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THE INFLUENCE OF MATHEMATICS ANXIETY, MOTIVATION AND ATTITUDES ON THE ACADEMIC PERFORMANCE OF SENIOR SECONDARY SCHOOL STUDENTS IN KATSINA STATE

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Abstract

This study investigates the influence of mathematics anxiety, motivation, and attitudes on the academic performance of senior secondary school students in Katsina State, Nigeria. Utilizing a descriptive survey design, a representative sample of 381 students was selected across the state's three senatorial zones. Data were collected using the Students' Anxiety Motivation Attitude and Academic Performance in Mathematics (SAMAP) questionnaire, which included measures of anxiety, motivation, attitudes, and a mathematics performance test. It has a reliability coefficient of 0.85. The study aimed to explore the relationships between these psychological factors and academic performance, and to assess potential gender differences. Descriptive statistics, ANOVA and linear regression were used for data analysis. The findings reveal a positive but weak correlation between mathematics anxiety and performance, suggesting that moderate anxiety may enhance achievement. Similarly, motivation showed a positive correlation with performance, indicating that motivated students tend to perform better in mathematics. Attitudes towards mathematics were also positively related to performance, though less significantly. Gender differences were found, with females experiencing higher

Keywords:
Mathematics Anxiety, Motivation, Attitudes, Academic Performance, Gender Differences.

levels of anxiety and motivation compared to males, but no significant difference in attitudes. These results highlight the complex interplay of psychological factors in academic performance and underscore the need for targeted interventions to reduce anxiety and enhance motivation in mathematics education.

Introduction

Mathematics plays a crucial role in the educational development of students, particularly in secondary schools. However, many students experience mathematics with anxiety, which can significantly impact their academic performance. Additionally, students' motivation and attitude toward mathematics also play crucial roles in their learning outcomes. This research proposal aims to investigate the influence of mathematics anxiety, motivation, and attitude on the academic performance of secondary school students.

Mathematics anxiety is related to poor academic performance in Mathematics and negative attitudes towards mathematics subject which resulted in students tend to avoid learning this subject. Mathematics anxiety has become catastrophe for debilitating test stress, low self-confidence, feared of failure and negative attitudes towards learning Mathematics. Students who have high level of mathematics anxiety will have lower level of mathematics achievement. Ho et al. (2000), reported that mathematics anxiety seriously constraints performance in mathematical tasks and reduction in anxiety is consistently associated with improvement in achievement. Similarly, mathematics motivation has extensive impacts on academic achievement. According to Gunderson, Park, Maloney, Beilock and Levine (2018) stated that just like mathematics anxiety, motivational frameworks have important, well-established impacts on academic achievement. Basically, increasing students' motivation in class is an important issue for teachers, especially when math achievement is related with students' mathematics motivation and behaviour, thus, mathematics motivation plays a role in students' performance.

The attitude of students toward mathematics has been the subject of a great deal of attention from educators. A study by Hwang and Son (2021) that relationship between students' attitudes toward mathematics and mathematics achievement has garnered tremendous attention from researchers. However, there is a degree of inconsistency in the findings regarding this relationship. They also confirmed the literature describing students' attitude toward mathematics is a multi-dimensionally integrated construct, comprising 'like mathematics,' 'value mathematics,' and 'confidence in mathematics.' Moreover, they discovered a positive relationship between students' attitudes toward mathematics and mathematics achievement. Therefore, this study aimed to identify the profiles of students' attitudes toward mathematics and examine their relationship with mathematics achievement.

The study also considers gender differences, as previous research has indicated variations in mathematics performance between male and female students. According to Dowker and Sheridan (2022), attitudes to mathematics were significantly associated with working memory, test anxiety, and both measures of mathematical performance. The other variables were not strongly associated with one another. There were no gender differences in mathematical performance, but females exhibited more negative attitudes to mathematics and higher test anxiety than males. After controlling for test anxiety, there ceased to be significant gender differences in attitudes to mathematics.

Statement of Problem

In recent years, there has been a growing emphasis on the role of mathematics anxiety, motivation and attitudes in mathematics education. Numerous studies have investigated how various emotional factors, such as motivation, attitudes, and anxiety, relate to students' performance in mathematics and several reasons have been put forward to explain these strong connections. Students who are motivated and possess positive attitudes toward mathematics tend to invest more time in the subject, leading to better performance. Conversely, individuals experiencing anxiety about mathematics often struggle with negative thoughts that disrupt their problem-solving processes, resulting in poorer performance (Ashcraft, 2002; Maloney & Beilock, 2012).

The multitude of these sub-constructs poses a challenge for both practitioners and researchers. While it's important to address all these facets to enhance mathematics performance, time constraints and practical considerations limit the ability to measure them all extensively. Nevertheless, research has shown strong correlations between many of these affective constructs and their sub-constructs. Positive aspects such as enjoying mathematics, having high motivation, confidence in problem-solving, valuing mathematics, and feeling comfortable with the subject tend to align with better mathematics achievement. Conversely, negative outcomes like mathematics anxiety and negative motivation are associated with poorer performance.

This raises the question of whether it's necessary to address all sub-constructs or focus on specific ones to enhance mathematics performance through affective interventions. Additionally, it's unclear which sub-constructs should be prioritized in research and practice. Currently, there is limited research available to guide practitioners and researchers in selecting the most relevant sub-constructs. To address this gap, it is crucial to examine the strength of the relationships between these sub-constructs and mathematics achievement, both in the short term and as predictors of long-term success.

Objectives

The main objective of this study is to examine the influence of levels of mathematics anxiety, motivation, and attitude on performance among secondary school students in Katsina state. The specific objectives are:

a) To investigate the relationship between mathematics anxiety and academic performance among secondary school students in Katsina state.

b) To explore the relationship between motivation and students' mathematics academic performance among secondary school students in Katsina state.
c) To determine the relationship between attitude toward mathematics and academic performance of secondary school students in Katsina state.
d) To determine whether there is gender difference in mathematics performance due to anxiety, motivation and attitudes among secondary school students in Katsina state.

Research questions and Hypotheses

The following are research questions and hypotheses to guide in achieving the aims of the study:

1. What is the relationship between mathematics anxiety and academic performance among secondary school students in Katsina state?
2. Does motivation relates with students' mathematics academic performance among secondary school students in Katsina state?
3. What is the relationship between students' attitudes toward mathematics and their academic performance in mathematics among secondary school students in Katsina state?
4. Is there a gender difference in mathematics performance due to mathematics anxiety, motivation, and attitudes among secondary school students in Katsina state?

The hypotheses are:

Ho_1: Mathematics anxiety has no significant influence on academic performance among secondary school students in Katsina state.
Ho_2: Motivation has no significant influence on mathematics academic performance among secondary school students in Katsina state.
Ho_3: Attitudes toward mathematics has no significant influence on academic performance in mathematics among secondary school students in Katsina state.
Ho_4: There is no significant gender difference in mathematics performance, with variations due to differences in mathematics anxiety, motivation, and attitudes among secondary school students in Katsina state.

Literature Review

Rončević Zubković and colleagues (2021) conducted a study involving 2,749 Croatian students, with 56% being girls and an average age of 14.58 years. They found that girls tended to have less positive self-concepts in mathematics compared to boys. Additionally, girls exhibited a higher use of certain learning strategies and reported higher levels of mathematics anxiety compared to boys. Interestingly, the study also revealed that a later transition to school correlated with lower motivation, a more positive perception of mathematics, and lower academic performance. Concerning the connections between

attitudes towards mathematics, anxiety, and other emotional factors, a recent investigation by Xiao and Sun (2021) focused on US students, with 51% of them being male. Their research explored various emotional and motivational factors such as attitudes, interest in mathematics, self-concept in mathematics, and mathematics anxiety. They identified distinct profiles based on motivation and emotions, with students who displayed higher motivation and lower mathematics anxiety exhibiting greater persistence and better mathematical performance. This study underscores the importance of such findings for educators to tailor their instruction to accommodate diverse motivational profiles.

In a similar context, Geisler et al. (2023) noted some evidence of connections between individual interest within attitudes toward mathematics and academic performance. However, they also acknowledged the need for more research due to some inconclusive results and even contradictory findings in certain studies, like Rach and Heinze (2017), which found no significant links between interest and academic performance. Concerning mathematics anxiety, Orbach et al. (2019) delved into trait components of mathematics anxiety by comparing them to real-time assessments of situational anxiety responses in children. Their study involved 1,179 4th and 5th grade students and measured various aspects, including mathematics anxiety, self-assessment of math skills, attitudes toward mathematics, learning motivation, mathematics performance, social anxiety, and intelligence. The results indicated a negative correlation between one aspect of mathematics anxiety and academic performance.

In another study, Lim and Chapman (2015) investigated the effects of incorporating mathematics history into mathematics instruction for grade 11 students in Singapore on their attitudes, finding positive outcomes resulting from this teaching approach. Two additional studies by Abín et al. (2020) and Suren and Kandemir (2020) focused on performance outcomes. Suren and Kandemir's study involved 777 8th-grade students in Turkey, using instruments like the Mathematical Motivation Scale (MMS) and Mathematics Anxiety Scale for Elementary School Students (MASESS). They discovered that anxiety and motivation levels exhibited a positive relationship, with anxiety serving as a stronger predictor of performance than motivation. Similarly, Abín et al. (2020) conducted research with 2,365 Spanish students across different secondary school grades, examining factors such as intellectual abilities, perceived competence in mathematics, perceived usefulness of mathematics, mathematics anxiety, causal attributions, and mathematics achievement. Their findings highlighted gender differences but did not identify significant effects of emotional or motivational variables on performance.

In summary, this literature review underscores the significance of mathematics anxiety, motivation and attitudes in mathematics education and the need to understand the relationships between them and mathematics achievement. It also emphasizes the importance of considering gender differences in mathematics motivation and attitudes for effective teaching and learning strategies.

Methodology

This study adopted the descriptive survey design. This will enable the researchers to get un-biased information from the respondents using item like questionnaire. The study area

is Katsina state in Nigeria which comprised of 34 Local Government areas with the population of secondary schools at 245 and senior secondary school students population of 218,232 (Male = 129113 and Female = 89119) (Ministry of Education Katsina State, 2023). A representative sample of secondary school students was selected using a random sampling technique from the three senatorial zones in the state. Two schools were randomly selected from each zone (one male and one female). The sample size was 420 students (140 from each zone and 70 each from the school selected). However, only 381 students responded to the questionnaires and returned for data analysis.

The research employed the use of well-designed questionnaire Students' Anxiety Motivation Attitude and Academic Performance in Mathematics (SAMAP) to collect quantitative form the respondents. The SAMAP consisted of 5 sections, personal data, anxiety level, motivation level, attitudes level and performance in mathematics. Section B-D consisted of 20 items each rated using 4 point Lickert scale, while section E consisted of 20 multiple choice questions in mathematics specifically arithmetic and geometric progressions and statistics which was scored 2 marks each totaling 40 marks. The instrument was validated by experts in Mathematics department of Federal College of Education, Katsina. The reliability of the instrument was ascertain using Cronbach alpha after conducting pilot study and obtained as 0.85. The data collected was analyzed using descriptive statistics, analysis of variance (ANOVA) and linear regression analysis to examine the relationships between variables.

Data Analysis and Discussion of Results

Data analysis for the study was conducted using data collected from the field which were collated, sorted, organized and presented for results computation and interpretation. The bio-data of the respondents is presented in table 1.

Table 1: Bio-data of the Respondents

SN	Items	Category	Number	Percentage (%)
1	Zones	Daura	127	33.3
		Funtua	125	32.8
		Katsina	129	33.9
		Total	381	100.0
2	Gender	Male	202	53.0
		Female	179	47.0
		Total	381	100.0
3	Age	15-17 years	202	53.0
		18-20 years	175	45.9
		21 years and above	04	1.1
		Total	381	100.0
4	Class	SS I	24	6.3
		SS II	329	86.4
		SS III	28	7.3
		Total	381	100.0

The results in table 1 presents the Bio-data of the Respondents. The respondents were drawn from three zones: Daura (33.3%), Funtua (32.8%), and Katsina (33.9%). The distribution of respondents across the three zones is relatively even, with each zone contributing around one-third of the total sample. The sample consists of 53.0% male and 47.0% female respondents. The gender distribution is reasonably balanced, with a slightly higher proportion of male participants. The majority of the respondents (53.0%) are in the 15-17 years age group, followed by 18-20 years (45.9%) and 21 years and above (1.1%). The sample is predominantly composed of younger secondary school students, with very few respondents in the oldest age category. Most of the respondents (86.4%) are in SS II, with smaller proportions in SS I (6.3%) and SS III (7.3%). Thus, the bio-data of the respondents indicates that the sample is fairly representative of the secondary school student population in Katsina state, with a balanced distribution across the three zones and genders.

Research Questions and Hypothesis Tests

Research Question 1: What is the relationship between mathematics anxiety and academic performance among secondary school students in Katsina state?

Table 2: Relationship between mathematics anxiety and mathematics performance

Items	N	Mean	Std.dev	Correlation	Mean difference
Mathematics anxiety	381	23.39	3.015	0.222	1.03
Academic performance	381	22.36	10.123		

Table 2 presents the relationship between mathematics anxiety and mathematics performance. The mean score for mathematics anxiety among the respondents is 23.39, with a standard deviation of 3.015. This suggests that on average, the secondary school students in the sample experience a moderate level of mathematics anxiety. The mean score for academic performance in mathematics is 22.36, with a standard deviation of 10.123. This indicates that the average mathematics performance of the students is relatively low. The mean difference between mathematics anxiety (23.39) and academic performance (22.36) is 1.03. This small difference indicates that the average level of mathematics anxiety is slightly higher than the average academic performance in mathematics. The correlation coefficient between mathematics anxiety and academic performance is 0.222. This positive correlation suggests that as mathematics anxiety increases, academic performance in mathematics also tends to increase, which is counterintuitive.

The results suggest that there is a positive, but weak, relationship between mathematics anxiety and academic performance among secondary school students in Katsina state.

The positive correlation coefficient and the small mean difference between anxiety and performance imply that higher levels of mathematics anxiety may not necessarily be associated with poorer academic performance in this sample. This could be due to various factors, such as the specific context, teaching methods, or coping strategies employed by the students. However, the overall low academic performance and moderate levels of mathematics anxiety suggest that there is room for improvement in supporting students' mathematics learning and reducing their anxiety levels.

Ho_1: Mathematics anxiety has no significant influence on academic performance among secondary school students in Katsina state.

Table 3: Regression analysis results of influence of mathematics anxiety on mathematics performance

Items	R^2	F-value	Df	p-value	Alpha	Decision
Anxiety vs performance	0.049	19.625	380	0.000	0.05	Reject Ho_1

Table 3 presents the regression analysis results of influence of mathematics anxiety on mathematics performance. The R-squared value is 0.049, which means that mathematics anxiety explains approximately 4.9% of the variance in academic performance in mathematics. The F-value is 19.625, which is statistically significant at the degrees of freedom are 380, p-value is 0.000, which is less than the chosen alpha level of 0.05. Since the p-value (0.000) is less than the alpha level (0.05), the null hypothesis (H01) is rejected. The regression analysis results indicate that mathematics anxiety has a statistically significant influence on the academic performance of secondary school students in Katsina state. This finding is consistent with the existing literature, which generally suggests a negative relationship between mathematics anxiety and academic achievement. The results highlight the importance of addressing mathematics anxiety among secondary school students in Katsina state, as it can have a detrimental impact on their mathematics performance.

Research Question 2: Does motivation relates with students' mathematics academic performance among secondary school students in Katsina state?

Table 4: Relationship between motivation and mathematics performance

Items	N	Mean	Std.dev	Correlation	Mean difference
Mathematics motivation	381	23.51	3.436	0.194	1.15
Academic performance	381	22.36	10.123		

Table 4 presents the results of relationship between motivation and mathematics performance. The mean score for mathematics motivation among the respondents is

23.51, with a standard deviation of 3.436. This suggests that on average, the secondary school students in the sample exhibit a moderate level of motivation towards mathematics. The mean score for academic performance in mathematics is 22.36, with a standard deviation of 10.123. This indicates that the average mathematics performance of the students is relatively low. The mean difference between mathematics motivation (23.51) and academic performance (22.36) is 1.15. This small difference indicates that the average level of mathematics motivation is slightly higher than the average academic performance in mathematics. The correlation coefficient between mathematics motivation and academic performance is 0.194. This positive correlation suggests that as mathematics motivation increases, academic performance in mathematics also tends to increase.

The results suggest that there is a positive, but weak, relationship between mathematics motivation and academic performance among secondary school students in Katsina state. This finding aligns with the expectation that higher levels of motivation would be associated with better academic performance in mathematics. The positive correlation coefficient and the small mean difference between motivation and performance imply that higher levels of mathematics motivation may be related to improved academic performance in this sample. However, the strength of the relationship is relatively low, suggesting that other factors may also play a significant role in influencing mathematics performance. The overall low academic performance and moderate levels of mathematics motivation indicate that there is room for improvement in supporting students' mathematics learning and enhancing their motivation levels.

Ho_2: Motivation has no significant influence on mathematics academic performance among secondary school students in Katsina state.

Table 5: Regression analysis results of influence of motivation on mathematics performance

Items	R^2	F-value	Df	p-value	Alpha	Decision
Motivation vs performance	0.038	14.879	380	0.000	0.05	Reject Ho_2

Table 5 presents the regression analysis results of influence of motivation on mathematics performance. The R-squared value is 0.038, which means that motivation explains approximately 3.8% of the variance in academic performance in mathematics. The F-value is 14.879, which is statistically significant at the degrees of freedom are 380, the p-value is 0.000, which is less than the chosen alpha level of 0.05. Since the p-value (0.000) is less than the alpha level (0.05), the null hypothesis (H02) is rejected. The regression analysis results indicate that motivation has a statistically significant influence on the academic performance of secondary school students in mathematics in Katsina state. This finding is

consistent with the existing literature, which generally suggests a positive relationship between motivation and academic achievement. The results highlight the importance of fostering and maintaining high levels of motivation among secondary school students in Katsina state, as it can have a positive impact on their mathematics performance.

Research Question 3: What is the relationship between students' attitudes toward mathematics and their academic performance in mathematics among secondary school students in Katsina state?

Table 6: Relationship between attitudes and mathematics performance

Items	N	Mean	Std.dev	Correlation	Mean difference
Mathematics attitude	381	23.43	3.622	0.163	1.07
Academic performance	381	22.36	10.123		

Table 6 presents the relationship between attitudes and mathematics performance. The mean score for mathematics attitude among the respondents is 23.43, with a standard deviation of 3.622. This suggests that on average, the secondary school students in the sample exhibit a moderately positive attitude towards mathematics. The mean score for academic performance in mathematics is 22.36, with a standard deviation of 10.123. This indicates that the average mathematics performance of the students is relatively low. The mean difference between mathematics attitude (23.43) and academic performance (22.36) is 1.07. This small difference indicates that the average level of positive attitudes towards mathematics is slightly higher than the average academic performance in mathematics. The correlation coefficient between mathematics attitude and academic performance is 0.163. This positive correlation suggests that as positive attitudes towards mathematics increase, academic performance in mathematics also tends to increase.
The results suggest that there is a positive, but weak, relationship between students' attitudes towards mathematics and their academic performance in mathematics among secondary school students in Katsina state. This finding aligns with the expectation that more positive attitudes would be associated with better academic performance in mathematics. The positive correlation coefficient and the small mean difference between attitude and performance imply that more positive attitudes towards mathematics may be related to improved academic performance in this sample. However, the strength of the relationship is relatively low, suggesting that other factors may also play a significant role in influencing mathematics performance. The low academic performance and moderately positive attitudes towards mathematics indicate that there is room for improvement in supporting students' mathematics learning and fostering more positive attitudes.

Ho_3: Attitudes toward mathematics has no significant influence on academic performance in mathematics among secondary school students in Katsina state.

Table 7: regression analysis results of influence of attitudes on mathematics performance

Items	R^2	F-value	Df	p-value	Alpha	Decision
Attitude vs performance	0.027	10.318	380	0.001	0.05	Reject Ho_3

Table 7 presents the regression analysis results of influence of attitudes on mathematics performance. The R-squared value is 0.027, which means that attitudes towards mathematics explain approximately 2.7% of the variance in academic performance in mathematics. The F-value is 10.318, which is statistically significant at the degrees of freedom are 380, and p-value is 0.001, which is less than the chosen alpha level of 0.05. Since the p-value (0.001) is less than the alpha level (0.05), the null hypothesis (H03) is rejected. The regression analysis results indicate that attitudes towards mathematics have a statistically significant influence on the academic performance of secondary school students in mathematics in Katsina state. This finding is consistent with the existing literature, which generally suggests a positive relationship between attitudes and academic achievement. The results highlight the importance of fostering positive attitudes towards mathematics among secondary school students in Katsina state, as it can have a positive impact on their mathematics performance.

Research Question 4: Is there a gender difference in mathematics performance due to mathematics anxiety, motivation, and attitudes among secondary school students in Katsina state?

Table 8: Gender differences in mathematics performance due to mathematics anxiety, motivation and attitudes

Items	Gender	N	Mean	Std.dev	Mean difference
Mathematics anxiety	Male	202	22.90	3.087	1.04
	Female	179	23.94	2.841	
Mathematics motivation	Male	202	23.10	3.345	0.86
	Female	179	23.96	3.491	
Mathematics attitude	Male	202	23.13	3.572	0.65
	Female	179	23.78	3.657	

Table 8 presents the gender differences in mathematics performance due to mathematics anxiety, motivation, and attitudes. The mean score for mathematics anxiety is 22.90 for male students and 23.94 for female students. The mean difference in mathematics anxiety

between male and female students is 1.04, with female students exhibiting higher levels of anxiety. The mean score for mathematics motivation is 23.10 for male students and 23.96 for female students. The mean difference in mathematics motivation between male and female students is 0.86, with female students exhibiting higher levels of motivation. The mean score for mathematics attitude is 23.13 for male students and 23.78 for female students. The mean difference in mathematics attitude between male and female students is 0.65, with female students exhibiting more positive attitudes towards mathematics. The results suggest that there are gender differences in mathematics anxiety, motivation, and attitudes among secondary school students in Katsina state.
Female students, on average, exhibit higher levels of mathematics anxiety compared to their male counterparts. This indicates that female students may experience more stress, worry, and negative emotions towards mathematics, which could potentially impact their mathematics performance. Similarly, female students demonstrate higher levels of mathematics motivation and more positive attitudes towards the subject compared to male students. This suggests that female students may be more engaged, interested, and confident in their mathematics learning, which could contribute to better academic performance. The observed gender differences in these factors (anxiety, motivation, and attitudes) provide insights into the potential mechanisms underlying gender disparities in mathematics performance among secondary school students in Katsina state. These findings align with the existing literature, which often highlights the complex interplay between gender, psychological factors, and academic achievement in mathematics.

Ho_4: There is no significant gender difference in mathematics performance, with variations due to differences in mathematics anxiety, motivation, and attitudes among secondary school students in Katsina state.

Table 9: ANOVA results of gender differences in performance based on mathematics anxiety, motivation and attitudes towards mathematics

Items	F-value	Df	p-value	Alpha	Decision
Mathematics anxiety	11.550	380	0.001	0.05	Reject
Mathematics motivation	5.979	380	0.015	0.05	Reject
Mathematics attitude	3.052	380	0.081	0.05	Accept

Table 9 presents the ANOVA results of gender differences in performance based on mathematics anxiety, motivation, and attitudes towards mathematics. The F-value for mathematics anxiety is 11.550, which is statistically significant at degrees of freedom of 380 and p-value is 0.001, which is less than the chosen alpha level of 0.05. Therefore, the null hypothesis is rejected for mathematics anxiety. The F-value for mathematics motivation is 5.979, which is statistically significant at degrees of freedom of 380 and p-

value is 0.015, which is less than the chosen alpha level of 0.05. Therefore, the null hypothesis is rejected for mathematics motivation. The F-value for mathematics attitude is 3.052, which is not statistically significant at degrees of freedom of 380 and p-value is 0.081, which is greater than the chosen alpha level of 0.05. Therefore, the null hypothesis is accepted for mathematics attitude.

The ANOVA results indicate that there are significant gender differences in mathematics performance due to differences in mathematics anxiety and motivation among secondary school students in Katsina state. However, the results do not show a significant gender difference in mathematics performance due to differences in attitudes towards mathematics.

These findings highlight the importance of addressing gender differences in mathematics anxiety and motivation to support the academic success of all students in mathematics. Interventions aimed at reducing anxiety and enhancing motivation, particularly among male students, may help in narrowing the gender gap in mathematics performance. However, the lack of a significant gender difference in attitudes towards mathematics suggests that this factor may not be a primary driver of the observed gender disparities in mathematics performance in this context.

The findings of this study showed that Mathematics anxiety, motivation, and attitudes each have a statistically significant, albeit small, influence on academic performance in mathematics and gender differences exist in the influence of mathematics anxiety and motivation on academic performance, with females showing slightly higher levels of both anxiety and motivation, but attitudes towards mathematics do not show a significant gender-based difference in performance impact. These findings highlight the importance of addressing the psychological factors that influence mathematics performance, particularly in the context of gender differences, to support the academic success of all secondary school students in Katsina state.

Firstly, the results indicate a positive, but weak, relationship between mathematics anxiety and academic performance among secondary school students. This finding is counterintuitive, as the literature generally suggests a negative relationship between mathematics anxiety and performance. However, some studies such as Cabuquin and Abocejo (2021) and Eleftherios and Theodosios (2011) have found a positive correlation between anxiety and performance, suggesting that moderate levels of anxiety may actually motivate students and enhance their academic achievement in mathematics. Secondly, the results show a positive, but weak, relationship between motivation and academic performance in mathematics among secondary school students. Motivated students are more likely to put in the effort, persist in the face of challenges, and engage actively in the learning process, leading to improved mathematics performance. This aligns with the existing literature by Iddrisu, et al (2023) and Stajkovic et al (2018) who

suggests that higher levels of motivation are associated with better academic performance in mathematics.

Thirdly, the results indicate a positive, but weak, relationship between attitudes towards mathematics and academic performance among secondary school students. Positive attitudes, such as enjoyment, confidence, and perceived usefulness of mathematics, can contribute to better performance in the subject. This finding is consistent with studies by Sadiku & Sylai (2019), Jolejole-Caube, Dumlao & Bacabac (2019) and Eleftherios & Theodosios (2011) that found a direct link between students' attitudes towards mathematics and their academic outcomes. Fourthly, the results show significant gender differences in mathematics performance due to differences in anxiety and motivation, but not in attitudes. Female students exhibit higher levels of mathematics anxiety but also higher levels of motivation compared to male students. These gender differences in psychological factors contributing to mathematics performance align with previous studies by Sekiwu, Naluwemba & Ssempala (2020) and Chavez (2018).

Overall, the findings highlight the complex interplay between psychological factors, such as anxiety, motivation, and attitudes, and their influence on the academic performance of secondary school students in mathematics. The results also underscore the importance of considering gender differences in these factors when supporting students' mathematics learning and achievement. Educators and policymakers should consider addressing mathematics anxiety and enhancing motivation among students, as these factors contribute to academic performance disparities. While attitudes towards mathematics are important, their direct influence on performance is less pronounced compared to anxiety and motivation. Understanding these factors can help in developing targeted interventions to improve mathematics education outcomes, particularly focusing on reducing anxiety and enhancing motivation among students.

Conclusion

This study explored the influence of mathematics anxiety, motivation, and attitudes on academic performance among secondary school students in Katsina state, as well as examined gender differences in these variables. Key findings reveal that while mathematics anxiety, motivation, and attitudes all correlate with academic performance, their effects are relatively modest. Specifically, mathematics anxiety and motivation significantly impact performance, with females generally experiencing higher levels of anxiety and motivation compared to males. Attitudes towards mathematics, while positively associated with performance, show a weaker influence and no significant gender difference.

Recommendations

Based on the findings of the study, the following recommendations can be made:

1. Implement strategies to alleviate mathematics anxiety among students, such as mindfulness exercises, peer support programs, or counseling services focused on anxiety management.
2. Foster a supportive learning environment that encourages intrinsic motivation towards mathematics. This could involve engaging teaching methods, setting clear goals, and highlighting the relevance of mathematics to students' future aspirations.
3. Develop initiatives to cultivate positive attitudes towards mathematics, including curriculum enhancements that make mathematics more engaging and relevant to students' everyday lives.
4. Recognize and address gender differences in mathematics anxiety and motivation through targeted interventions that cater to the specific needs of male and female students.

By implementing these recommendations, educators and policymakers can foster a more supportive and inclusive learning environment that enhances mathematics education outcomes for all students, regardless of gender or individual differences in anxiety, motivation, and attitudes.

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