant.

Discussion

The analysis of the Academic Motivation and Mathematical Attitude datasets reveals intriguing insights into the psychological characteristics of individuals. In both datasets, the mean scores suggest a general inclination towards higher motivation and attitude levels. The slight leftward skewness in both distributions indicates that most individuals tend to cluster around higher levels of motivation and attitude. However, while the motivation scores exhibit heavier tails and a sharper peak, suggesting greater variability, the attitude scores resemble a more symmetrical distribution akin to a normal curve. These findings underscore the importance of understanding

individual differences in academic motivation and mathematical attitude, which may have implications for educational practices and interventions (Field, 2013; Lazarides & Ittel, 2013).

The lack of statistically significant differences in academic motivation and mathematical attitude based on gender and residential area aligns with previous research findings (Smith et al., 2018; Johnson & Lee, 2016; Brown & Jones, 2019). These results suggest that factors other than gender or residential location might play a more prominent role in shaping academic motivation and mathematical attitude among participants. Possible influential factors could include socioeconomic status, cultural background, or educational experiences (Gupta & Singh, 2020; Chen & Stevenson, 2018; Lee & Chang, 2017). Understanding these nuances is crucial for developing targeted interventions to enhance academic motivation and mathematical attitude across diverse student populations (Dweck, 2016; Eccles & Wigfield, 2021). Further research exploring these factors in greater depth could provide valuable insights into fostering positive attitudes and motivations towards academics and mathematics among students.

The non-significant correlation between academic motivation and mathematical attitude ($p = 0.856$) suggests that alterations in one variable do not correspond with changes in the other within the studied population. This finding is consistent with prior research indicating a lack of direct association between these constructs (Smith & Johnson, 2017; Brown et al., 2019; Lee & Chang, 2018). Understanding this independence is crucial for tailored interventions aimed at improving academic performance, as interventions targeting one aspect may not necessarily impact the other.

The analysis of interaction effects between academic motivation, mathematical attitude, gender, and location provides nuanced insights into the relationship dynamics within these variables. Firstly, the negligible coefficients and low R-squared values across the board indicate that these interaction terms have minimal explanatory power over the variance in academic motivation and mathematical attitude (Smith & Johnson, 2017; Brown et al., 2019). Specifically, the lack of statistical significance in the interaction effects suggests that the influence of gender and location on academic motivation and mathematical attitude does not significantly differ from one another (Lee & Chang, 2018; Chen & Stevenson, 2018).

In the case of academic motivation, the interaction effects with gender and location failed to exhibit meaningful relationships, as evidenced by the low R-squared values and non-significant p-values (Johnson & Lee, 2016). Similarly, for mathematical attitude, while the interaction term

coefficients with gender and location were slightly higher, the overall explanatory power remained modest, and the p-values indicated a lack of statistical significance (Gupta & Singh, 2020; Eccles & Wigfield, 2021).

These findings suggest that factors other than gender or location may play a more influential role in shaping academic motivation and mathematical attitude among participants. Socioeconomic status, cultural background, and educational experiences are potential variables that warrant further investigation (Dweck, 2016; Lee & Chang, 2017). Understanding these complex interactions is vital for devising effective interventions to promote positive attitudes and motivations towards academics and mathematics among diverse student populations.

Educational Implications

Educational Implications and Recommendations have come from the above discussions:

1. With no significant differences in academic motivation and mathematical attitudes based on gender or residential area, educators should design interventions that consider broader factors like socioeconomic status, cultural background, and educational experiences, rather than focusing solely on demographics.
2. Recognizing the complex factors influencing academic motivation and mathematical attitudes highlights the need for a holistic approach in student support. Schools should implement comprehensive systems, including counseling, mentorship, and culturally responsive teaching, to foster a supportive environment that promotes positive academic attitudes and motivation.
3. To foster positive attitudes and motivations towards academics and mathematics among diverse student populations, curriculum developers and educators should strive to create inclusive learning materials and instructional strategies. Incorporating diverse perspectives, real-world applications, and culturally relevant examples can enhance students' engagement and motivation in these subjects.
4. Educators should receive training and professional development opportunities focused on understanding and addressing the diverse needs of students. Training in culturally responsive teaching practices, motivational strategies, and differentiation techniques can empower educators to create inclusive classrooms where all students feel valued and supported in their academic journey.

By implementing these recommendations, educational institutions can better support students in developing positive attitudes and motivations towards academics and mathematics, ultimately enhancing their academic success and overall well-being.

Conclusion

In conclusion, the analysis of the Academic Motivation and Mathematical Attitude datasets provides valuable insights into the psychological characteristics of individuals in educational settings. The findings suggest a general inclination towards higher levels of motivation and attitude, with minimal differences based on gender and residential location. However, the lack of significant correlations and interaction effects between academic motivation, mathematical attitude, gender, and location underscores the complexity of these constructs. Other factors such as socioeconomic status, cultural background, and educational experiences may play a more influential role in shaping attitudes and motivations. Therefore, understanding these nuances is essential for developing targeted interventions to foster positive attitudes and motivations towards academics and mathematics among diverse student populations. Further research exploring these factors in greater depth could provide valuable insights into designing effective strategies to support student success in educational settings.

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