

Attitude towards Mathematics and Academic Engagement as Predictors of Primary School Pupils' Achievement in Mathematics

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Abstract

Mathematics achievement of young children gives them the opportunity to advance in technology and science related courses later in life. However, many pupils are not enthusiastic and well-disposed to learning mathematics due to some factors such as teachers' attitudes, erroneous beliefs, teaching methods, learning environment, students' engagement among others. This study explored academic engagement and attitude towards mathematics to establish the influence of these variables on pupils' mathematics achievement. Two hundred and fifty Basic six pupils were randomly selected from ten randomly selected public primary schools in Ijebu North East LGA of Ogun State. Data were collected with the adapted version of Attitudes towards mathematics inventory (ATMI), student engagement in mathematics scale (SEMS) and the Mathematics Achievement Test (MAT). The reliability coefficient of ATMI and SEMS were 0.61 and 0.74 respectively while the reliability coefficient of the MAT was 0.55. Data were analysed using Pearson Product Moment Correlation Coefficient and Multiple Regression Analysis at 0.05 level of significance. The findings demonstrated a strong positive correlation between students' academic involvement and their proficiency in mathematics. Additionally, research demonstrated a positive correlation between mathematical achievement and attitude. It was recommended that primary school pupils should attend mathematics class regularly, this is because regular attendance at school will help pupils observe how mathematics questions are solved by teachers. Primary school teachers should relate mathematics to real life experiences so as to make the children note the connection between mathematics and their day-to-day activities.

Keywords: Academic Engagement, Attitude towards Mathematics, Mathematics Achievement

Pupils' achievement in mathematics sets them in the right trajectory to succeeding in science related courses in secondary schools and higher institutions later in life. This is due to the significant role mathematics plays in the

scientific and technological advancement of an individual and the overall development of a nation. The Organization for Economic Co-operation and Development, or OECD, (2016) highlighted that a country's fiscal development and well-being are a direct outcome of its population's proficiency in mathematics. However, many pupils are of the opinion that mathematics is tedious and difficult (Burkett, 2002; Pope, 2002; Okafor & Uche, 2013; Otoo, Iddrisu, Kessie, & Larbi, 2018); thus, affecting the engagement (Advisory Committee of Mathematics Education, 2011) and the attitude of pupils towards the subject (Mohamed & Waheed, 2011; Mata, Monteiro & Peixoto, 2012; Ngussa and Mbuti, 2017). Teachers' attitudes (Uluget. *al.*, 2011), students' attitudes toward Mathematics (Mahanta, 2014, Hwang & Son, 2021), the learning environment (O'Hara *et. al.*, 2022), parent involvement, teacher encouragement, student engagement (Muller, Stage & Kinzie, 2001), governmental factors, infrastructure issues, class size, mathematics anxiety (Mohamed & Tarmizi, 2010), and other factors have all been identified by scholars as potentially influencing students' mathematical achievement. One of the most important strategies to improve students' academic performance in schools is to support their academic engagement (Dotterer, McHale, & Crouter, 2007; Guthrie, Wigfield, & VonSecker, 2000). Academic engagement are the activities that pupils partake in in relation to their education as well as behavioural activities (Mahboob & Saeed, 2021). Chapman (2003) and Skinner *et.al.*, (2009) asserted that academic engagement encompasses pupil's enthusiastic participation in academic undertakings, which includes regular attendance in school, the keenness demonstrated at teacher's instructions and completion of school work/assignments. Lee and Shute (2010) defined academic engagement as the degree of psycho-social drive a pupil devotes to completing an educational work. Additionally, students use behavioral, cognitive, and emotional engagement as the three components of academic engagement in order to learn. Engagement via behavior relates to class involvement by means of applying vigor, force, and persistence particularly constructive collaboration and communication in classroom activities (Northey *et. al.*, 2015). Emotional engagement refers to active emotional condition for instance, pleasure, enthusiasm and interest that is experienced in the classroom or in the teaching and learning process (Skinner *et. al.*, 2009). Costa and Farla (2020) averred that emotional engagement indicates the dedication or optimistic impact with regard to academic activities. While cognitive engagement entails self-regulating behaviours, keeping an eye on own learning, putting forth intellectual efforts, and aspiring to attain academic success (Uden, *et. al.*, 2014; Archambault & Dupéré, 2017).

It is impossible to overstate the value of academic engagement. For example, children who are emotionally engaged are more interested in learning mathematical concepts and will not see education as a fraud but rather as a way to get ready for adulthood. (Skinner & Belmont, 1993; Finn & Voelkl, 1993). Since mathematics is sometimes perceived as less exciting and enjoyable than other subject matters (Grootenboer & Marshman, 2016) and many schoolchildren experience anxiety when learning it (Jackson & Leffingwell, 1999; Radišić, Videnović, & Baucal, 2015), pupils' affective engagement is especially important for mathematics learning. According to Radišić *et. al.*, (2015), pupils who exhibit negative emotional states, such as anxiety during learning Mathematics, may receive low grades in the subject. On the other hand, pupils who are emotionally invested and have a positive outlook, such as joy and contentment in their Mathematical education (Frenzel, Pekrun, & Goetz, 2007; Pekrun, Frenzel, Goetz, & Perry, 2007), would perform better in Mathematics (Goldin, Epstein, Schorr, & Warner, 2011). Additionally, pupils' behavioral engagement reflects their actions during the learning process and in the classroom, as evidenced by their focus on Mathematics assignments and discussions of Mathematics problems with friends (Finn & Voelkl, 1993). According to the National Research Council and Institute of Medicine (2009), pupils who are more behaviorally engaged attend class more frequently and work harder throughout their courses. Additionally, they are more likely to overcome early learning difficulties and connect what they have learned to basic Mathematical concepts (VomHofe, 2001; Pierce & Stacey, 2004). As a result, their academic performance is exceptional (VomHofe, 2001; Klem & Connell, 2004; Pierce & Stacey, 2004; National Research Council and Institute of Medicine, 2009).

Moreover, pupils who persist in solving Mathematics problems and use cognitive approaches in the learning activity—such as processing a lot of data when solving a Mathematics problem—are more likely to be cognitively engaged (Fredricks, Blumenfeld, & Paris, 2004; Walker, Greene, & Mansell, 2006; Mahatmya, Lohman, & Matjasko, & Farb, 2012). Perhaps as a result of their greater motivation in learning mathematics (Thatcher, 2001; Bragg, 2007; Thiessen & Blasius, 2008; Bal, 2012; 2013), cognitively engaged students perform better academically (Green *et. al.*, 2004; Spanjers, 2007).

Previous research on the connection between academic engagement and achievement has not consistently

produced reliable findings. For example, research by Finn and Zimmer (2012), Deveci and Karademir (2019), and Finn and Voelkl (1993) have demonstrated that academic achievement is predicted by academic engagement. However, academic engagement did not significantly predict mathematics success, according to a study by Sunawanet. *al.*, (2017). In a similar vein, Wong, Lam, and Kong's (2003) study demonstrated that there was no connection between academic engagement and mathematical proficiency. It is suitable for this study to determine the association between primary school pupils' academic engagement and mathematics achievement based on the explanation above.

According to Sarmah and Puri (2014), attitude is the taught propensity of an individual to react either positively or negatively to an idea, a circumstance, an object, or a person. It is also regarded as a viewpoint that people have that reflects their feelings and convictions and is sometimes manifested in behavior (Joseph, 2013). Mohamed and Waheed (2011) opined that attitude is associated with evaluations of groups, people and other types of things in our community. They emphasized the importance of attitude since it affects both the way the natural world is perceived and the way actions are taken. The things individuals take pleasure in usually control their activities. Attitudes, likes and dislikes immensely have great influence on a person's disposition and comportment (Mohamed & Waheed, 2011). The idea of attitude towards mathematics originated from attitudes (Wang, 2017). Ajzen (1993) put forward the ABC Attitude Model in describing attitude towards Mathematics. In his conceptualization of attitudes, he distinguished three measurable combinations: affect (A), behavior (B), and cognition (C). In the model, affect refers to emotion, that is, the pleasure or nervousness that occurs when learning Mathematics as a subject matter that is difficult, dull, or interesting. Behaviour implies pupils' behavioural predispositions in Mathematics classes, which are linked to their enthusiasm to learn Mathematics. While, cognition refers to the consciousness of the utility of mathematics. In the same vein, Tapia and Marsh (2004) submitted that an individual's attitude towards mathematics has four subscales, which include enjoyment, value, self-confidence, and motivation. They further explained that enjoyment is the liking or disliking of mathematics; value is the conviction that mathematics is beneficial or not; self-confidence conveys the assurance that one is excellent at mathematics or not; and finally, motivation is the predisposition to participate in Mathematical activity or steer clear of Mathematics.

He (2007), expressed that pupils' attitudes towards Mathematics develop through motivation to participate in Mathematics activities, enjoyment of Mathematics, and the conviction that Mathematics is beneficial, significant and trustworthy. Attitude towards Mathematics refers to the positive or negative disposition of pupils to Mathematics learning. According to earlier research, pupils' attitudes toward Mathematics and their Mathematical accomplishments are positively correlated (Bramlett & Herron, 2009). Additionally, Hwang and Son (2021) demonstrated in their research that pupils' attitudes toward learning Mathematics have a significant impact on their academic performance; students with negative attitudes will hinder effective learning and, eventually, their success, while students with positive attitudes will also perform better in the subject (Joseph, 2013; Nusantara *et. al.*, 2020; Lelasari *et. al.*, 2021). Nevertheless, prior research on the connection between students' attitudes toward Mathematics and their mathematical achievement has been inconsistent (He, 2007; Hacıomeroglu, 2017). For instance, Bouchy and Harter (2005), Foire (1999), Samuelsson and Granström (2007) discovered that negative attitudes towards Mathematics frequently give rise to poor engagement and low pupils achievement. On the contrary, Phan (2008), in his comparative study on the performance of students in the USA, Canada, Egypt and South Africa, established that Egyptian students had high positive attitudes in spite of their low point of performance. In the bid to justify this correlation, Phan revealed that such attributes may be linked to the culture of nationality, particularly in developing nations, if attitudes have a tendency to rise irrespective of the level of achievement. In a similar vein, Jaafari's (2010) study found a negative correlation between Saudi students' attitudes toward mathematics and their mathematical proficiency. Because of the disparity in previous research, this study is necessary to determine whether students' attitudes toward mathematics and academic engagement would predict their mathematical success.

Objective of the Study

The objectives of this study are to:

- To determine the relationship between academic engagement and Mathematics achievement of primary school pupils.
- To ascertain the relationship between pupils' attitudes towards Mathematics and Mathematics achievement.

- To verify the combined influence of the independent variables (academic engagement and attitude towards mathematics) on the dependent variable (Mathematics achievement) of pupils.

The following hypotheses were proposed for the research:

H₀1: There is no significant correlation between pupils' achievement in Mathematics and their level of academic engagement.

H₀2: Pupils' attitudes toward Mathematics and their mathematical achievement are not significantly correlated.

H₀3: There is no significant relationship of the combined influence of academic engagement and attitude on pupil's mathematics achievement.

Methodology

For this study, a survey using a descriptive research design was employed. All Basic 6 pupils in Ogun State's Ijebu North East Local Government Area made up the population. Ten public primary schools were chosen using a simple random selection procedure, and twenty-five (25) pupils were chosen at random from each school. Two hundred and fifty Basic six pupils participated in the study. Three components make up the instrument used to gather data for the study. Section A comprises demographic data, such as age, gender, and class while the Section B consists of two sub-scales which are attitude towards Mathematics and student engagement in Mathematics scale (SEMS) and Section C entails Mathematics achievement Test. Attitudes towards mathematics inventory (ATMI) by Tapita (1996) was adapted in this study. Thirty-five items were adapted out of the original forty items to measure attitude/behaviour. A 4-point Likert scale, with "Strongly Agree" to "Strongly Disagree" as the extremes, was employed. Examples of attitudes items include "I wish to improve my mathematical abilities," "Mathematics does not scare me at all", "I really like mathematics", and "The challenge of Mathematics appeals to me". The student engagement in Mathematics scale (SEMS), (Leis, et.al., 2015) was adopted in this study. "Students in my class helped each other learn today," "I enjoyed thinking about mathematics today and "Today in math class, I had to think a lot." are samples of items for measuring student engagement in Mathematics. The instrument consists of 18 items, each of which is scored on a 4-point scale that goes from "No, not at all true" to "Yes, very true." Section C is the Mathematics Achievement Test. It has 20 items with multiple choice answers (a-d), it was used to assess pupils' achievement in Mathematics. The reliability coefficient of attitudes towards Mathematics and student engagement in Mathematics scale are 0.61 and 0.74 respectively using Cronbach Alpha method. The split-half method was used to determine reliability coefficient for the Mathematics achievement test which was 0.55.

Frequency counts, percentages, Pearson product moment correlation, and multiple regression analysis were used to analyze the study's data.

Results

Table 1
Gender Frequency of Pupils

Gender	Frequency	Percentage
Male	106	42
Female	144	58
Total	250	100

Table 1 shows pupils' distribution by gender. The table shows that only 106 (42%) of the pupils are male and 144 (58%) are females. This further implies that there are more females in the sample.

Hypothesis 1: There is no significant correlation between pupils' achievement in mathematics and their level of academic engagement.

Table 2
Relationship between academic engagement and pupil Mathematics achievement

Variables	Mean	Std	N	R	Sig
Academic engagement	26.12	12.10	250	.139	.026
Mathematics achievement	24.22	12.03			

Table 2 shows measure of relationship between academic engagement and mathematics achievement. The two variables exhibit a strong positive correlation ($r=.139$, $P < 0.05$). It also shows mean score of 26.12 (Std = 12.10) for academic engagement and 24.22 (Std = 12.03) mean score for Mathematics achievement with relationship of 0.026. Thus, there is a strong correlation between pupils' academic engagement and their success in Mathematics.

Hypothesis 2: Pupils' attitudes toward mathematics and their Mathematical achievement are not significantly correlated.

Table 3
Relationship between pupils' mathematical achievement and attitudes about the subject

Variables	Mean	Std	N	R	Sig
Attitude towards Mathematics	22.23	13.32	250	.188	.003
Mathematics Achievement	24.22	12.03			

Table 3 demonstrates the connection between mathematical achievement and attitude. It shows the two variables have a significant positive connection ($r=.188$, $P < 0.05$). The table shows mean score of 22.23 (Std = 13.32) for Attitude towards Mathematics and 24.22 (Std = 12.03) mean score for Mathematics achievement.

Hypothesis 3: There is no significant relationship of the combined influence of academic engagement and attitude on pupil's mathematics achievement.

Table 4
Regression Analysis of Combined Influence of Academic Engagement and Attitude Towards Mathematics on Pupil Mathematics Achievement

ANOVA						
	Model	Sum of Squares	Df	Mean Square	F	Sig
R =0.216	Regression	520.700	1	2805.603	2.173	.0000
R² = 0.046	Residual	76232.34	198	303.360		
Adj. R² = .088	Total	79038.57	199			
Std Error=9.51291						

Table 4 show the results of the regression of the predictor variables (academic engagement and attitude towards Mathematics) on pupils' Mathematics achievement. The outcome is significant ($F = 2.173$, $p < 0.05$), according to the results. This suggests that the variables that predict academic engagement and attitude towards mathematics, contribute significantly to the variance in pupils' mathematics achievement. With an R^2 value of 0.46, an adjusted R^2 value of 0.088, and a multiple correlation coefficient of 0.216, the results indicate that the predictor variables

explained 4.6% of the variance in the dependent variable. As a result, pupils' performance in Mathematics is greatly influenced by both their attitude toward Mathematics and their level of academic engagement.

Discussion of Findings

The results of hypothesis one demonstrated a strong positive correlation between pupils' academic engagement and their proficiency in mathematics. The implication of this is that when there is an increase in academic engagement, there is also a significant increase in mathematics achievement. This outcome supports previous findings by Finn and Zimmer (2012), Deveci and Karademir (2019), and Finn and Voelkl (1993). This is probably because the pupils that participated in the study are in Basic six class and Basic six class is a transition class where the children will be proceeding to secondary school. All hands are on deck to ensure the children come out in flying colours so that they can gain admission into secondary schools of their choice. On the other hand, the result of this study negates the report of Sunawan, *et.al.*, (2017), They discovered that mathematical achievement was not strongly predicted by academic engagement. The conclusions of Wong *et. al.*, (2003) are likewise refuted by the results of this investigation. They found no connection between mathematical achievement and academic engagement.

The second hypothesis's conclusion showed a strong positive correlation between pupils' achievement in Mathematics and their attitudes about the subject. This suggests that there is a substantial rise in mathematical achievement together with an improvement in attitude toward the subject. This outcome is consistent with the research conducted by Hwang and Son (2021) and Bramlett and Herron (2009). A possible explanation for this result might be due to the preparation for external examination into secondary schools. This might have improved the pupils' attitude toward mathematics and, consequently, their performance in the subject. However, Phan (2008) and Jaafari (2010) found that learners' attitudes toward mathematics and their mathematical achievement were negatively correlated.

The third hypothesis's analysis revealed a significant result ($F = 2.173, p < 0.05$). This suggests that the variables that predict academic engagement and attitude towards mathematics, play a major role in the variation in pupils' performance in mathematics. Accordingly, the combination of academic involvement and attitude toward mathematics has a considerable impact on pupils' mathematical achievement, which is consistent with the findings of Bouchy and Harter (2005), Foire (1999) and Samelsson and Granström (2007). The possible explanation for this result may be as a result of the engagement and positive attitude of the pupils towards Mathematics. Another possible reason for result, may be because experienced teachers are employed to handle the upper primary class and this might have increased the engagement of the children and make them have a positive attitude towards mathematics.

Conclusion

As a result of these findings, it was concluded that academic engagement and attitude towards Mathematics influence pupils' Mathematics achievement. It is determined that pupils' attitudes and levels of participation in mathematics education are critical factors in determining their academic success.

Recommendations

The study's conclusions led to the following suggestions being made.

- The primary school pupils should attend mathematics class regularly; this is because regular 'attendance at school will expose pupils to various ways mathematics questions could be solved by teachers.
- Mathematics has to do with problem solving therefore pupils should be resolute and determined in order not to develop academic disengagement which will affect their mathematics achievement in the long-run.
- Primary school teachers should relate mathematics to real life experiences so as to make the children see the connection between mathematics and their day-to-day activities thereby making the pupils to be well-disposed towards mathematics.
- Teachers should motivate pupils to learn mathematics by making it interesting and enjoyable by solving many problems, they can relate with and also giving them hands-on activities and manipulatives. The students' attitude toward mathematics will improve as a result of the approach.

- Teachers should encourage pupils to cultivate a favorable attitude toward mathematics as a subject through the use of reinforcements such as verbal praise, special privileges (choosing a classroom activity), tangible rewards (like stickers).

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