

Predicting Mathematics Student S' Learning Outcomes in Senior Secondary School using Dimensions of Academic Engagement

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Abstract

Academic engagement is a potential antidote to issues surrounding students' learning outcomes. It is a multidimensional construct, which comprises of three aspects such as; emotional, cognitive and behavioural engagement. These dimensions are vital to one another and should not be considered in isolation. This paper investigated the dimensions of students' academic engagement as predictors of male and female self-efficacy in and attitude to Senior Secondary School Mathematics. The study used an ex-post facto correlation approach. 1680 students from Senior Secondary School Two made up the study's sample from the twenty one randomly selected schools in the three Local Government Areas of Remo division of Ogun State. Three instruments were used namely, Mathematics Student Academic Engagement Scale (MSAES) with $r = 0.776$; Mathematics Attitude Scale (MAS) with $r = 0.928$ and Mathematics Self Efficacy Scale (MSES) with $r = 0.882$. Findings showed a significant contribution in male students' attitude to Mathematics ($F = 149.857$, $p < 0.05$) and self-efficacy in Mathematics ($F = 146.368$, $p < 0.05$). The study revealed that the predictor factors significantly explain the variation in female students' attitudes toward mathematics when they are combined ($F = 182.978$, $p < 0.05$) and self-efficacy in Mathematics ($F = 239.960$, $p < 0.05$). This study concluded that cognitive, emotional and behavioural engagements are good predictors of the secondary school mathematics self-efficacy and attitude of male and female students. To increase students' self-efficacy in and attitude toward mathematics, stakeholders in Nigerian education are advised to make sure that students are engaged cognitively, emotionally, and behaviourally.

Keywords: Academic engagements, Attitude, Learning outcomes, Mathematics, Self-efficacy.

INTRODUCTION

Mathematics is seen as important subject that is vital to people in various aspects of life such as science, technology, education, economy, business or in other walks of life, in which its teaching involves numeracy, orderliness, logic, accuracy and precision in thought, [1]. Also, [2] reported that Politics, economics, science, and technology are just a few of the many facets of human activity that are impacted by the intellectually engaging field of Mathematics, therefore it serves as a model for how scientific ideas should be understood and used. In fact, without it, individuals would find it challenging to learn other disciplines like physics, chemistry, biology, and computer science/information technology [3]. This makes it the "queen" of the sciences.

Researchers have equally pointed out some students factors that contribute to low achievement such as entry level/background, anxiety, attitudinal problem, lack of interest in Mathematics, self-concept, study habit, achievement motivation, disadvantaged exposure, techniques of solving problems, misconception of Mathematical terms and symbols, misinterpretation of word problems, failure to adhere to examination instructions, gender issues and insufficient preparation for Mathematics examinations [4].

Students' opinions and beliefs regarding their achievement in Mathematics, each of these factors may be viewed as a distinct component of an individual's attitude toward mathematics, depending on how much they like and respect mathematics as well as what they anticipate for their own future education. [5]. [6] opined that due to widespread failure in the subject, a lot of students have a bad attitude about studying mathematics, therefore students' attitude towards Mathematics has long been a shared passion of math teachers, and this is seen to be a key element in influencing students' involvement in and success in math. In agreement with the researcher, Depending on how students feel about mathematics, attitudes can be characterized as either good or negative [7].

[8] reported student attitudes toward mathematics are general assessments of one's liking or disliking of mathematics, their propensity to engage in or refrain from mathematical activities, and their opinion of whether mathematics is beneficial or not. The development of positive attitudes is a goal for many educational systems; they are seen as necessary for students' academic engagement and to boost learning. Attitudes are learners' predispositions that reflect the school's habitual character and the larger social context in which Mathematics instruction occurs. As a result, attitudes can be influenced by policy. There is a favorable association between attitudes toward Mathematics and academic accomplishment [5].

[9] reported that Mathematics academic engagement is influenced by attitude because students with negative attitude will see no reason to engage in the learning of Mathematics. [10] argued that students' perceptions of their academic talents influence how they approach learning and how well they do in class, this is as a result of what students believe they can accomplish. Students that have a positive outlook may think that mathematics is relevant to their daily lives or that it is fun to solve mathematical issues. Even while they might think mathematics is essential, they might not think they have the skills necessary to solve a mathematical issue. This suggests that even someone with a positive attitude may not be very self-effective. On the other hand, if they think that mathematics is significant, they could stick with it and gradually increase their self-efficacy. [11].

[12] opined that self-efficacy is one factor that affects student engagement in academics which then affects performance of the student. Also, [11] asserted that students who lack confidence feel they can't do a work, think it's useless, and don't want to invest the time and effort necessary to accomplish it. As a result, they don't want to participate in the task. [13] reported that students that lack self-efficacy may attempt to avoid engaging in learning activities voluntarily or become academically involved, which will lead to failure. Self-efficacy, according to [14], is an individual's self-belief or personal judgment about a student's skills. This assessment is mostly a cognitive one of one's capacities to fulfill an upcoming performance based on prior performances.

[15] according to their study, students who hold low efficacy beliefs exhibit fear and reluctance to study mathematics, but to make them attain high efficacy focus must be on their level of involvement, which implies adequate academic engagement. The issue of gender cannot be overlooked, as it is a key point when talking about the attitude and self-efficacy of students in secondary schools. [16] reported that Girls frequently underrate their capacity for science and mathematics, he also found that compared to male pupils, female students exhibit poorer self-efficacy in mathematics and science. Students show some level of difficulty with Mathematics as they transit to secondary school [17].

Most of the students are yet to develop the rudiments of Mathematical concepts in order to be successful in Mathematics. To help learners reach their potential in Mathematics, the learning environment needs to be a place where students are more engaged in learning. Students with low self-esteem may also lack the motivation to participate in their classes [18]. Also, it is observed by the researcher that in our secondary schools today, students don't learn much in class and have a negative attitude toward education, harder to motivate, more difficult to hold their attention and only a few of these students are interested in what goes on in the class. This is supported by [19] they reported that there is a shortcoming trend in the development of academic commitment and student learning outcomes in secondary schools in Nigeria. Hence, this lack of engagement has been a persistent problem and potentially harmful to the future well-being of the educational system in Nigeria.

[20] reported that the idea of "academic engagement" is based on the idea that when students are curious, engaged, or inspired, their learning is often better than when they are bored. The engaged students are more attentive, excited, involved, and eager to participate in teaching and learning activities. According to [21], student engagement is a multifaceted concept that includes their feeling of agency, self-efficacy, and drive to succeed in their classes. It also includes their sense of belonging and connectivity to their school, instructors, and classmates. [22] reported that since high levels of engagement are linked to a variety of desired learning outcomes, student engagement is a crucial learning tool.

Therefore, in order to attain effective learning outcomes, [23] said that student academic engagement is the quality and quantity of their psychological, cognitive, emotional, and behavioral responses to the learning process as well as to in-class/out-of-class academic and social activities. Students' cognitive, emotional, and behavioral reactions to in-class activities are considered indicators of class engagement. [24] reported that students' academic engagement is not only the number of times students respond but the quality of their responses in terms of the intensity and quality of their participation during the instructional procedure.

In line with [23], it is stated that before students may become cognitively engaged, they must be present in class (behaviourally engaged) and feel emotionally at ease and connected to others (emotionally engaged). Since this three-dimensional model was developed through a comprehensive synthesis of research, it covers essentially everything in educational settings [22]. In essence, emotional and behavioral engagements are prerequisites for intellectual involvement. Behavioural engagement can be seen from the engagement of the students and their eagerness to ask and respond to questions during the teaching and learning process [25].

According to [26], emotional engagement is viewed as an affective orientation toward both learning itself and school-related entities include classmates, instructors, and the institution. While Cognitive engagement is students' investment tailored to their demands and how they appreciate the mental challenges, in their own learning [23]. It is on this background that this study looks at predicting Mathematics students' attitude and self-efficacy in senior secondary schools using behavioural, emotional and cognitive engagement in Remo division of Ogun State.

OBJECTIVES OF THE STUDY

This study's goal is to determine male and female secondary school students' learning outcomes that is attitude towards and Mathematics self-efficacy are predicted by dimensions of academic engagement (behavioural, emotional and cognitive)

Statement of Hypotheses

The 0.05 level of significance will be used to assess the following hypotheses that were developed for this investigation.

1. Cognitive, behavioural and emotional engagements, when taken together, will not substantially predict male students' attitude towards mathematics in senior secondary school.
2. Cognitive, behavioural and emotional engagements, when taken together, will not substantially predict male students' mathematics self-efficacy in senior secondary school.
3. Cognitive, behavioural and emotional engagements, when taken together, will not substantially predict female students' attitude towards mathematics in senior secondary school.
4. Cognitive, behavioural and emotional engagements, when taken together, will not substantially predict female students' mathematics self-efficacy in senior secondary school.

MATERIALS AND METHODS

A correlation study using an ex-post facto research approach was used in this investigation, sample comprises of one thousand six hundred and eighty students (1680) which were selected from twenty one (21) public senior secondary schools in Ogun East Senatorial District (Remo Division) of Ogun state, using purposive and simple random sampling technique. This technique was used because there is scarcity of study on student academic engagement aspects as predictors of senior secondary school Mathematics learning outcomes in Remo Division, Ogun State, Nigeria.

Mathematics Student Academic Engagement Scale (MSAES), Mathematics Attitude Scale (MAS) and Mathematics self-efficacy Scale (MSES) was utilized to obtain data from the students. The MSAES is a four-point type scale adapted from the scale of [27], with choices from Strongly Agree to Strongly Disagree. There are four divisions on the instrument, numbered A through D. The demographic data of the students are contained in Section A. The demographic information entails the student name, school name, sex and class. There are 10 items in Section B eliciting information on behavioural engagement of the students. Section C contains 10 questions collecting data on emotional engagement of students while Section D also contains 10 questions collecting data on cognitive engagement of students offering Mathematics. MAS are made up of twenty items (20) of both positive and negative statement which bothers on the student's Mathematics attitude adapted from the scale of [28]. The scale has four points, with choices from Strongly Agree to Strongly Disagree. Also MSES consist of 20 items eliciting information on student's level of self-efficacy in mathematics adapted from [29]. Copies of the instrument were granted to subject-matter specialists of psychology education for feedback on the suitability of items about the language's precision and the items' relevance, their contributions and suggestions were used to raise the instrument's level of quality. Validated instruments were trial tested on twenty five (25) students from another school to improve the instrument's quality, using the Cronbach alpha reliability coefficient as a reliability measure, it was estimated to be MSAES = 0.776, MAS = 0.928, MSES = 0.882 respectively.

The selected schools were visited by the researcher and permission was taken from the school authority then the respondents were briefed on the purpose of the study and clarification was made on the importance. As the respondents were informed that their answers would be kept confidential, the researcher makes sure the instruments are correctly filled out with the assistance of research assistants. Data collected was analyzed using multiple regression analysis.

RESULTS AND DISCUSSION

H₀₁: Cognitive, behavioural and emotional engagements, when taken together, will not substantially predict male students' attitude towards mathematics in senior secondary school.

Table 1: Regression of the Predictor Variables on Male Students' attitude towards Mathematics

Multiple R = 0.606					
Multiple R ² = 0.367					
Adjusted R ² = 0.364					
Std. Error of the Estimate = 8.242					
Gender = Male					
Model	Sum of Squares	Df	Mean Square	F	Sig. of F
Regression	30537.124	3	10179.041	149.857	.000*
Residual	52709.875	776	67.925		
Total	83246.999	779			

* indicate significant F at $\alpha = .05$

The outcome of the regression of the combined three predictor variables (cognitive, behavioral, and emotional engagements) on the attitude toward mathematics of the sampled male students is shown in Table 1. The outcome is significant ($F = 149.857$, $p 0.05$), according to the result. This suggests that the predictor variables significantly contribute to the variation in the male students' attitudes toward mathematics when viewed as a whole.

H₀₂: Cognitive, behavioural and emotional engagements, when taken together, will not substantially predict male students' mathematics self-efficacy in senior secondary school.

Table 2: Regression of the Predictor Variables on Male Students' Self-efficacy in Mathematics

Multiple R = 0.601					
Multiple R ² = 0.361					
Adjusted R ² = 0.359					
Std. Error of the Estimate = 7.458 Gender = Male					
Model	Sum of Squares	Df	Mean Square	F	Sig. of F
Regression	24422.596	3	8140.865	146.368	.000*
Residual	43160.372	776	55.619		
Total	67582.968	779			

* indicate significant F at $\alpha = .05$

The results of the regression of the combined three predictor variables (cognitive, behavioral, and emotional engagements) on the self-efficacy scores of the male students in mathematics are displayed in Table 2. The outcome is significant ($F = 146.368$, $p 0.05$), according to the result. This suggests that the predictor variables significantly contribute to the variation in the male students' self-efficacy in mathematics when taken as a whole.

H₀₃: Cognitive, behavioural and emotional engagements, when taken together, will not substantially predict female students' attitude towards mathematics in senior secondary school.

Table 3: Regression of the Predictor Variables on Female Students' attitude towards Mathematics

Multiple R = 0.616					
Multiple R ² = 0.380					
Adjusted R ² = 0.378					
Std. Error of the Estimate = 8.016					
Gender = Female					
Model	Sum of Squares	Df	Mean Square	F	Sig. of F
Regression	35273.907	3	11757.969	182.978	.000*
Residual	57576.133	896	64.254		
Total	92850.040	899			

* indicate significant F at $\alpha = .05$

The results of the regression of the combined three predictor variables (cognitive, behavioral, and emotional engagements) on the attitude toward mathematics of the sampled female students are shown in Table 3. The outcome is significant ($F = 182.978$, $p 0.05$), according to the result. This suggests that the predictor variables, when considered collectively, significantly contribute to the variation in the attitude toward mathematics among female students.

H₀₄: Cognitive, behavioural and emotional engagements, when taken together, will not substantially predict female students' mathematics self-efficacy in senior secondary school.

Table 4: Regression of the Predictor Variables on Female Students' Self-efficacy in Mathematics

Multiple R = 0.667					
Multiple R ² = 0.446					
Adjusted R ² = 0.444					
Std. Error of the Estimate = 6.862 Gender = Female					
Model	Sum of Squares	Df	Mean Square	F	Sig. of F
Regression	33897.073	3	11299.024	239.960	.000*
Residual	42190.087	896	47.087		
Total	76087.160	899			

* indicate significant F at $\alpha = .05$

The results of the regression of the combined three predictor variables—cognitive, behavioural, and emotional engagements—on the self-efficacy scores for female students in mathematics are displayed in Table 4. The outcome is significant ($F = 239.960$, $p = 0.05$), according to the result. This suggests that the predictor variables significantly contribute to the variation in the self-efficacy of female students in mathematics when viewed as a whole.

DISCUSSION OF FINDINGS

Findings are presented and discussed with reference to the analyses obtained, employing inferential statistics from multiple regression analysis to test hypotheses at a level of significance of 0.05.

The finding revealed that cognitive, behavioural and emotional engagements, when taken together, significantly predict the attitudes of Senior Secondary School pupils, both male and female, toward mathematics as shown in table 1 and 3, this conclusion is somewhat consistent with the [30] research that female students show high classroom support than the male students but [31] suggested when students are actively participating in academics, there is no discernible difference in the attitudes they have about mathematics between male and female students.. Finally, the finding of this study revealed that cognitive, behavioural and emotional engagements, when taken together, significantly predict the self-efficacy in mathematics of senior secondary school students, both male and female as shown in table 2 and 4, the findings is at variance with the work of [32] who concluded that female students lack confidence when performing mathematics calculations and perception that mathematics is a masculine domain. [16] is also in support of the finding by Meelissen and Luyten that when compared to male students, female students had poorer self-efficacy in mathematics.

CONCLUSION

The study's findings supported the assertion that when students are cognitively engaged it improved their attitude towards Mathematics bringing about positive attitudinal traits and the level of confidence is increased. Also the behavioural aspect was significant which shows that the level at which students participate and put effort in their learning process brought about improvement in attitude and possess high self-efficacy. Similarly emotional engagement was significant on all the outcomes (attitude towards and self-efficacy in Mathematics). Therefore the dimensions of students' academic engagement are good predictor of attitude towards and self-efficacy in senior secondary school mathematics.

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