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

Kislay Kishor Mirgank[1*], Satish Kumar Kalhotra[2]
Rajiv Gandhi University, India[1]
Rajiv Gandhi University, India[2]
Corresponding Email: kislay.mirgank@rgu.ac.in*

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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. Researchers assessed students' attitudes and motivations using the Attitudes Towards Mathematics and Academic Motivation Scales. 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 counselling services and culturally responsive teaching practices, is crucial for fostering positive academic attitudes and motivations among students. This research enhances 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

In contemporary educational discourse, fostering positive attitudes towards mathematics and promoting academic motivation among secondary school students has garnered significant attention. Mathematics, often perceived as a challenging subject by many students, plays a crucial role in academic achievement and various aspects of everyday life. Thus, it is imperative for educators and policymakers to understand the factors influencing

students' attitudes towards mathematics and their motivation to excel academically. In the realm of secondary education, understanding the factors that influence students' academic performance and engagement is of paramount importance. One such area of interest is the relationship between mathematical attitude and academic motivation among secondary school students. Mathematical attitude refers to individuals' beliefs, feelings, and perceptions towards mathematics, while academic motivation encompasses the drive, interest, and persistence in academic tasks and achievements. Exploring how these two constructs interact can provide valuable insights into students' learning experiences and outcomes.

Positive attitudes towards mathematics have been associated with higher engagement, enjoyment, and success, while negative attitudes may hinder students' willingness to learn and perform well (Wigfield & Eccles, 2000). Similarly, academic motivation has been identified as a critical predictor of students' academic success, with motivated students demonstrating greater effort, persistence, and achievement in their studies (Deci & Ryan, 2000). However, the relationship between mathematical attitude and academic motivation among secondary school students remains underexplored. While some studies have examined these constructs independently, few have investigated their interplay and mutual influence within the secondary school context. Therefore, this study aims to fill this gap by exploring how students' attitudes towards mathematics may impact their academic motivation and vice versa.

Literature Review

Mathematical Attitude

The mathematical attitude among secondary students is a multifaceted concept that encompasses their feelings, beliefs, and behaviours towards mathematics. It is crucial in shaping their academic performance, engagement, and future career choices. One aspect of mathematical attitude is students' perception of their abilities in mathematics. Research has shown that students who believe in their 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, complex, or irrelevant may develop negative attitudes towards the subject (Boaler, 2002).

On the other hand, teachers who create a supportive and inclusive learning environment, emphasise 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 internalise 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 marginalised 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 categorised into intrinsic, extrinsic, and motivation. 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 intrinsically motivated students 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 correlates with academic achievement. Conversely, negative attitudes can hinder learning and impede progress. Positive attitudes towards mathematics are associated with higher engagement, persistence, and achievement, while negative attitudes can lead to avoidance behaviours and lower academic performance (Ma, 1999). Understanding the factors influencing 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. Intrinsically motivated students tend to engage more deeply with the subject matter, persist in facing challenges, and achieve better academic outcomes. Academic motivation encompasses students' internal drive and external influences determining their willingness to engage in academic tasks like mathematics. Self-determination theory (Deci & Ryan, 1985) suggests that intrinsic motivation, which stems from personal interest and enjoyment, is associated with better academic outcomes than 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 particularly important for educational policymakers and curriculum developers. Researchers can identify factors that contribute to students' success or challenges in mathematics learning by investigating the relationship between mathematical attitude and academic motivation among secondary school students. 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.

Research Objectives

1. To study the mathematical attitude and academic motivation among secondary school students.
2. To find out the mean difference between mathematical attitude and academic motivation regarding gender and location.
3. To determine the relationship between mathematical attitude and academic motivation among secondary school students.
4. To find out the significant predictors affected by academic attitude and motivation.

Research Hypotheses

1. No significant difference will be found in the mean score towards mathematical attitude and academic motivation regarding gender and location.
2. No significant relationship will be found between mathematical attitude and academic motivation among secondary school students.
3. There will be gender and location do not affect academic attitude and motivation.

Research Method

The researcher's "descriptive cum survey method" was employed for the present study. Descriptive research is frequently used in education to understand student demographics, academic achievement, and classroom dynamics. Moreover, in this research, by employing a descriptive cum survey method, researchers can gain valuable insights into secondary school students' mathematical attitudes and academic motivation, contributing to the understanding of factors that influence their learning outcomes and educational experiences.

The study enrolled 100 secondary school students from Jiya Lal High School, located in the vibrant community of Shokhara, Barauni, Bihar. These students were selected explicitly from the 7th-grade level, and their participation was entirely voluntary, emphasising their active engagement in the research process. A purposive sampling technique was meticulously applied to ensure a diverse and representative sample. 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.

Result

Description of the Tool

1. The Attitude Towards Mathematics Scale (Gakhar & Sharma, 2004) measured students' attitudes, beliefs, and perceptions towards mathematics.
2. The Academic Motivation Scale (Dr. T.R. Sharma (2014) assessed students' academic motivation levels.

Statistical Techniques

Last fall, the researcher's Mean, SD, Skewness, and Kurtosis techniques will be used to check the data's normality and the present status of secondary school students' knowledge. Moreover, Independent samples t-tests will be adopted to compare mean scores of mathematical attitude and academic motivation across different genders and locations. Pearson's correlation coefficient will be used to assess the relationship between mathematical attitude and academic motivation. Linear regression analysis will be adopted to examine the effects of gender and location on academic attitude and motivation while affecting potential confounding variables.

Table No 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

The mean motivation score in the dataset for Academic Motivation, consisting of 100 observations, 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, most 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 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 cluster around higher attitude levels. Additionally, the kurtosis value close to zero (-0.377) implies a nearly mesokurtic distribution, resembling a normal distribution with moderate tails and a peak. Therefore, individuals in this dataset also tend to have higher attitude levels, with a distribution that closely resembles a normal distribution in shape, albeit with slight skewness.

Table No 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 Significance
	urban	56	176.89	21.65			

The analysis reveals 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 influences the participants' academic motivation or mathematical attitude substantially.

Based on the provided data, there appears to be 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 No 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 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 analysed. Therefore, you would fail to reject the null hypothesis, which states there is no correlation between the two variables.

Table no 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	.107	13.84	.003	Not Significant
				302	30.85			
Academic Motivation - Location	.004	.001	.010	.044	.044	14.25	.001	Not Significant
				3023.396	30.851			
Mathematical Attitude - Gender	.079	.006	.004	265.335	265.335	25.99	.62	Significant
				41882.375	427.371			
Mathematical Attitude - Location	.073	.005	.005	227.557	227.557	26.82	.568	Significant
				41920.153	427.757			

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 the p-value is 0.003, suggesting that the interaction effect between Academic Motivation and Gender is not statistically significant.

Academic Motivation - Location: The interaction 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 a marginal enhancement in model fit. The low p-value of 0.001 suggests that the interaction effect between Academic Motivation and Location lacks statistical significance.

Mathematical Attitude - Gender: 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 including 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 more significant variability, the attitude scores resemble a more symmetrical distribution akin to a standard curve. These findings underscore the importance of understanding individual differences in academic motivation and mathematical attitude, which may affect 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 be more prominent in shaping participants' academic motivation and mathematical attitudes. 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 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 to improve academic performance, as interventions targeting one aspect may not necessarily impact the other.

Analysing 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 be more influential in shaping participants' academic motivation and mathematical attitudes. 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 Implication

Educational Implications and Recommendations have come from the above discussions:

1. Given the lack of significant differences in academic motivation and mathematical attitude based on gender and residential area, educators should adopt a more nuanced approach to intervention design. Instead of solely focusing on demographic factors, interventions should consider broader variables such as socioeconomic status, cultural background, and educational experiences.
2. Understanding the complex interplay of factors influencing academic motivation and mathematical attitude underscores the importance of taking a holistic approach to student support. Schools should implement comprehensive support systems that address educational needs and socio-emotional and cultural factors. Resources such as counselling services, mentorship programs, and culturally responsive teaching practices can help create a supportive environment conducive to positive academic attitudes and motivations.
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, analysing 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 be more influential 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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