

Motivational Factors as Determinant of Mathematics Achievement of Students in Senior Secondary Schools

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Abstract: The issue of student motivation is of utmost importance for achieving academic excellence in secondary schools. This study aimed to investigate the influence of motivational factors on the academic achievement of senior secondary school students in mathematics. The study was guided by five hypotheses and underwent testing at a significance level of 0.05. A descriptive survey design was employed, specifically selecting five senior secondary schools in the study area. A total of 300 students from these schools, located in the Ijebu Ode Local Government Area of Ogun State, Nigeria, were selected. The research utilised questionnaires and a Mathematics Achievement Test (MAT), with reliability coefficients of 0.75 and 0.80, respectively. The findings revealed that intrinsic motivation, extrinsic motivation, self-efficacy, and goal orientation had a positive and significant impact on academic achievement. Furthermore, when these factors were considered collectively, they demonstrated a significant influence. The conclusion drawn from this study is that motivational factors greatly affect the academic achievement of senior secondary school students in mathematics in Ijebu Ode, Ogun State, Nigeria. Therefore, it is recommended that schools

actively promote these factors during the teaching and learning processes to enhance students' achievement in mathematics.

Keywords: Student achievement, extrinsic motivation, goal orientation, intrinsic motivation, self-efficacy.

1. Introduction

Mathematics encompasses the systematic exploration of quantities, including their interconnections, operations, and measurements, expressed through numbers and symbols (Olukola, 2023). It is widely regarded as the scientific discipline that systematically investigates numbers, shapes, arrangements, quantities, measurements, and related concepts in a logical manner, as defined by the mathematics dictionary. As Olukola (2023) contends, nearly every scientific field relies on mathematical concepts to elucidate its theories, models, or concepts. With the increasing sophistication of digitalisation, scientific discoveries, and technological advancements, which are prevailing trends in our society, mathematics has become indispensable in all areas of life, extending its influence across various spheres (Olaniyan, 2023).

The acquisition of proficiency in mathematics holds immense importance for individuals and nations in contexts such as international and domestic trade, scientific research, technological development, problem-solving, and decision-making in a wide range of real-world situations (Wood, 1989). Asanre et al. (2023) underscore the extensive application of mathematics in all human endeavours and across various academic subjects, highlighting its indispensability. However, despite its significance, researchers have observed a decline in students' academic performance in mathematics over time. They argue that prioritising students' achievement is crucial for effective mathematics education.

In many cases, students tend to perceive mathematics as primarily procedural and rule-based, which hampers their ability to fully comprehend the depth and versatility of the subject, as well as the

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different approaches that can foster proficiency (Roh, 2019). Abiodun et al. (2022) assert that the chief examiners' reports for the West African School Certificates Examinations (WAEC) indicate significant weaknesses in students' performance in mathematics, particularly in areas such as permutation and combination, mensuration, word problems, and solving equations simultaneously involving indices. These weaknesses are cause for concern and must be addressed. Ifamuyiwa et al. (2024) reported on the various factors that researchers have identified as contributing to low academic achievement among students. These factors include entry level/background, anxiety, attitudinal problems, lack of interest in Mathematics, self-concept, study habits, motivation factors, disadvantaged exposure, problem-solving techniques, misconceptions of Mathematical terms and symbols, misinterpretation of word problems, failure to adhere to examination instructions, gender issues, and insufficient preparation for Mathematics examinations. The challenge of motivating students has long been recognised as an important issue in secondary schools, as it is closely linked to achieving good academic records. Motivation is an internal condition that encompasses the arousal, direction, and maintenance of student behaviour. This explains why students expend diligent efforts to achieve high academic standing, particularly in science classes like mathematics (Abah et al., 2022).

Motivation is defined as the elements that ignite the drive to achieve a specific objective (Bryant, 2017). Bryant further emphasised that motivation is considered a foundational aspect of engagement and an essential component of student education. Furthermore, Abín et al. (2020) asserted that motivation can be characterised as the beginning of the educational journey, the process of setting direction, and the determination to persist along the chosen path. Extensive research has explored the association between academic motivation and proficiency in mathematics, covering elementary to high school levels. It has been consistently found that students with higher motivation demonstrate greater eagerness to seek learning opportunities and achieve superior performance in mathematics compared to their peers.

Hammad et al. (2022) suggested that successful mathematics classrooms significantly foster students' motivation and achievement. Motivation is a crucial factor that influences students' learning outcomes in mathematics. However, several factors are found to be associated with motivation and determine students' academic achievement in secondary school mathematics. At times, students may experience a lack of interest or motivation in the course material, questioning whether their efforts will truly enhance their academic performance. A recent study found that it is important to boost students' self-esteem and reduce their negative emotional reactions to mathematics tasks. Motivated students are more likely to ask questions to facilitate their learning and gain a better understanding of mathematical concepts. When students express issues to their teachers, they are expressing dissatisfaction with their current understanding and a desire to expand their mathematical thinking (Nayab et al., 2023). In Olukola's (2023) study, four motivational factors that impact students' academic achievement were identified: goal orientation, extrinsic motivation, intrinsic motivation, and student self-efficacy. According to Abah et al. (2022), intrinsic motivation results from a student's internal desire for exceptional academic achievement, while extrinsic motivation is driven by external stimuli such as awards, peer recognition, and praise from teachers. The authors further argue that intrinsic motivation, which stems from human nature, drives individuals to seek out new tasks and fuels students' eagerness to learn and grow, even in the absence of external rewards or incentives.

Therefore, when motivation is internal, individuals can perform well academically in mathematics without being influenced by external factors that may hinder their success. Asanre (2023) highlights the importance of self-confidence, noting that students lacking confidence may believe they are unable to complete a task, see it as pointless, and therefore, do not wish to invest the necessary time and effort to accomplish it. Consequently, they may choose not to participate in the work at all. Ozkal (2019) emphasises that students with low self-efficacy tend to avoid learning tasks and lack motivation to engage in them, resulting in academic failure.

Self-efficacy refers to an individual's self-belief or personal judgment regarding their skills. This cognitive assessment is based on prior performances and determines one's belief in one's ability to succeed in future tasks. Sides and Cuevas (2020) posit that high levels of self-efficacy increase confidence in intended learning outcomes and play a crucial role in a learner's persistence and goal achievement. Additionally, Adamma et al. (2018) suggest that extrinsic motivation, through the use of rewards as positive reinforcement, promotes effort and performance. Compared to intrinsic motivation, extrinsic motivation typically requires less effort and offers more immediate benefits. Students driven by extrinsic motivation often prioritise earning higher grades and acquiring rewards in their academic pursuits. Olukola (2023) further explains how extrinsic motivation can help students establish specific goals in mathematics. The presence of external rewards or incentives can provide students with explicit objectives to strive towards. Examples of extrinsic motivation encompass monetary rewards, grades, commendation, recognition, or the desire to avoid criticism, failure, or discomfort. Furthermore, Deraja et al. (2023) posited that individuals' goal orientation denotes their inclination or predisposition to develop or validate their abilities within achievement-focused settings. Two types of goal orientations delineated by early goal researchers were performance, or ego goal orientation, which entails the aspiration to exhibit superiority and make a favourable impression, and mastery, or task goal orientation, which involves the aspiration to acquire new knowledge or attain expertise in a previously acquired skill. Additionally, Goal orientation is described by Ekene and Nne (2024) as the embodiment of the natural potentialities that inspire students to adapt and work toward success in academic environments. Subsequently, the accomplishment goal orientation was presented as each person's personal motivations for desiring to succeed or fail in any academic assignment.

Mõttus et al. (2020) also contended that achievement motivation plays a role in shaping accomplishment goal orientations, which can function as predictors of personality, facilitators of behaviour, and robust indicators of outcomes. They further expounded that students' motivation to engage in educational pursuits is influenced by a multifaceted system encompassing the drive for achievement, with goal orientation serving as a representation of this intricate framework.

1.1 Problem statement

Bearing in mind the concern among educational stakeholders regarding the decline in students' achievement in mathematics (Chinaemerem et al., 2023), it is worth noting that the 2022 WAEC results in mathematics for Ogun State revealed a decrease compared to previous years. Out of the 37 states in Nigeria, including the FCT, statistics provided by WAEC indicate that out of the 1.6 million candidates who sat for the examination in 2022, 76.36% obtained credit in five subjects, including English and mathematics. However, there was a decline of 5% in students' performance compared to the previous year, where the performance rate was 81.1% in 2021. In 2020, approximately 66% of students passed, but this declined to 54% in 2021, highlighting the inconsistency in students' performance.

The WAEC chief examiners' report on general mathematics for 2022 identified several areas of weakness among the candidates that may have contributed to their poor performance. These areas of inadequacy include poor question interpretation, inability to apply mathematical principles correctly, insufficient knowledge of the angle of elevation and depression, coordinate geometry, circle geometry, set theory, logical reasoning, and probability (WAEC, 2022). The report suggested six remedies, three of which emphasised the need to 'encourage' candidates to take certain actions. The term 'encourage' can be viewed as a form of motivation that drives problem-solving, underscoring the significance of motivation in students' learning and academic achievement. Previous literature has recognised motivation as a factor that influences students' academic achievement in mathematics (Tella, 2007; Herges et al., 2017). However, limited research has been conducted on the use of motivational factors such as intrinsic and extrinsic motivation, self-efficacy,

and goal orientation as determinants or predictors of mathematics achievement among senior secondary school students in the Ijebu Ode Area of Ogun State, Nigeria. Therefore, it is necessary to examine the motivational factors of intrinsic motivation, goal orientation, extrinsic motivation, and self-efficacy as factors influencing mathematics academic achievement, particularly among students enrolled in senior secondary schools in the Local Government Area of Ijebu Ode, Ogun State. Hence, this study aims to investigate the individual and combined contributions of these various factors to students' mathematical achievement in senior secondary school.

1.2 Objective and hypothesis

Examining motivating factors as predictors of abilities in mathematics for senior secondary school students is the primary goal of the research. That is, the research aims to explore the relative and composite contributions of the independent variable to the dependent variable. Based on this, the following hypothesis was raised:

- Ho: Goal orientation, self-efficacy, extrinsic motivation, and intrinsic motivation will not significantly determine the academic achievement of students in senior secondary school mathematics.

2. Methodology

For this research, a descriptive survey research approach was employed to carefully describe and explain factual and detailed information regarding the respondents' opinions on the motivational factors that determine academic achievement in senior secondary mathematics classes in Ogun State. The sample size was determined using a simple random sampling procedure. In the study area, five senior secondary schools in the Ijebu Ode Local Government Area of Ogun State were specifically selected, resulting in a sample of three hundred senior secondary 2 (SS 2) students. Students were chosen because they would have already been taught some basic mathematics concepts and would not be distracted by external examinations.

The research tools utilised in this study were a mathematics achievement test (MAT) and a questionnaire. The questionnaire consisted of forty items divided into two sections: Section A contained questions about the respondents' demographics, while Section B focused on the motivational variables under investigation. A four-point rating system (Strongly Disagreed [SD], Disagreed [D], Agreed [A], Strongly Agreed [SA]) allowed respondents to indicate their level of agreement or disagreement with the items presented. The MAT comprised twenty multiple-choice questions with options A to D, designed to assess students' academic achievement in mathematics. The questions were drawn from past WAEC examinations and covered topics from the SSS 2 syllabus, including word problems leading to mathematical equations (7 questions), simultaneous equations involving indices (6 questions), and quadratic equations (7 questions). These topics were selected because students would have already been exposed to them. The MAT assessed students' knowledge, comprehension, and application levels. The questionnaire's validity was evaluated by experts in the departments of educational psychology and mathematics education using face and content validity. Additionally, twenty students from a different school participated in trial testing of the validated tools to determine their reliability. The Cronbach alpha coefficient was used to assess the questionnaire's reliability, resulting in a value of 0.75. The reliability coefficient for the MAT, determined using the Split Half Method, was 0.80.

The data collected from the instruments were transferred to data coding sheets. Responses from the questionnaire were coded as follows: SA = 4, A = 3, D = 2, SD = 1. The codes generated from the responses were computed for each participant. Each question on the MAT was scored out of five, resulting in a total possible score of 100. The MAT score for each participant was also computed. Inferential statistics were conducted using multiple regression analyses to test the hypotheses at a significance level of 0.05. The Statistical Package for the Social Sciences (SPSS) was used for the

statistical analysis. The researcher visited the selected schools and obtained permission from the school authorities. The study's goals were explained to the respondents, emphasising its significance. Participants were assured that their responses would remain confidential, and the researcher ensured that the instruments were correctly filled out with the assistance of research assistants.

3. Presentation of Results

Hypothesis: Goal orientation, self-efficacy, extrinsic motivation, and intrinsic motivation will not significantly determine the academic achievement of students in senior secondary school mathematics.

Table 1: Regression of Goal orientation, self-efficacy, extrinsic motivation, and intrinsic motivation on Students' achievement in mathematics.

Model Summary					
Multiple R = 0.669					
Multiple R ² = 0.447					
Multiple R ² (adjusted) = 0.446					
Std Error Estimate = 3.572					
F value = 240.497					
Model	Sum of Squares	Df	Mean Square	F	Sig.
Regression	3068.445	1	3068.445	240.497	.000 ^b
Residual	3789.348	297	12.759		
Total	6857.793	298			

* Significant of F at $\alpha = .05$

a. Dependent Variable: Students' performance in mathematics

b. Predictors: Goal orientation, self-efficacy, extrinsic motivation, and intrinsic motivation

Table 2: Contribution of each of the Predictor Variables to achievement of students in Mathematics

Model	Unstandardised coefficients		Standardised Coefficients	T	Sig
	B	Std.Error	Beta		
(Constant)	28.052	.088		319.964	.000
Goal Orientation	.030	.002	.044	12.601	.000
Self-Efficacy	.052	.004	.076	14.308	.000
Extrinsic motivation	.754	.002	.799	355.149	.000
Intrinsic motivation	.161	.004	.201	36.929	.000

Dependent Variable: achievement of students' mathematics

The result in Table 1 reveals the regression of the combined independent variables (goal orientation, self-efficacy, extrinsic motivation, and intrinsic motivation) on the students' achievement scores in Mathematics. The result shows a significant outcome ($F = 240.497, p < 0.05$). This implies that the combined independent variables (goal orientation, self-efficacy, extrinsic motivation, and intrinsic motivation) significantly contribute to the variance in the students' achievement in mathematics. Additionally, the result shows a multiple correlation coefficient of .669 and an R-Square value of .447, thus indicating that the independent variables (goal orientation, self-efficacy, extrinsic motivation, and intrinsic motivation) account for 44.7% of the variance in the dependent variable (students' achievement in Mathematics). Therefore, the null hypothesis is rejected. Consequently, it is concluded that the combination of goal orientation, self-efficacy, extrinsic motivation, and intrinsic motivation will significantly predict students' achievement in mathematics.

The regression model of student achievement in mathematics is $= K + aGO + bSE + cEM + dIM$,

The above regression model was obtained from the coefficients of prediction (B values) as presented in Table 2, where K is the constant of prediction. A, B, C, and D are the regression coefficients of the predictor variables, given that GO represents Goal Orientation, SE represents Self-efficacy, EM represents Extrinsic Motivation, IM represents Intrinsic Motivation, and MA represents Mathematics Achievement. Therefore, the regression model is given as:

$$MA = 28.052 + 0.030a + 0.052b + 0.754c + 0.161d.$$

Table 2 also shows the relative contribution of each of the independent variables to the prediction of senior secondary school students' achievement in mathematics. It showed that Goal orientation was a significant determinant of students' academic achievement in mathematics with ($\beta = 0.044, t = 12.601, p < 0.05$); similarly, self-efficacy shows a positive significant determinant of students' academic achievement in mathematics with ($\beta = 0.076, t = 14.308, p < 0.05$), extrinsic motivation revealed a significant determination of the dependent variable ($\beta = 0.799, t = 355.149, p < 0.05$) and intrinsic motivation also reflects a positive significant determination with ($\beta = 0.201, t = 36.929, p < 0.05$).

4. Discussion of Findings

Findings indicate that intrinsic motivation significantly influences the achievement of mathematics at the senior secondary school level. This result is consistent with the findings of Abah et al. (2022), who concluded that there is sufficient statistical evidence to suggest a noteworthy correlation between academic achievement in junior secondary school students' mathematics in Benue State, Nigeria's Ohimini Local Government Area and their intrinsic desire to master the subject. These findings also align with the conclusions of Awofala et al. (2020), who found that intrinsic motivation is a strong predictor of senior secondary school students' performance in mathematics.

Additionally, the findings highlight the significant influence of extrinsic motivation on the academic achievement of senior secondary school students in mathematics. It is also evident that extrinsic motivation is the most potent contributor to determining students' academic achievement in mathematics. This could be attributed to the low socioeconomic status of the participants' families, causing them to rely on external sources of motivation to perform well in mathematics. Similarly, students may work hard to meet the expectations of parents or teachers to avoid negative consequences, such as punishment or disappointment, which are extrinsic in nature. These results corroborate the findings reported by Adamma et al. (2018), who showed that extrinsically motivated learners achieve better academically and gradually develop intrinsic motivation over time. This development may be attributed to the rewarding teaching style employed by the teacher in the classroom, which motivates students to strive for good grades in their subjects. However, these results contradict the findings of Awofala et al. (2020), who claimed that extrinsic motivation does not significantly contribute to predicting students' academic performance in mathematics.

Furthermore, the findings indicate that students' achievement in mathematics at the senior secondary school level is highly influenced by their level of self-efficacy. Students with high levels of confidence, due to motivation, perform better in mathematics tasks. This finding is consistent with the conclusions drawn by Asanre (2023), who discovered a relationship between academic achievement and secondary school students' self-efficacy in mathematics. It is also supported by the findings of Nayab et al. (2023), who concluded that self-efficacy is a significant predictor of students' mathematics literacy.

The findings also suggest that there is a statistically significant connection between goal orientation and the mathematical achievement of secondary school students. This indicates that students' positive intrinsic motivation, extrinsic motivation, high level of self-efficacy, and goal orientation are

intertwined, shaping their decision-making regarding academic success and mathematical accomplishment. However, the findings by Deraja et al. (2023) demonstrate that there is little to no link between respondents' task-goal orientation and their mathematical academic achievement.

Finally, the findings reveal that goal orientation, self-efficacy, extrinsic motivation, and intrinsic motivation all have a significant impact on senior secondary school students' mathematical competence. Taken together, these motivational factors significantly determine students' mathematical achievement in senior secondary school. This finding supports the assertion made by Adesua (2023), who suggested that motivation plays a significant role in students' academic performance. In South West Nigeria, students' academic achievement in senior secondary school is greatly influenced by their level of motivation. This aligns with the conclusions of Hammad et al. (2022) and Ugama (2018), who found that secondary school students' success in mathematics is significantly correlated with high levels of motivation. These findings are further supported by the findings of Abah et al. (2022), who found that highly motivated students view effort positively, are not deterred by difficulties, and see setbacks as opportunities to solve problems instead of humiliations or condemnations of their abilities.

5. Conclusion and Recommendation

The results indicate that students attending senior secondary schools in Ogun State, Nigeria, specifically in Ijebu Ode Local Government Area, have their academic achievement in mathematics strongly determined by motivational factors. The independent variables of intrinsic motivation, extrinsic motivation, self-efficacy, and goal orientation all show significant influence on the academic achievement of senior secondary school students. However, it is important to note that the outcomes of this study may have been influenced by other factors, such as environmental factors, parental involvement, and peer influence. The level of motivation provided by parents, teachers, and friends can greatly impact a student's academic outcomes. Therefore, it can be concluded that intrinsic and extrinsic motivation, self-efficacy, and goal orientation are key factors in determining the academic achievement of senior secondary school students in mathematics in Ijebu Ode, Ogun State, Nigeria. However, it should be noted that the findings of this study cannot be generalised to all senior secondary school students in Nigeria due to the limited sample size used. Recommendations based on these findings include encouraging interactive lessons and self-directed exploration to foster a genuine desire for learning and to excel in mathematics. Implementing reward systems or publicly acknowledging academic achievements can also help motivate students. Additionally, guidance should be provided to students on breaking down larger goals into smaller, manageable tasks to foster a higher level of goal orientation. Open communication between parents, teachers, and students should be encouraged to create a collaborative learning environment that reinforces motivation and positive academic outcomes. Furthermore, future studies can be conducted in other parts of the country and in different fields, taking into consideration intervening variables, as the results of this study can serve as a foundation for further research on motivational factors as determinants of students' achievement in mathematics among secondary schools.

6. Declarations

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