Journal of Education and Learning (EduLearn)
Vol. 13, No. 3, August 2019, pp. 341~348
ISSN: 2089-9823 DOI: 10.11591/edulearn.v13i3.12874

Comparative analysis of students' achievement in senior school certificate further mathematics examinations in kwara state, Nigeria (2007-2016): Implication for stakeholders in education

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Article Info

Article history:

Received Apr 9, 2019
Revised May 22, 2019
Accepted Jul 15, 2019

Keywords:

Comparative analysis
Further mathematics
Kwara State
Students' achievement

ABSTRACT

This study explored the trends in students' achievement in Senior School Certificate Examination (SSCE) in Further Mathematics in Kwara State, Nigeria. The study adopted descriptive research design of ex-post factor type. The sample comprised all Further Mathematics students in 79 public senior secondary schools with 3 Local Government Areas in Kwara State. Two research questions were raised and answered in the study. Frequency count, Percentage and Autoregressive (AR) processes for modelling of time series analyses were used to analyse the data. The results revealed that the trend of students' achievement in WASSCE Further Mathematics from 2007 to 2016 was stochastic with random walk steadily progressive and percentage of the students obtained credit ranged from 23.0 to 77.3; pass ranged from 18.2 to 72.2 and fail ranged from 0.0 to 25.8. It was recommended among others that stakeholders in education should improve the quest for scientific literacy particularly for science-based subjects and further Mathematics curriculum should be all inclusive and non-discriminating to allow development of problem solving ability.

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1. INTRODUCTION

Education is obviously the basic instrument of economic growth and technological advancement in any society. According to the West African Examinations Council (WAEC) syllabus [1], Further Mathematics is a subject that bridges the gap between Elementary Mathematics and Higher Mathematics. The relevance of Further Mathematics to scientific and technological development cannot be underestimated because it serves as the bedrock for development of all science courses in all ramifications. It is obvious that Further Mathematics in the world of science and technology has the key to unlock the door to technological advancement of the Nation [2].

Further Mathematics has been perceived as an advanced portion of Mathematics that goes beyond Ordinary Arithmetic, Geometry, Algebra and Trigonometry [3]. Tropical contents of Further Mathematics include Calculus, Coordinate Geometry, Differential Equation, Matrices, Sets and Logic, Mechanics, Theory of Numbers, Probability and Statistics. Therefore, Further Mathematics is the center force for future progress if the craves for science and technology is to be realistic. The negligence of Further Mathematics is due to the general assumption that Further Mathematics is carved out for few who may be interested to pursue higher mathematics and a discipline like engineering [4].

Chief Examiner Report pointed out that students need to be prepared better on questions dealing with vectors and mechanics since it is the fundamental basis for technological advancement [3, 5]. Kabir [6] and Jonah [7] noted that the trend of poor academic achievement in Further Mathematics has created a shortfall in the number of qualified candidates required to fill the quota for mathematics and mathematics oriented courses in Nigerian Universities. It is therefore necessary for students who would want to train as mathematician, engineers, medical doctors, scientists, science and technology related courses to put more effort in attending Further Mathematics classes since these categories of students need more mathematics than general mathematics [7, 8]. Odili and Asuru [9] stated that there are two features that could be the causes of ineffective implementation of Further Mathematics curriculum that is low institutional enrolment figures in Further Mathematics and low achievement of a very large of students in Further Mathematics papers of WAEC and NECO examinations.

The broad aim and expectations of any teaching and learning programme is productivity and end-product which is achievement, but presently there have been complaints from parents, government and stakeholders that their investment in education on children is not yielding the desired dividend. This is one way the nation's technological advancement is weakened and the needed national development in the area of technology has not being achieved [10]. To search for holistic solution to this problem, attempts had been made in this regard such as the work of Odili and Asuru [9], Jonah [7] and Odili [11] whose studies were on the impact and implementation of Further Mathematics curriculum in secondary school. It is against this backdrop that this study examined students' achievement in senior school certificate Further Mathematics examinations between 2007 and 2016 in Ilorin, Kwara State.

2. LITERATURE REVIEW

A comprehensive literature review has shown that there are a number of factors that hindered students' achievement in Further Mathematics for the senior secondary schools examinations. Some observed factors as submitted by researchers include; ineffective teaching methodology, poor quality of mathematics teacher, low motivation, school location or type, wrong peer groups, low retention of the students, negative students attitude or interest towards Further Mathematics and gender inequalities among other problems [7, 8, 12, 13].

There have been series of researches on the attitude, achievement and performance of students in Further Mathematics and science related subjects at various academic levels. Zalmon and Wonu [14], Kajuru et al [12], Mamman and Eya [15]; Jegede, Awodun and Olusola [16] revealed that poor achievement of students in secondary schools examinations is related to some factors like parental factors, wrong peer groups, low motivation and low retention of the students. Gegbe and Koroma [13] believed that the falling level of academic achievement of students is attributed to teaching methods of some teacher, while Udonsa's [17] findings showed that inadequate teaching materials, unqualified mathematics teachers and large class size is one of the major factors responsible for students' poor performance. Inekwe [4] concluded that student attitude toward Further Mathematics is due to Math-phobia which has eaten deep as a cancer in student for many years. Some happily, and boldly saying "Mathematics is not required in the course I want to offer in the University" This false assumption thins out into reality on entering the University where they realize that they have left undone something they out to have done Further Mathematics [4]. Jonah [7] revealed that Further Mathematics implementation rate in public schools is very low when comparing to private schools. Odili [16] noted that there was shortage of qualified mathematics teachers in most public schools which leads to the poor quality of learning outcome.

Gegbe and Koroma [13] investigated the causes of poor academic performance of students in General and Further Mathematics in secondary schools in B.O district, Sierra Leone. This study used a survey questionnaire on the causes of poor academic performance of students on teaching and learning with 100 students and 75 teachers as respondents. The study focused on teachers' method of teaching, motivation and attitudes. The research findings showed that teaching method have a great influence on poor performance of students in General and Further Mathematics, therefor, teachers need to motivate the students in order to develop positive attitude towards the subject. Jegede et al [16] worked on comparative analysis of students' achievement in SSCE in Physics between 2007and 2012. This study investigated the trends in students' achievement in SSCE in Physics in Ekiti State and adopted a survey research design of ex-post facto type. This study concluded that there is neither significant fall nor significant academic achievement in Physics in WASSCE result. This indicated that there was fluctuation in the performance over the year of the study.

Moreso, Udonsa [17] investigated trend on students' performance in Mathematics at Senior Secondary Certificate Examination in Nigeria. The researcher examined the factors that contributed to the consistent poor performance of students in SSCE Mathematics by analysing the trend and rates of failure in

mathematics and hypotheses were formulated and tested based on the factors that seemed to be the major impediment. The findings revealed that inadequate teaching materials, unqualified teachers and large class size are the major factors responsible for poor students' achievement in Mathematics in SSCE examination. Jonah [7] also investigated the implementation of the Further Mathematics curriculum in schools in Bayelsa state. The study examined the main problem associated to the effective implementation of Further Mathematics curriculum in senior schools. The study adopted a survey design and the sample consisted of 400 SS3 students, 80 mathematics teachers and 4 official bodies were randomly selected from 4 schools in each 10 educational zones. The study revealed that Further Mathematics curriculum is not being effectively implemented in public schools. Zalmon and Wonu [14] worked on comparative analysis of student mathematics achievement in West Africa Senior Secondary Certificate Examination in Nigeria. This study also adopted a survey design of the expost-facto research type and the findings showed that the population of students that sat for WASSCE in Mathematics increased and there was improvement over the year of the study.

Furthemore, Asim, Bassey and Essien [18] focused on trend analysis of West Africa Senior Certificate Examination results in Science, Technology and Mathematics (STM). The researchers analysed May/June WASCE result from 1999-2003 to determine the achievement of the students. In all the STM subjects reviewed, less than 50% of candidates passed at credit level. The researchers concluded that improve performance could be achieved in teaching and learning through improved school practices which can lead to interest of students in STM subjects in Nigerian Secondary Schools. Mamman and Eya [15] studied the trends of students' Mathematics performance in WASSCE in Nasarawa state. The researchers investigated on the pattern of students' performance for 10 years and inferred the implication of the observed and predicted mathematics performance on Nigerian vision of 20:2020. The study revealed that performance pattern were unstable over time, the observed and predicted performance rates indicated that less than 50% of the candidates passed at credit level over the reviewed period. The researchers concluded that based on the forecast, Nigerian vision 20:2020 might not be realized development in human capital in science, technology, engineering and other sectors of the economy and recommended that policy makers should review the existing mathematics curriculum and enforce its implementation [8].

Lastly, Hamzah, Muntari and Ahmed [19-22] investigated on the effect of Further Mathematics on students' achievement in Mathematics, Biology, Chemistry and Physics in Katsina state, Nigeria. Experimental research design was employed with three research questions. The findings showed that there was no significant difference between further mathematics and non-further mathematics groups in achievement in each subject and further mathematics students had significantly better overall achievement. The researchers concluded that all science students should be encouraged to offer Further Mathematics but this present study worked on comparative analysis on students' achievement in Further Mathematics in WASSCE and NECO SSCE carried out in Ilorin Metropolis of Kwara State.

2.1. RESEARCH OBJECTIVES

This study aims to comparatively analyse the trends in students' achievement in Senior School Certificate Further Mathematics Examinations in Ilorin Metropolis. Specifically, the study sought to find out:

a. The trend of students' achievement in senior school Further Mathematics Certificate Examination in WASSCE and NECO SSCE in Ilorin Metropolis from 2007 to 2016.
b. The comparative students' achievement in senior school Further Mathematics Certificate Examination in WASSCE and NECO SSCE from 2007 to 2016.

2.2. RESEARCH QUESTIONS

a. What is the trend of students' achievement in senior school Further Mathematics Certificate Examination in WASSCE and NECO SSCE in Ilorin Metropolis from 2007 to 2016?
b. What is the comparative students' achievement in senior school Further Mathematics Certificate Examination in WASSCE and NECO SSCE in Ilorin Metropolis from 2007 to 2016?

3. METHODS

The study adopted a descriptive survey design of the ex-post facto research type. The population for the study comprised of all senor secondary school students offering further mathematics at Senior Secondary Certificate Examination level in Ilorin metropolis of Kwara State, Nigeria. The sample for this study was 79 public senior secondary schools within Ilorin Metropolis. This consists of Ilorin East (30), South (21) and West (28) local government areas. The purposive sampling technique was used to select thirty two (32) senior secondary schools in Ilorin metropolis, since only the results of schools registered students for Further Mathematics examinations with WAEC and NECO bodies were considered. Secondary data were collected

on students' achievement from schools between 2007 and 2016. First, the records of total number of students who registered and sat for WASSCE and NECO SSCE in Further Mathematics were obtained. Second, the total number of students who registered and sat for WASSCE and NECO SSCE and their percentage grade in Further Mathematics from 2007 to 2016 were collected. Frequency count, percentage and time series analyses were used to analyse the data. The frequency count was used for the collation of data, percentages was used to do the analysis while time series was used to do the graphical representation of data collected between 2007 to 2016. The estimation technique for the study is Autoregressive (AR) processes for modelling of time series.

4. RESULTS AND ANALYSIS

Research Question 1: What is the trend of students' achievement in senior school Further Mathematics Certificate Examination in WASSCE and NECO SSCE in Kwara State from 2007 to 2016?

The Table 1 presented the number and percentage of the students obtained Credit (A_1- C_6), Pass (D_7& E_8) and Fail (F_9) in WASSCE in selected secondary school, Kwara State from 2007-2016. The percentage of the students obtained credit ranged from 22.6 to 89.8; pass ranged from 10.2 to 54.6 and fail ranged from 0.0 to 45.3.

Table 1. Percentage of students obtained Credit (A_1-C_6), Pass (D_7 & E_8) and Fail (F_9) in WASSCE Further Mathematics between 2007 and 2016

Year	Total number of students sat	Number of students obtained credit (%)	Number of students obtained pass (%)	Number of students obtained fail (%)
2007	98	40(40.8)	22(22.5)	36(36.7)
2008	83	40(48.2)	34(41.0)	9(10.8)
2009	106	24(22.6)	34(32.1)	48(45.3)
2010	238	60(25.6)	130(54.6)	48(30.2)
2011	286	194(67.8)	62(21.7)	30(10.5)
2012	196	96(49.0)	94(48.0)	6(3.0)
2013	248	102(41.1)	100(40.3)	46(18.6)
2014	238	166(69.7)	68(28.6)	4(1.7)
2015	222	132(59.5)	68(30.6	22(9.9)
2016	236	212(89.8)	24(10.2)	-
Mean (%)		51.37	32.96	15.67

The time series plot represented by Figure 1 showed non-stationary trends in achievement patterns. The trends showed upward and downward patterns over times. This implies that the trend of students' achievement in WASSCE Further Mathematics in Kwara State from 2007 to 2016 was stochastic with random walk (steadily progressive).

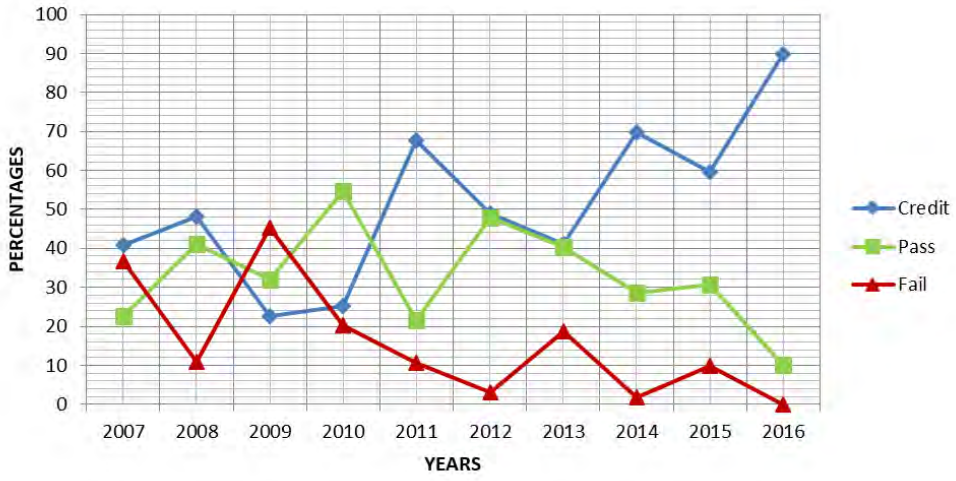

Figure 1. Trends of students' achievement in WASSCE Further Mathematics by Credit (A_1-C_6), Pass (D_7&E_8) and Fail (F_9) between 2007 and 2016.

The Table 2 presented the number and percentage of the students obtained Credit (A_1 – C_6), Pass (D_7& E_8) and Fail (F_9) in NECO SSCE in selected secondary schools, Kwara State from 2007-2016. The percentage of the students obtained credit ranged from 23.0 to 77.3; pass ranged from 18.2 to 72.2 and fail ranged from 0.0 to 25. 8.

Table 2. Percentage of students obtained Credit (A_1-C_6), Pass (D_7&E_8) and Fail (F_9) in NECO SSCE Further Mathematics between 2007 and 2016.

Year	Total number of students sat	Number of students obtained credit (%)	Number of students obtained pass (%)	Number of students obtained fail (%)
2007	66	34(51.5)	32(48.5)	-
2008	88	68(77.3)	16(18.2)	4(4.4)
2009	130	18(13.9)	94(72.2)	18(13.9)
2010	232	64(27.6)	108(46.6)	60(25.8)
2011	122	28(23.0)	82(67.2)	12(9.8)
2012	142	84(59.2)	52(36.6)	6(4.2)
2013	188	90(47.9)	72(38.3)	26(13.8)
2014	166	102(61.5)	54(32.5)	10(6.0)
2015	188	136(72.3)	44(23.4)	8(4.3)
2016	160	120(75.0)	30(18.8)	10(6.2)
	Mean (%)	50.92	40.23	8.85

The time series plot represented by Figure 2 showed non-stationary trends in achievement patterns. The trends showed upward and downward patterns over times. This implies that the trend of students' achievement in NECO SSCE Further Mathematics in Kwara State from 2007 to 2016 was stochastic with random walk. Over the period, the trend of Fail was lower than Credit and Pass.

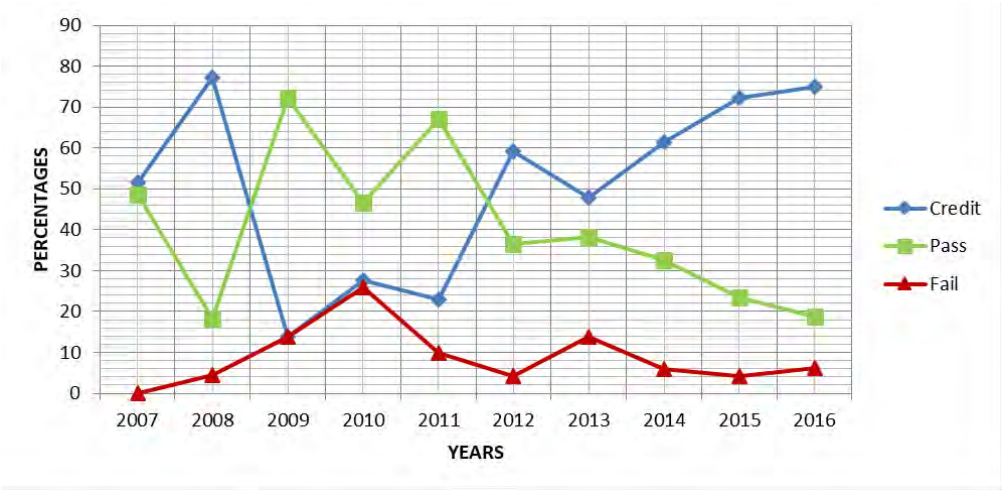

Figure 2. Trends of students' achievement in NECO SSCE Further Mathematics by Credit (A_1-C_6), Pass (D_7&E_8) and Fail (F_9) between 2007 and 2016

Response to Research Question 2: What is the comparative students' achievement in senior school Further Mathematics Certificate Examination in WASSCE and NECO SSCE in Kwara State from 2007 to 2016?, it can be seen in Table 3.

Table 3. Mean percentages of the number of students obtained Credit (A1 – C6), Pass (D7 & E8) and Fail (F9) in WASSCE and NECO SSCE between 2007 and 2016.

Exam Type	Mean (%) of students obtained Credit	Mean (%) of students obtained Pass	Mean (%) of students obtained Fail
WASSCE	51.37	32.96	15.67
NECO SSCE	50.92	40.23	8.85

The percentage of students who sat for WASSCE and NECO SSCE between 2007 and 2016 that obtained credit (A1-C6) was above average since the mean percentages of the students obtained credit in WASSCE and NECO SSCE were 51.37% and 50.92% respectively as shown in Figure 3. This further showed that there slightly difference in the students' achievement in senior school Further Mathematics Certificate Examination in WASSCE and NECO SSCE in Kwara State from 2007 to 2016.

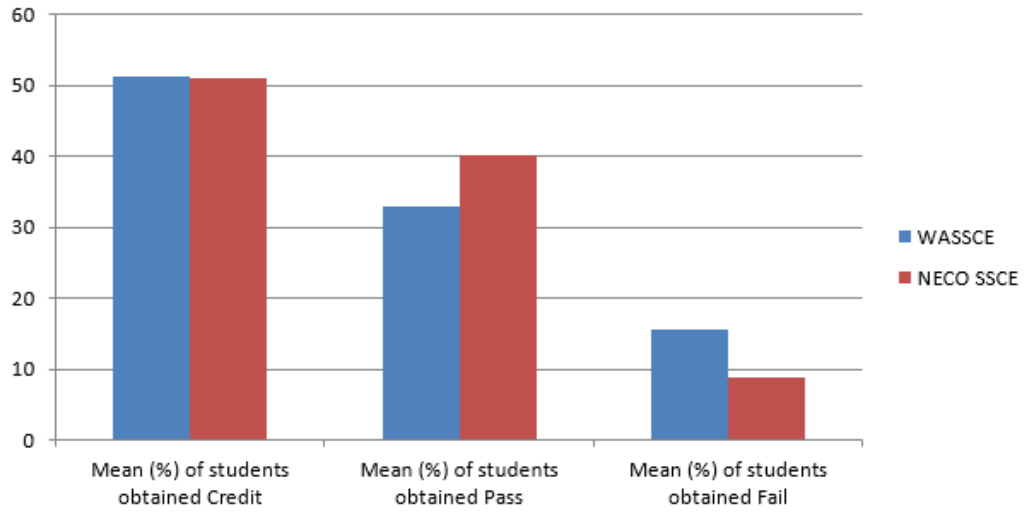

Figure 3. Mean percentages of the number of students obtained Credit (A1 – C6), Pass (D7 & E8) and Fail (F9) in WASSCE and NECO SSCE between 2007 and 2016

5. DISCUSSION

It can be seen in Table 1 that in the year 2007, 2008, 2009, 2010, 2012 and 2013, the total number of students obtained credit were less than 50% while in the year 2011, 2014, 2015 and 2016 were greater than 50%. Also, Table 2 in the year 2009, 2010, 2011 and 2013, the total number of students obtained credit were less than 50% while in the year 2007, 2008, 2012, 2014-2016 were greater than 50%. It is observed that there was fluctuation in the students' achievement in Further Mathematics over the period involved in this study. This is in congruent with the study conducted by Jegede, Awodun and Olusola [16] who found that fluctuation in performance of students in Physics. It is also in line with the study of Mamman and Eya [15] who recorded unstable performance of students in Mathematics. There have been series of researches on the attitude, achievement and performance of students in Further Mathematics and science related subjects at various academic levels. Similarly, the studies of Zalmon and Wonu [14], Kajuru et al [12] Mamman and Eya [15]; Jegede, Awodun and Olusola [14] revealed that poor achievement of students in secondary schools examinations is related to some factors like parental factors, wrong peer groups, low motivation and low retention of the students. Also, the study conducted by Gegbe and Koroma [13] established that the falling level of academic achievement of students is attributed to teaching methods of some teacher, while Udonsa's [17] findings showed that inadequate teaching materials, unqualified mathematics teachers and large class size is one of the major factors responsible for students' poor performance.

The percentage of students who sat for WASSCE and NECO SSCE between 2007 and 2016 that obtained credit (A1-C6) was above average since the mean percentages of the students obtained credit in WASSCE and NECO SSCE were 51.37% and 50.92% respectively.This is in support of the study of Zalmon and Wonu [14] who worked on the comparative analysis of students in mathematics achievement and their findings showed that there was improvement over the year of the study but negate the study of Asimetal [18] who recorded less than 50% passed at credit level in science, technology and Mathematics. Also, the total number of students sat for the WASCE between 2007 and 2016 was 1,951 and in NECO SSCE was 1,128 this shows that very few numbers of science students registered and sat for WASSCE and NECO SSCE. Therefore, this study is in agreement with Jonah [7], who observed that few students that sat for further mathematics examination perform better and Kajuru, et al [12] whose study showed the impact of Further Mathematics on the performance of students in general mathematics and other science subjects. Literature review has shown that there are a number of factors that hindered students' achievement in Further Mathematics for the senior secondary schools examinations. Some observed factors as submitted by

researchers include; ineffective teaching methodology, poor quality of mathematics teacher, low motivation, school location or type, wrong peer groups, low retention of the students, negative students attitude or interest towards Further Mathematics and gender inequalities among other problems [7, 8, 12, 13].

6. IMPLICATION FOR STAKEHOLDERS IN EDUCATION

Based on the findings of this study, it has several implications for stakeholders in education:

a. To improve the quest for scientific literacy, particularly for science based students, offering of Further Mathematics should be made compulsory. This could in turn enhance student performance even in General Mathematics.
b. Government at all levels should be ready to train more teachers, especially in the areas of science and Further Mathematics. This, when implemented could guarantee raising a generation with needed computational skills for technological advancement.
c. Educational administrators should be encouraged to allocate more time to the teaching and learning of Further Mathematics on school time-table. This is to assist in full coverage of teaching syllabus and preparing well-grounded learners on relevant topics for future challenges.
d. Contents of Further Mathematics curriculum should be all inclusive and non-discriminating to allow development of problem solving ability which could be useful for daily needs of our society.
e. Training and retraining of Further Mathematics teachers should be encouraged.
f. Extra moral class of Further Mathematics should be encouraged by the parents and school administration.
g. Teachers should make teaching of Further Mathematics simple for the students. The subjects should always be taught by specialized teachers.

7. CONCLUSION

From the result of the findings, it could be concluded that students' achievement in May/June WASSCE and NECO SSCE Further Mathematics examinations from 2007 to 2016 in Kwara State had been consistently unstable. It cannot be categorically stated that there is fall in students' achievement in WASSCE and NECO SSCE in Further Mathematics within the period under the study, since there was fluctuation in academic achievement of students in Further Mathematics over the years of study. Although, the percentage of students who sat for WASSCE and NECO SSCE between 2007 and 2016 that obtained credit was above average, the mean percentages for those who had credit in WASSCE and NECO SSCE were 51.37% and 50.92% respectively. Therefore, the findings of this study negate some finding that recorded less than 50% credit in SSCE Further Mathematics. Although, previous studies were domiciled in the northern region of Nigeria that has lower per cent in western education.

8. DIRECTION FOR FUTURE RESEARCH

First, researchers in the field of science education are encouraged to replicate this study by including other variables that were not included in this study. Specifically, a comparative study on students' achievement in Further Mathematics based on gender could be investigated. Second, since the scope of the current study was limited to Ilorin metropolis (Ilorin East, Ilorin South and Ilorin West Local Governments) area of Kwara State, additional studies are needed to extend the scope of the study by covering other local governments to ensure generalizability.

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