An Analysis of Correlates of Achievement in Mathematics at the Senior School Certificate Examination

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Abstract

In this article, the correlates of achievement in mathematics of Senior Secondary School three (SS3) students at the Senior School Certificate Examination in Ika North-East and Ika South Local Government Areas of Delta state, Nigeria was examined. The study employed the correlational and ex-post facto research design. The sample for the study comprised of three hundred and sixty (360) SS3 students randomly selected from twelve (12) public senior secondary schools in two local government areas of Delta North Senatorial district. The instruments used were Students' Mathematics Achievement Test (SMAT) and Students' Attitude to Mathematics Scale (SAMS). Two-way (2x2) Analysis of Variance (ANOVA) and Pearson's r inferential statistics were used to analyze the data collected. The results revealed that: There is a positive significant relationship between students' attitude and their academic achievement in mathematics. There is a significant difference in mathematics achievement of students of urban schools and rural schools. There is a significant interaction influence of gender and school location on the achievement of students. Considering the central role of attitude and school location in mathematics achievement of students, it was recommended among others: Government should bridge the gap between the rural and urban locations by providing the rural dwellers basic facilities and amenities that will enhance better academic achievement of students in SSCE and also make life meaningful, competitive and creative. The Parent Teacher Association (PTA), Philanthropist and other charitable organizations are also implored to compliment the effort of the government to boost the achievement of students by building Mathematic laboratories and providing library facilities in schools.

Keywords: Mathematics; Academic achievement; student's attitude; School location; Interaction influence

Introduction

Some countries are described as developed today due to the level of the development of science and technology in that country. Science and technology uses mathematics as its basic tool (Kolawole & Udeh, 2012). Hence, Ukeje (2005) stated that without mathematics, there is no science; without science there is no modern technology; and without modern technology there is no modern society. In other words, mathematics is the precursor and the Queen of science and technology and the indispensable

single element in modern societal development. Mathematics serves as a tool for use in science, technology and industries. This implies that the increase in the knowledge and the achievement in mathematics of the citizens of a nation is directly proportional to the level of development of science, technology and industries in that nation.

The students' academic achievement in mathematics is not just a concern for a particular country, but has become a global concern over the years, that originated the Trends in International Mathematics and Science Study (TIMSS) assessment of 1995, 1999, 2003, and 2007. The annual reports of the Chief Examiners in mathematics indicate that students' achievement in senior secondary school certificate mathematics examinations remains very low. Uwadiae (2012) reported that 38.81% of the total candidates who sat for West African Senior School Certificate Examination (WASSCE) May/June 2012, obtained credits in five subjects and above, including English language and Mathematics. He further gave the breakdown for those who credited mathematics (Grades A_1-C_6) in the previous years as 25.99% in 2009, 23.83% in 2008, 46.75% in 2007, 41.12% in 2006, 38.20% in 2005, 33.97% in 2004, 36.91% in 2003, 34.06% in 2002, 36.55% in 2001 and 32.79% in 2000 (WAEC, 2003; WAEC, 2006; Odili, 2006; Dike, 2007; Asikhia, 2010;

Olaoye, 2011; Kolawole & Udeh, 2012).
Several studies and researches have been done in many countries to find the factors that influence students' achievement in mathematics. Among these factors, students' attitude to mathematics is one important factor that has been consistently studied. Often, the studies on relationship between students' attitude and their academic achievement show a positive relationship (Mohamed & Waheed, 2011; Mohd, Mahmood & Ismail, 2011; Bramlett & Herron, 2009; Schenkel, 2009; van der Sandt, 2007; Tapia & Marsh, 2004; Ashcraft & Kirk, 2001). Hence, students' attitude to mathematics is a major factor that might influence students' achievement. Apart from the students' attitude to mathematics, the environment both in and outside the school in which the child grows has a great influence on academic achievement of the students. In fact, environment influence on educational attainment is another issue that begs for attention. Hence, Musa (2009) asserted that the richer the learning environment the great the opportunities exists to listen, talk, read and write. Generally, schools are either located in urban or rural areas. Research evidence revealed that students in urban areas achieve better than those in rural areas, their low achievement in mathematics has been attributed to lack of mathematics teachers. Majority of schools in urban areas are over staffed with professional teachers, whereas, this is not so with rural schools. Consequently, there are significant differences in mathematics achievement of urban and rural schools and students in urban schools had better academic achievement than their rural counterparts (Owoeye, 2011; Eraikhuemen, 2003). Eraikhuemen further stated that there was a significant interaction influence of gender and school location on the academic achievement of students. In contrast, Maliki, Ngban and Ibu (2009) found that the students of rural school performed better than students of urban schools in mathematics examination.

The award of marks by teachers and grade pattern are often been used to represent students' academic achievement standing, the reliability of such marks is questionable (Ajogbeje,

2011). Hence, the study of correlates of achievement in mathematics at the senior school certificate examination.

Statement of the Problem

Students' mathematics achievement is often associated with future economic power of a country (Baker & LeTendre, 2005; Wobmann, 2003; Bush, 2001). Thus, the desire to understand and identify factors that may have meaningful and consistent relationship with mathematic achievement has been commonly shared among national leaders and policy makers as well as educators around the world (Phan, 2008).

The place of mathematics in the technological development of any nation cannot be compromised. Hence, the Nigerian Government recognizes the significance of mathematics to the extent of making it a compulsory subject at the primary and secondary school levels (FRN, 2004). In spite of the objectives and importance attached to mathematics, the WAEC Annual Chief Examiners' Reports (2009, 2008, 2007, 2006, 2005, 2004, 2003, 2002, 2001, and 2000) indicated a low achievement of students in mathematics. In Nigeria, the topic of how to improve students' achievement in mathematics has been hotly debated for decades. Therefore, the researchers see the need to investigate the relationship between students' attitude and their academic achievement in mathematics, patterns of academic achievement of students of urban and rural schools with particular interest in the interaction influence of gender and school location on the achievement of students in mathematics at the Senior School Certificate Examination (SSCE) in Ika North-East and Ika South Local Government Areas of Delta State, Nigeria.

Purpose of the Study

The purpose of this study was to investigate correlates of achievement in mathematics at the Senior School Certificate Examination (SSCE). Six urban schools and six rural schools that participated in the WAEC SSCE May/June 2010 were selected for this study. Specifically, the study was designed to find out the relationship between students' attitude and their academic achievement in mathematics, the difference in mathematics achievement of students of urban schools and those of rural schools, and the interaction influence of gender and school location on the achievement of students in mathematics. Ultimately, this study aimed to produce state-specific research findings related to senior secondary school students' mathematics achievement that can be used directly by state leaders and policy makers as well as educators from these local government areas, especially rural areas, to support their educational decisions.

Research Questions

The study aimed to address the following set of research questions:

(1) Is there any relationship between students' attitude and their academic achievement in mathematics?
(2) Is there any difference in mathematics achievement of students on the basis of their school location?
(3) Is there any interaction of gender and school location on the academic achievement of students in mathematics?

Research Hypotheses

Based on the questions raised, the following hypotheses were postulated:

Ho_1: There is no significant relationship between students' attitude and

their academic achievement in mathematics.

Ho_2: There is no significant difference in mathematics achievement of students of urban schools and those of rural schools.

Ho_3: There is no significant interaction influence of gender and school location on the academic achievement of students in mathematics.

Method

Research Design

This study employed the correlational and ex-post facto research design. Anderson (1998) described correlational research as one way of describing in quantitative terms the degree to which variables are related. He argued that correlation studies investigate a number of variables believed to be related to an important variable such as academic achievement. Gay (1996) described an ex-post facto research as an after fact study which does not involve the manipulation of variables. Also, Akuezuilo and Agu (2003) stated that an ex-post-facto design is where a researcher carried out empirical enquiry but did not have direct control of the independent variables because their manifestations had already occurred.

Population and Sample for the Study

The target population for the study was all public senior secondary school 3 students in Ika North-East and Ika South Local Government Areas of Delta State. In all, the sample study comprised of three hundred and sixty (360) SS3 students randomly selected from twelve (12) senior secondary schools (six in the urban schools and six in the rural schools). Thirty (30) students were selected from each school to make up the sample through stratified random sampling.

Research Instruments

The study used two main instruments to collect data from the subjects. They are:

1) Students' Mathematics Achievement Test (SMAT)
2) Students' Attitude to Mathematics Scale (SAMS)

SMAT: This was a 50-item test adapted from West African Examinations Council (WAEC) WASSCE/SSCE May/June 2010 Mathematics objective test consisting of a 50-item multiple-choice objective test.

SAMS: This consisted of structured statement with a modified Likert-type scale. It was a 20-item questionnaire divided into two parts. Part I comprised of some personal information while part II was a 20-item questionnaire.

The original Fennema-Sherman Attitude Scales (1976) were designed to measure the attitudes and beliefs of secondary students. They consist of a group of nine instruments: (1) Attitude toward Success in Mathematics Scale, (2) Mathematics as a Male Domain Scale, (3) Mother Scale, (4) Father Scale, (5) Teacher Scale, (6) Confidence in Learning Mathematics Scale, (7) Mathematics Anxiety Scale, (8) Effectance Motivation Scale in Mathematics, and (9) Mathematics Usefulness Scale.

The Attitudes toward Mathematics Inventory (AMI), created by Tapia and Marsh (2004) was based on the Fennema-Sherman instrument, with some items eliminated in order to focus on only six factors (Confidence, Anxiety, Value, Enjoyment, Motivation, and Parent/teacher expectations). An adaptation of Tapia and Marsh questionnaire was created for used in this study to be appropriate for secondary students who are in SS3. Questions relating to parent influence were

eliminated and questions relating to confidence in teaching mathematics were included.

Validity and Reliability of Instruments

The content validity of the SMAT was established by use of Table of specification after which three experts in the field of study in University of Benin were used to ascertain the face and content validity of SMAT and SAMS. The suggestions made by the experts were used to revise the instruments before collecting data. The pilot study involves four schools that are not part of the study sample. The results for SMAT and SAMS were established through Split-half and application of Pearson's Product-Moment correlation coefficient (Pearson's r) reliability which yielded correlation coefficients of 0.61 and 0.58 respectively, thereby establishing the instruments' internal consistency reliability.

Data Collection

The researchers sought for a research permit and a research authorization letter (Letter of Introduction) from John Harris Library, University of Benin, Nigeria before embarking on data collection process as dictated by ethics. The instruments were administered through personal visits on appointment with Heads of Mathematics Departments in schools through the schools' principals. The SMAT was administered in the presence of the researchers after agreeing on the dates. While the questionnaires (SAMS) were administered a day after SMAT was done. The researchers took times to explain any issues arising from the questionnaires.

Method of Data Analysis

The data collected were analyzed using descriptive statistics such as the mean and standard deviation as well as inferential statistics such as correlation analysis and two-way (2x2) Analysis of Variance (ANOVA) through the application of Statistical Package for Social Sciences (SPSS) version 17.0 at 0.05 alpha level of significance.

Results

The results of the study are summarized in accordance to the hypotheses set for the study.

Hypothesis 1

There is no significant relationship between students' attitude and their academic achievement in mathematics.

Table 1: Pearson's r of students' attitude and their academic achievement in mathematics

Variables	N	Mean	SD	r	Sig. (p-value)
Students' attitude	360	53.84	10.02	0.163	0.002
Mathematics achievement	360	26.85	9.07		

**P<0.05 level of significance*

Table 1 showed that there is a positive relationship between students' attitude and their academic achievement in mathematics. Also, the relationship is statistically significant ($r=0.163$, $p<0.05$; $p<\alpha$) which clearly indicates that the null hypothesis (Ho_1) is rejected. Therefore, there is a positive significant relationship between students' attitude and their academic achievement in mathematics.

Hypothesis 2

There is no significant difference in mathematics achievement of students of urban schools and those of rural schools.

Table 2: Mean and standard deviation of the students' achievement by gender and school location in mathematics

Dependent variable	Gender	School location	Mean	SD	N
Students' Achievement (Mathematics)	Male	Urban	31.24	10.42	90
		Rural	24.36	8.42	90
		Total	27.80	10.06	180
	Female	Urban	26.36	7.82	90
		Rural	25.44	7.96	90
		Total	25.90	7.88	180
	Total	Urban	28.80	9.51	180
		Rural	24.90	8.19	180
		Total	26.85	9.07	360

Table 3: Analysis of Variance (ANOVA) showing difference in school location

Source of variation	Sum of Squares (SS)	DF	Mean Square (MS)	F	Sig. (p-value)
Corrected Model	1368.900	1	1368.900	17.389	0.000
Intercept	259532.100	1	259532.100	3296.757	0.000
Main Effect:					
School location	1368.900	1	1368.900	17.389*	0.000*
Residual	28183.000	358	78.723		
Corrected Total	29551.900	359			

**P<0.05 level of significance*

Table 2 revealed that the students of urban schools ($\overline{X}$=28.80, SD=9.51) obtained higher mean score than those of rural schools ($\overline{X}$=24.90, SD=8.19) in mathematics. ANOVA as shown in table 3, the computed value of F for school location was found to be 17.389 significant at p=0.000 level, which indicates that the difference is statistically significant [F(1,358)=17.389, P<0.05]. Therefore, the null hypothesis (Ho_2) on School location is rejected in favour of the alternative. The researchers then concluded that there is a significant difference in mathematics achievement of students of urban schools and those of rural schools.

Hypothesis 3

There is no significant interaction influence of gender and school location on the achievement of students in mathematics.

Table 4: Summary of 2x2 ANOVA showing the main and interaction effects of gender and school location on the achievement of students in mathematics

Source of variation	Sum of Squares (SS)	DF	Mean Square (MS)	F	Sig. (p-value)
Corrected Model	2497.811	3	832.604	10.956	0.000
Intercept	259532.100	1	259532.100	3415.137	0.000
Main Effects:					
Gender	324.900	1	324.900	4.275	0.039
School location	1368.900	1	1368.900	18.013	0.000
Interaction Effect:					
Gender*School loc.	804.011	1	804.011	10.580*	0.001*
Residual	27054.089	356	75.995		
Corrected Total	29551.900	359			

**P<0.05 level of significance*

The result in table 4 show the interaction influence of gender and school location on the achievement of students in mathematics is statistically significant, since the computed value of F for the interaction effect of gender and school location (Gender*School location) was found to be 10.580 significant at p=0.001 level [F(1,356)=10.580, P<0.05]. Therefore, the null hypothesis (Ho_3) on the interaction influence of gender and school location is rejected and the alternative upheld. The researchers concluded that there is a significant interaction influence of gender and school location on the achievement of students in mathematics.

In order to determine the nature of the interaction between the two independent variables (gender and school location), the cell means shown in table 2 is graphed below.

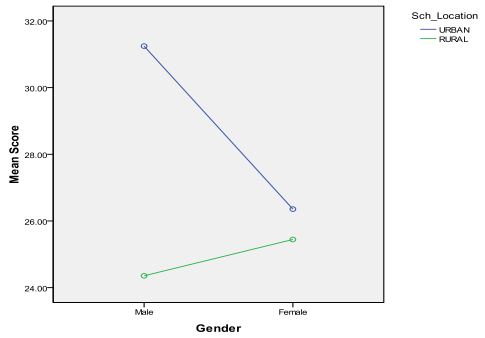

Fig.1: *Interaction Influence of Gender and School location on the achievement of students in mathematics*

Figure 1 reveals that the interaction is ordinal in nature (since there is no intersection). In other words, the lines are not parallel then there is the possibility of an intersection taking place. This means that the students of urban schools achieve better than those of rural schools irrespective of gender.

Summary of Findings

Based on the above analysis and presentation of results, these are the major findings of this study:

1) There is a positive significant relationship between students' attitude and their academic achievement in mathematics.
2) There is a significant difference in mathematics achievement of students of urban schools and those of rural schools.
3) There is a significant interaction influence of gender and school location on the academic achievement of students in mathematics

Discussion

The main focus of this study was to determine the correlates of achievement of Senior Secondary three (SS3) students in mathematics at the Senior School Certificate Examination. The findings of the study showed that, a positive significant relationship exists between students' attitude and academic achievement in mathematics. This implies that students' attitude positively correlates to academic achievement in mathematics. This result confirmed the earlier findings of Mohamed and Waheed (2011), Mohd, Mahmood and Ismail (2011), Bramlett and Herron (2009), Schenkel (2009), van der Sandt (2007), Tapia and Marsh (2004), and Ashcraft & Kirk (2001). The analysis further pointed out the strength of the relationship between the students' attitude and their academic achievement in mathematics, which is stronger in students' attitude to mathematics than their achievement in mathematics.

The findings revealed that there is a significant difference in mathematics achievement of students of urban schools and those of rural schools. Also, the students of urban schools achieve higher than their rural peers. This finding is consistent with the findings made by previous researchers (Owoeye, 2011; Eraikhuemen, 2003). The findings were however at variance with the finding of Maliki, Ngban and Ibu (2009) who found that students from rural schools against all odds performed higher than those from urban schools. This suggests the need for further research in this area of study.

Further finding of the study showed that there is a significant interaction influence of gender and school location on the achievement of students in mathematics. This finding is in consonance with the finding of Eraikhuemen (2003) in a research conducted in Edo state.

Conclusions

Based on the findings of this study, the researchers reached the following conclusions:

- The achievement of students in mathematics is dependent on attitude. When attitude was considered, a positive significant relationship between students' attitude and academic achievement in mathematics was detected. However, it is interesting to know that despite the lower achievement of Ika North-East and Ika South students in mathematics, there still exists a positive significant relationship between their attitude to mathematics and achievement in mathematics.
- The achievement of students in mathematics is dependent on school location. Generally, students of urban schools achieve better than those of rural schools in mathematics at the Senior School Certificate Examination. This indicates that a significant difference was detected in students' mathematics achievement.

- When the interaction influence of gender and school location on the academic achievement of students was considered, a significant influence was detected. This implies that there is a significant influence of gender and school location on the academic achievement of students in mathematics.

Recommendations

The researchers made the following recommendations after careful observation of the outcome of this study:

- Considering the central role of attitude in mathematics achievement, parents should endeavour to encourage and sustain positive attitude to mathematics in their children by creating conducive home environment for learning and providing the necessary mathematics learning materials for them.
- There is the need for mathematics teachers to make every class interesting by stimulating the students' attitude that will enhance better achievement in mathematics.
- There is the need for government to bridge the gap between the rural and urban locations by providing the rural dwellers basic facilities and amenities that will enhance better academic achievement of students in SSCE and also to make life meaningful, competitive and creative.
- The Parent Teacher Association (PTA), Philanthropist and other charitable organizations are also implored to compliment the effort of the government to boost the achievement of students in SSCE by building Mathematic laboratories and providing library facilities in schools.
- Finally, adequate incentives should be provided by government to rural school teachers to encourage them to remain in duty stations and put in their best.

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