EFFECTS OF DATA-DRIVEN INSTRUCTION AS A TEACHING STRATEGY ON JUNIOR SECONDARY SCHOOL STUDENTS' CLASSROOM PARTICIPATION IN MATHEMATICS IN EKITI STATE, NIGERIA .

Kehinde-Dada O. V
and
Ojo, A. A.

Abstract

This study assesses the effects of data-driven instruction as a teaching strategy using pre-service Teachers of University of Nigeria Nsukka, College of Education Ikere chapter, Ekiti State and also secondary school students' classroom participation in Mathematics. A sample of eight (8) pre-service teachers and one hundred and twenty-five (125) junior secondary school students are used. Students' classroom observational scale is developed and validated at the reliability coefficient of scott's pi of 0.92. Data is analysed using ANCOVA at 0.05 level of significance. The result of the analysis shows a significant main effect of students' classroom interaction on partial eta =0.10. The result also shows that the mean score of female is better at (28.45) than male at (25.08). Based on these findings, recommendations that would improve the performance of the students in Mathematics are made.

Keywords: Data-driven, Instructional strategy, Pre-service teachers, classroom participation.

Introduction

Low performance in secondary school mathematics in Nigeria is increasing on daily basis. Consequently, many scholars have researched into reasons for this low performance. Some of the reasons identified as responsible for this negative attitude towards Mathematics are: (Adeleke 2007, Ala & Olatunji 2014), lack of problem solving abilities, poor methods of teaching, poor teacher preparation, lack of commitment, devotion and dedication to duty and motivation (Kolawole 2013) to mention but a few.

Considering the status and the relevance of mathematics in various aspects of our daily living, poor teaching methods by either the tutor or teachers at all levels of education should not persist. It is obvious by the way technology is moving fast in the global world

today that there is no doubt human beings might not be able to survive without the application of mathematics and technology especially, with the way almost all kinds of jobs are being computerised. This points to the fact that all hands must be on deck to ensure effective teaching of mathematics at both the primary and secondary level where solid foundation for further studies in mathematics, sciences and technology could be laid (Salami, 2014).

Lesson plan adopted by a teacher dictates the mode of presentation the teacher will take and the presentation determines the extent to which the students acquire the knowledge or not. Some researchers have observed that, the format of lesson plan that pre-service teachers are exposed to hardly gives room for student –centered lessons (Olosunde 2009, Salami 2009). Majority of this higher students of education (pre-service teachers in tertiary institution) are daily taught using lecture method which is basically teacher-centered. Since so many teachers are product of their teachers, it is seemingly impossible for the products (teachers whether pre-service or cooperate) to plan, prepare and deliver a mathematics lesson in a way that students will be actively involved.

Studies reveal that teachers' preparation and method of teaching have great impact in determining the performance of students in that particular course of subject. Therefore, it is important that teachers at all levels should constantly undergo training in their various disciplines. That is one of the reasons why Federal Government of Nigeria has affirmed in National Policy of Education that no educational system can rise above the quality of her teachers which implies that the way a teacher teaches has a long way to go in teaching-learning process. This study introduces pre-service teachers to certain mathematical concepts using data-driven instructional strategy. This strategy is a student-centered strategy wherein the pre-service teacher demonstrates the acquired skills needed to design a lesson plan and deliver the lesson he/she has planned or prepared and as well allow the students to participate in class. The pre-service teacher who has undergone training on the strategy will now practise what he/she has acquired on the students.

A study carried out by the researcher in College of Education, Ikere Ekiti, Nigeria, shows that pre-service teachers in the college are taught using conventional methods and most of them are even taught by adjunct lecturers who do not bother whether the students learn what they need to learn. See Table 1.

Table 1 Summary of the exploratory study in College of Education Ikere Ekiti, Nigeria.

S/N	SCHOOL	DEPARTMENT	SOURCE OF LECTURER	METHOD OF TEACHING
1	Education	Guidance & Counseling	Psychology DEPT	LECTURE METHOD
2	Social Science	Pol. Sc, Health Education	Curriculum Dept	Lecture Method
3	Sciences	Math/Physics	Curriculum (Part Time)	Lecture Method
4	Art & Humanity	English	Curriculum (Part Time)	Lecture Method
5	Vocational	Acct/Agric	Psychology Dept	Lecture Method

Table 1 shows that 80% of lecturers teaching the mathematics related courses are not lecturers from the department. They are either seconded from another department or are part-time lecturers. The result also shows that 40% of the Lecturers are seconded from other departments, 40% are part-time Lecturers while the remaining 20% are lecturers from the department, but all the lecturers use lecture methods to teach the students. No one is found using student –centered method of instruction to teach. This indicates that pre-service teachers are not being taught appropriately the right methods that would help them impact well in their secondary school teaching practices and even as prospective teachers of mathematics.

Data-driven instruction is an instructional package that focuses on facts about what students actually learned using data-based methods and not the traditional methods that emphasise what teachers apparently taught in schools. There are four major aspects of data-driven instruction: culture, assessment, analysis and action (Bambrick-santoyo, 2010).

A school's culture includes student aspirations and a code of conduct that promotes positive learning behaviours, which instructions alone might not be able to do. Assessment, analysis, and action are indispensable in increasing students' achievement, and should be included in the school's culture (Christie 2005 in Bambrick-Santoyo 2010). Many school heads use a simple but highly effective yearly data calendar which they display publicly and refer to constantly so that everyone in the school community, including students and their guardians, know when important events will take place. In the school culture, the principal has a right to carve out time for assessment analysis, and action and teachers need to succeed in each part of the cycle. In order to get everyone in the school working toward the same goal of preparing every child for both internal and external examination and career readiness, teachers must adhere to the same standards and assessments for all students in a given class level and content area (Velom & Rohani

2010). This is very important if teachers are to collaborate on data analysis, professional development, and strategies for re-teaching and improving students' learning.

Statement of the Problem

Poor students' learning outcomes in Mathematics has been attributed to many factors like school, home, teacher, and students' factors. This subject which has been identified as very important, in secondary education system is believed not to be effectively taught by teachers and pre-service teachers. This has resulted in poor performance of the students over the years. The instructional strategy used for teaching students, which is an important factor, is considered a major challenge in the teaching and learning process. Studies have shown that so many strategies have been used by teachers in the teaching and learning process. Some of these strategies are cooperative learning, personalised system of instruction, direct instruction to mention a few. It seems none of these strategies have been able to find a lasting solution to the problem of poor performance of students in Mathematics. Also, most of the available studies looked at methods of teaching that do not involve collecting student-related data that can improve students' learning outcomes in Mathematics. This study fills the gap by adopting data-driven instructional strategy to investigate its effects on the teaching and learning process.

Purpose of the Study

The results of this study provides empirical evidence on the effect of data driven instruction for practicing teachers in their application of new methods of teaching Mathematics at the secondary school level to make learners attain mastery of curriculum content areas they will be exposed to. The practice of teaching Mathematics methodology courses in the Colleges of Education through teacher-centered method would be revisited and the student-centered method (data-driven instructional strategy) would be embraced.

The data-driven instructional strategy, if found to be effective in this context, would be a way of providing teachers information on every individual students' performance and also improving the teaching-learning process.

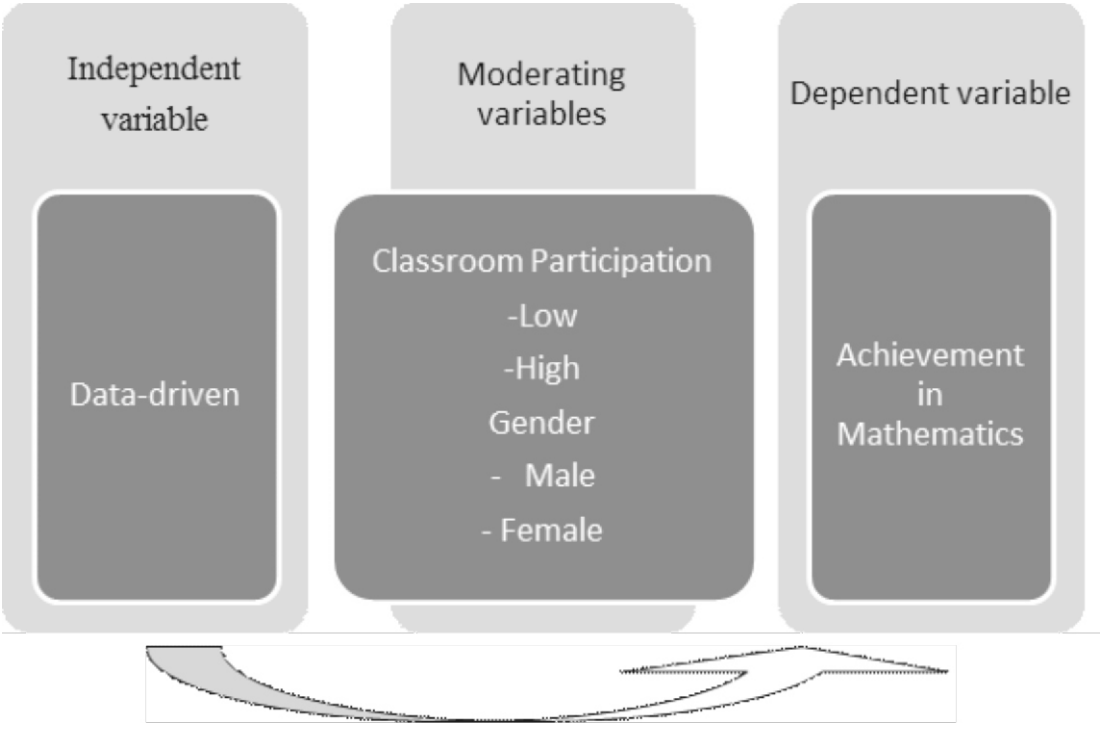
Research Hypotheses

1. There is no significant main effect of treatment and students' participation in class on Students' learning achievement in Mathematics.
2. There is no significant main effect of students' participation in class on students' achievement in Mathematics.
3. There is no “interaction effect” of students' participation in class and gender on students' achievement in Mathematics.

4. There is no interaction effect of treatment between students' participation in class and students' gender on students' learning achievement in Mathematics.

Effective professional teaching approach

Professional Teaching and Learning Cycle (PTLC) is described as a process for creating a professional learning community while focusing on a factor essential to reaching high level of student learning, and the alignment of curriculum, instruction, and assessment to state standards (Airasian, 2004; Cawelti, 2004; Kannapel & Clements, 2005; Marzano, 2003). The process provides a structure for collaboration on teaching and learning that promotes continuous job-embedded professional development to improve teaching and learning (Cowan, 2006; Tobia, 2007). The professional teaching and learning cycle (PTLC) is adapted from an originally developed model which is a joint effort by SEDL and Charles A. Dana Centre at the University of Texas (Southwest Educational Development Laboratory, 2005). It consists six steps which are study, select, plan, implement, analyse, and adjust. There is also an implementation of the PTLC which is supported by three leadership strategies which are: communicating clear expectations, building capacity, and monitoring and reviewing. This is represented in the two cycles below:



Population

Population of the study comprises all students in Junior Secondary School year two in some selected public schools in Ekiti State.

Sampling Procedure and sample

Multi-stage sampling technique is used to select participants of this study. Purposive sampling is used to select four research assistants (pre-service students) exposed to special teaching method and Data-driven instruction based on their 'gain performance' (i.e post test score minus pretest score). These are used in Data-driven instruction (treatment group). In addition, research assistants (pre-service students) exposed to special teaching methods only are selected, based on their performance (gain performance) to teach secondary school students (control group). Simple random sampling technique is used to select one senatorial district (Ekiti central) out of the three existing senatorial districts in Ekiti State. Simple random sampling technique is used to select two Local Government Areas (LGAs) from the six Local Government Areas (LGAs) in the selected senatorial district in Ekiti state: Ado and Efon-Alaaye. Simple random sampling is used to select two schools from each of the two LGAs selected giving a total number of four schools. Two schools in each of the selected LGAs are assigned randomly to the treatments (data-driven) and control. The total number of students in all the schools together is one hundred and twenty-five.

Instrumentation

The research instruments that are used for this study; are response and stimulus instruments.

A. Response instruments
1. Mathematics Achievement Test (MAT)
2. Students' Classroom Observation Checklist (SCOC)

B. Stimulus
1. Data Driven instructional Package

Mathematics Achievement Test (MAT)

The Mathematics Achievement Test (MAT) is developed based on the scheme of work in Ekiti State for second terms and it contains two sections; A & B. Section A captures the bio-data of the respondents like name, school, age and gender. Section B consists questions on achievement test to test the learners' cognitive level. It consists (100) multiple choice test items with four options A to D, having one correct option and three distractions. This is reduced later to sixty items (60) after validation. Kuder-Richardson 20 formula is used to determine the psychometric property and this gives a value of 0.87. Correct response to each of the items attract a score of 1 while an incorrect response

attract a score of 0.The content areas covered are: - Simple equation and expansion, Plane shapes and calculations: areas of triangle, rectangles and squares, cylinder and volume, Angles: Pythagoras theorem, angle of elevation and depression and Bearing.

Table 3.6.1: Table of Specification for Mathematics Achievement Test (MAT)

Content/Objectives	Knowledge 24%	Comprehension 26%	Application 50%	Total
Plane shapes and calculations i.e triangle, rectangle, circle and cylinder 44%	Q1,Q7,Q32,Q52,Q60 (5)	Q6,(2)	Q2,4,10,12,20,22,33,37,40,50,47,53,54,55,58,39,38, 35,28,(19)	26
Angles: Interior angles of a polygon, triangle, Pythagoras theorem and Elevation and depression 25%	Q5,25,34,42,44 ,56,59, (7)	Q10,15,30,43,51, (5)	Q18,21,55 (3)	15
Bearing 10%		Q3,28,36 (3)	Q14,26,47 (3)	6
Simple and linear equation 11%	Q8(1)	Q23,27,46(3)	Q19,70,92 (3)	7
Algebraic operation 10%	Q24, (1)	Q11,16, 48(3)	Q,23 49(2)	6
Total	14	16	30	60

Students' Classroom Observation Checklist (SCOC)

This scale is developed by the researchers and it consists fifteen (15) items to rate the students class-room participation on asking questions, answering questions, identification of formulae, application of the formulae as it is in the appendix ll. The instrument is based on 3-point scale. The rating is done according to the students' ability level being measured by each item. Each student is rated by awarding an appropriate mark as follows:

If the student does not possess the character at all---------- 0
If the student has low ability----------1
If the student has high ability----------2

The highest score a student can get in SCOC is 64 while the lowest score is -16. The items are later reduced to ten (10) after validations by experts. The criticism and comments of the experts are used to establish the content and construct validity of the instrument. The reliability is established using inter-rater (Scotts' pie) at 0.92. Scott's Pie formula is presented thus:

$$\text{Scott's Pie} = \frac{P_0 - P_e}{100 - P_e}$$

Where

$P_0 = 100 - (\%\text{difference})$

$P_e = \frac{(\%\text{Average})^2}{10}$

And P_0 is value observed and P_e is value expected.

Data-Driven Instructional Package (DDIP)

This is adapted by the researcher from the work of Bambrick-Santoyo (2010) and it consists the guide on data-driven instructional strategy as well as the package to be delivered which is used to prepare the pre-service teachers in the experimental group. The instrument covers the six topics in JSS2 second term scheme of work in Ekiti State.

Data-driven instruction model

The model used in this study is 6-part model suggested by Bambrick-Santoyo (2010). They are:

I. Pre-assessment stage wherein the entry behaviour of the students will be measured
ii. Select topics to be taught based on the difficult areas from the simulated group
iii. Learn relevant skills for teaching using data (teaching methods)
iv. Give interim assessment to determine the learning outcomes
v. Re-teach until at least 80% of the students improve
vi. Evaluate and analyse data as feedback on the effectiveness of the instruction. This is represented in figure 3.

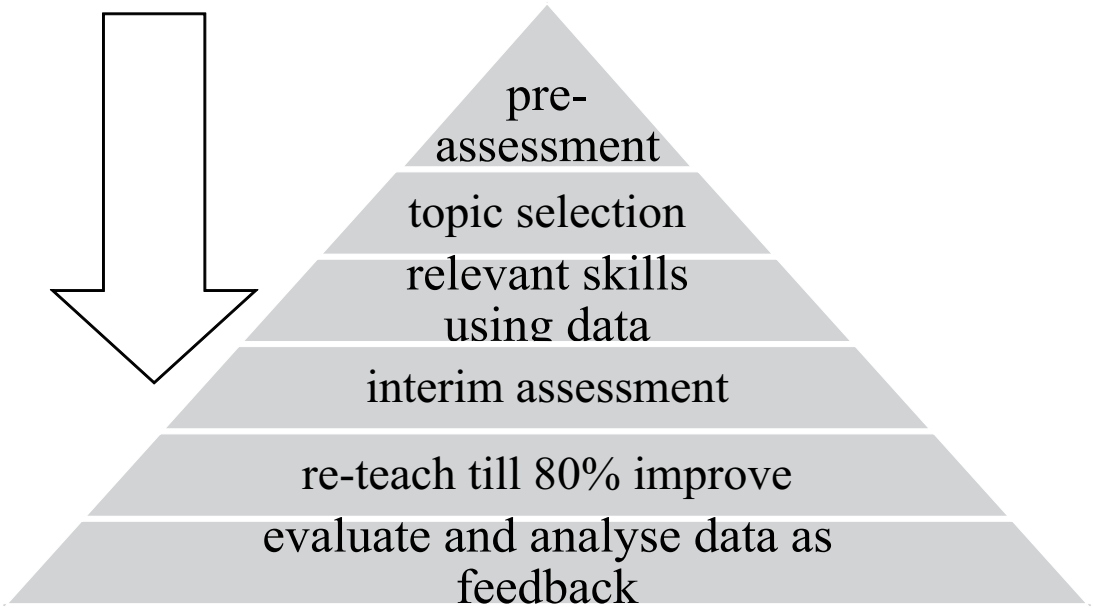


Figure 3 shows the steps in Data-driven instruction model

Method of Data Analysis

The post-treatment scores are subjected to Analysis of Covariance (ANCOVA) using the pre-treatment scores as covariates. All hypotheses are tested at 0.05 level of significance (p = 0.05).

Results

$Ho_{1:}$ There is no significant main effect of treatment on students' achievement in Mathematics

Table 3 shows the main effect of treatment on Students' achievement in Mathematics.

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	13887.870[a]	8	1735.984	68.403	.000	.825
Intercept	2539.164	1	2539.164	100.051	.000	.463
Pre student achievement	1001.727	1	1001.727	39.471	.000	.254
treatment	10022.954	1	10022.954	394.934	.000	.773
Student gender	21.925	1	21.925	.864	.355	.007
Classroom Participation	313.662	1	313.662	12.359	.001	.096
treatment * student gender	17.243	1	17.243	.679	.411	.006
treatment * Classroom Participation	31.440	1	31.440	1.239	.268	.011
Student gender * Classroom Participation	4.447	1	4.447	.175	.676	.002
treatment * student gender * Classroom Participation	17.759	1	17.759	.700	.405	.006
Error	2943.938	116	25.379			
Total	99676.000	125				
Corrected Total	**16831.808**	**124**				

a. R Squared = .825 (Adjusted R Squared = .813) significant at p< 0.05.

The table shows that the main effect of treatment is significant on students' achievement in Mathematics [$F_{(1,116)}$=394.934, p<.05]. The hypothesis which states that there is no significant main effect of treatments (DDI) on Students' learning achievement (pre-test and post-test scores) in Mathematics is rejected. The partial Eta squared estimate is 0.77. This implies that 77% of the variance observed in the students' achievement post test score is due to treatment (DDI).

$Ho_{2:}$ There is no significant main effect of students' participation in class on students' achievement in mathematics

Results on Table 3 reveal that Students' classroom participation has a significant main effect on Students' learning achievement in Mathematics [$F_{(1,116)}$= 12.359; p<.05]. Based on this finding, hypothesis Ho_2 is rejected. The partial Eta squared estimate is 0.10 which implies that students' participation in class accounts for 10% of the variance observed in post-test scores of students' learning achievement in Mathematics.

Table 4: Mean of Students' classroom participation of male and female on students achievement in Mathematics.

Classroom participation			95% Confidence Interval	
	Mean	Std. Error	Lower Bound	Upper Bound
Male	25.076[a]	.613	23.862	26.290
Female	28.449[a]	.725	27.013	29.884

Table 4. shows that the mean score of Female is better at (x = 28.449) than Male (x= 25.076)) in students' classroom participation.

Ho_3There is no significant interaction effect of treatment and students' participation in class on students' learning achievement in Mathematics.

Table 3 shows that there is no significant interaction effect of treatment and Students' participation in class on Students' learning achievement in Mathematics [$F_{(1,116)}$=1.239; p>0.05]. The conclusion is that the hypothesis $Ho_{3(a)}$ is not rejected. The partial Eta squared estimate is .011. This implies that interaction effect of treatment and students' participation in class accounts for 1.1% of the variance observed in post-test scores of students' learning achievement in Mathematics.

Ho4 There is no significant interaction effect of treatment, students' participation in class and gender on students' achievement in Mathematics.

Table 3 shows that there is no significant interaction effect of treatment, students' participation in class and gender on students' learning achievement in Mathematics [$F_{(1,116)}$=0.700; p>0.05]. The conclusion is that the hypothesis $Ho_{4(a)}$ is not rejected. The partial Eta squared estimate is 0.006. This implies that interaction effect of treatment, students' participation in class and gender accounts for 0.6% of the variance observed in post-test scores of students' learning achievement in Mathematics.

Discussion

Results on Table 3 reveal that Students' classroom participation has a significant main effect on students' learning achievement in Mathematics [$F_{(1,116)}$= 12.359; p<.05]. Based on this finding, hypothesis $Ho_{2(a)}$ is rejected. The partial Eta squared estimate is .096 which implies that students' participation in class accounts for 9.6% of the variance observed in post-test scores of students' learning achievement in Mathematics. Table 4.7 shows that the mean score of female is better at (x= 28.449) than male which is (x = 25.076). The result of the study shows that students' participation in class goes a long way in the achievement of students in Mathematics class. This may be attributed to the teacher's teaching method. Literature reveals that the teaching methods used by the teacher will encourage the students in classroom participation. Audu and Achor (2003) state that participation in the classroom involves an active encounter of the teacher and the students through verbal, gestural and resource instrumentality to bring about effective communication in a teaching and learning process. The teacher and fellow students both play a role in influencing student achievement since this relationship is an essential part of the teaching and learning process. This result gives credence to Inamullah's (2005) observation that teacher- student interaction in the classroom is a two-way process which improves learning outcomes because each participant influences the other's behaviour; the students condition their teacher's behavior and vice versa.

Table 3 shows that there is no significant interaction effect of treatment and students' participation in class on students' learning achievement in Mathematics [$F_{(1,116)}$=1.239; p>0.05]. Since P(0.268) is greater than 0.05 alpha levels. This suggests that there is no significant interaction effect of treatment and students' participation in class on students' learning achievement in Mathematics. Therefore, hypothesis $Ho_{4(a)}$ is not rejected. The partial Eta squared estimate is .011. This implies that interaction effect of treatment and students' participation in class accounts for 1.1% of the variance observed in post-test scores of students' learning achievement in Mathematics and it is not significant.

Table 3 shows that there no significant interaction effect of treatment, students' participation in class and gender on students' learning achievement in Mathematics [$F_{(1,116)}$=0.700; p>0.05]. Since p(0.405) is greater than 0.05 alpha levels, it can be concluded that there is no significant interaction effect of treatment, students' participation in class and gender on students' learning achievement in Mathematics. The conclusion is that the hypothesis $Ho_{4(a)}$ is not rejected. The partial Eta squared estimate is .006. This implies that interaction effect of treatment, students' participation in class and gender accounts for 0.6% of the variance observed in post-test scores of students' learning achievement in Mathematics.

Conclusion

• This study has been able to establish that Data-driven Instructional Strategy is effective in ameliorating the low performance of learners' achievement in Mathematics. Instructors at all levels need to improve on the way students are taught so as to increase the students' learning outcomes in Mathematics. Similarly, the method of teaching in any teaching-learning environment is governed by the preparation of the teacher and his / her teaching methods which ultimately has effect on learners' attitude. Students' achievement is not sensitive to student's gender and also there is no interactive effect that is significant in all cases. To this effect, teachers should find out how best to teach a given topic in order to increase learners' learning outcomes.

Recommendations

1. Teachers should be encouraged by educational authorities to incorporate DDI strategy for teaching and learning of Mathematics topics. This is because introducing instructional methods that range from conventional to contemporary has a positive effect on the academic performance of low-achieving students.
2. Curriculum planners should make provision for data-driven decision making in the curriculum. More time should be allocated to the teaching of Mathematics so that students will perform better in the subject.

References

Adeleke, J.O. 2007. Identification and effect of cognitive Entry. Characteristics of students' Learning Outcomes in Bearing in Mathematics. An unpubished Ph.D Thesis Institute of Education, University of Ibadan, Ibadan, Nigeria.

Adewale, J.G. & Ibidiran, O.V. 2013. Construction and validation of affective behaviour of students in Ekiti State West African *Journal of Education Vol.XXXII* (published at University, of Ibadan).

Ala O.D &Olatunji, M.O. 2014. Teaching and Assessing of Affective Characteristics: a Critical Missing Link in Online Education. Copyright © International Journal on New Trends in Education and Their Implications / www.ijonte.org, 4 (1)96-113.

Ale, S. O. & Adetula, L. O. 2010. The national mathematical centre and the mathematics improvement project in nation building. *Journal of Mathematical Sciences Education. 1(1)1-19.*

Akinsola, O. & Awofala 2011. International Journal of Mathematics Trends and Technology- Volume2 Issue3- http://www.internationaljournalssrg.org Page 21.

Awolola, S.A. 2009. Impact of brain-based Instructional Strategy on students' learning outcome in senior secondary school mathematics in Oyo State, Nigeria. Ph.D. Thesis, University of Ibadan.

Bambrick-Santoyo, P. 2010. *Driven by Data. A practical guide to improve instruction*. Jossey- Brass a Wiley Imprint 989 market, San Franciso, CA 94103- 1741.

Federal Republic of Nigeria. 2013. National Policy on Education (6th Edition) Lagos: Nigerian Educational Research and Development Council (NERDC).

Ogunsanwo,T. 2003. Homework mode and parental involvement in homework as determinants of primary school pupils learning outcomes in Mathematics in Ibadan North. An unpublished PhD research thesis, University of Ibadan.

Olosunde, G.R 2009.Impact of constructivist model-based training programmes on pre-service teachers knowledge, attitude, classroom practices on school Mathematics. Unpublished PhD thesis, Department of Teacher Education, University of Ibadan.

Popoola, A. A. 2004. Effects of programmed instructional strategies on Senior Secondary School student learning outcomes in Mathematics in Ekiti State, Nigeria. An unpublished Ph.D Thesis, University of Ibadan.

Salami, I. A. 2009. An investigation into teaching methods in primary mathematics teachers training institutions. A paper presented in an international conference on Education for sustainable development, Faculty of Education,University of Ibadan.

Salami, I. A 2014. Effects of Training Programmes on Pre-service Primary Mathematics Teachers' Planning and Utilisation of Activity-Based Lessons in Southwestern States, Nigeria. Unpublished P.hD theses.

Wayman, J.C., V. Cho, and Johnson, M. T.. 2007. "The Data-Informed District: A District-Wide Evaluation of Data Use in the Natrona County School District." Austin, Texas: The University of Texas.