EFFECT OF ASEI-PDSI TEACHING APPROACH ON JUNIOR SECONDARY SCHOOL STUDENTS' RETENTION IN MATHEMATICS IN ABUJA, NIGERIA

By

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Abstract

This study investigated the effects of ASEI-PDSI teaching approach on junior secondary school student's Retention in Mathematics. The study was guided by three objectives, three research questions and three null hypotheses. The study was carried out in Kwali Area Council, Federal Capital Territory (FCT) Abuja and adopted the quasi-experimental research design. The population for the study was 2,445 students, comprising of 1,414 males and 1,031 females. Simple random sampling technique was adopted with a sample size of 157 students, consisting of 69 males and 88 females were involved in the study. Mathematics Retention Test (MRT) was the instrument used in collecting data for pre-test and post-test respectively. The reliability index of the instrument was found to be 0.90. The data were analyzed using Mean and Standard Deviation to answer research questions and ANCOVA statistic was used to test the hypotheses at 0.05% level of significance. The results of the findings showed that students exposed to ASEI-PDSI teaching approach retained better in Mathematics than those exposed to the conventional method of instruction. Again, the findings indicated no significant difference in retention of male and female students when taught Mathematics using ASEI-PDSI teaching approach. Based on the findings, recommendations were made on the need to adopt the use of ASEI-PDSI teaching approach in teaching Mathematics in junior secondary schools. Secondly, Mathematics teachers should be advised and encouraged to attend in-service education and training (INSET) especially outside the country to gain wider experience on the application and effectiveness of ASEI-PDSI teaching approach in Mathematics since it has been found effective in enhancing students' academic retention. In conclusion, the result of this study provides empirical evidence that the use of ASEI-PDSI teaching approach enhanced students' Retention more than the use of conventional teaching method in Mathematics

and therefore teachers should be encouraged to embrace the use ASEI-PDSI teaching approach in Mathematics classroom.

Keywords: ***Activity, Students, Experiment, Improvisation-Plan, Do, See. Improve (ASEI-PDSI), Conventional Method of Teaching Mathematics, Retention Test.***

Introduction

Mathematics is a tool for scientific and technological advancement. It is a fundamental science that is needed for the understanding of most fields in science and technology education (Bolaji, 2008). Anaduaka and Hassan (2017) stressed that Mathematics is the bedrock upon which scientific knowledge rests and hence, for a modern existence, amid rapid technological development, a good knowledge of Mathematics is inevitable. Mathematics helps students to develop a sense of critical thinking, observation and to acquire appropriate skills which in turn lead to scientific solution of problems.

Mathematics is a core subject at the primary and post-primary school levels of the Nigerian educational system (Federal Republic of Nigeria (FRN), 2014). This important position occupied by the subject in the school curricula is borne out of the role of Mathematics in the nation's aspirations for scientific and technological developments. Mathematics is the central intellectual discipline of the technological societies and it has contributed more to the objectives of the general education of man than any other subject (Salami & Popoola, 2017). It is for this reason that almost all nations of the world make the study of Mathematics compulsory both at primary and secondary levels of education. Nigerian government made it a compulsory subject to be offered by every student from primary to secondary level of education (FRN, 2014). On the basis of the National Policy on Education (FRN, 2014) and with particular reference to the aims and objectives of secondary education, the general objectives for teaching and learning of Mathematics in Nigeria are:

> to generate interest in Mathematics and to provide a solid foundation for everyday living; to develop computational skills; to foster the desire and ability to be accurate to a degree relevant to the problem at hand; to develop precise, logical and abstract thinking; to develop the ability to recognize problems and to solve them with related mathematical knowledge; to provide necessary mathematical background for further education; and to stimulate and encourage creativity (FRN, 2014) page 14.

Despite the importance of Mathematics in the development of the nation, a review of the performance of students in internal and external examinations has revealed a poor and disturbing picture with respect to the trend in academic performance of secondary school students in Mathematics in the last two decades which has become a source of worry to all stakeholders in the field of education including parents, students, school administrators and the general public. Students have not been performing well in Mathematics in most examinations (Akanmu, 2017). Azuka (2005) asserted that academic failure is not only frustrating to the students and the parent; its effects are equally grave on the society in terms of dearth of manpower in all spheres of the economy and polity. Azuka (2005) further stressed that Nigeria needs Mathematics in achieving a functional education required for the attainment of the Nigerian national objectives. In realization of this fact, the Federal Government of Nigeria made Mathematics a prerequisite for admission to study most science courses in our tertiary institutions. Yet, students' performance in Mathematics is still very poor.

Year	Candidate that sat for examination	Students that obtained (A1 - C6)	% of students with credit and above	Students with (D7-F9)	% of students with D7-F9.
2008	1,268,213	726,398	44.43%	541815	55.57%
2009	1,348,528	634,382	43.74%	714,146	56.26%
2010	1,306,535	548,065	41.95%	758,470	58.05%
2011	1,508,965	608,866	40.35%	900,099	59.65%
2012	1,658,357	838,879	50.58%	819,478	49.42%
2013	1,658,187	899,901	54.27%	758,286	45.73%
2014	1,632,377	1,011,608	61.97%	620,769	38.03%
2015	1,605,248	837,513	52.17%	767,735	47.83%
2016	1,552,758	772,117	49.72%	780,641	50.28%
2017	1,559,162	923,486	59.23%	635,676	40.77%
2018	1,572,396	786,016	49.98%	786,380	50.02%
2019	1,590,173	923,486	59.97%	666,687	40.03%

The annual Mathematics results of West African Senior Secondary Certificate Examination (WASSCE) released by the West African Examination Council (WAEC) computed for more than a decade shows the problematic nature and the

general poor performance of secondary school students in Mathematics. Statistics showing the Mathematics performance of students at the Senior Secondary Certificate Examination (SSCE) from 2008 to 2019 is presented in **Table 1: Trends of students' Performance in Mathematics in Nigeria (WASSCE May/June 2008-2019)**

Source: WAEC direct online result; https.//www.waecdirect.org. Retrieved August 18, 2019.

The WAEC annual Mathematics performance from 2008 to 2019 as shown, gives the percentage of students with credit and above as follows: in (2008 (44.43%), 2009 (43.74%), 2010 (41.95%), 2011 (40.35%), 2012 (50.58%), 2013(54.27%), 2014 (61.97%), 2015 (52.17%), 2016 (49.72%), 2017 (59.23%),2018 (49.98%), 2019 (59.97%)).

Statistics showing the Mathematics performance of students at the Senior Secondary Certificate Examination (SSCE, NECO June/July from 2011 to 2019) is presented in Table 2

Table 2: Trends of students' Performance in Mathematics in Nigeria (SSCE NECO June/July 2011-2019)

Year	Candidate that sat for examination	**Students that obtained (A1-C6)**	% of students with credit and above	**Students with (D7-F9)**	% of students with D7-F9.
2011	1,160,049	290,012	25.0%	870,037	75.0%
2012	1,124,879	567,011	50.4%	557,868	49.6%
2013	1,034,263	668,314	65.5%	365,949	34.5%
2014	978,886	680,227	69.49%	298,659	30.51%
2015	969,991	662,503	68.3%	307,488	31.7%
2016	1,055,988	736,446	69.74%	319,542	30.26%
2017	1,051,472	745,053	70.85%	306,419	29.15%
2018	1,041,536	863,148	89.90%	178,388	10.10%
2019	1151,016	954,399	71.50%	196,617	28.52%

Source: https://mypastquestion.com>necoresults: Retrieved August 18, 2019.

The National Examination Council (NECO) results showed that the percentage of students with at least a credit pass in Mathematics in 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018 and 2019 were 25%, 50.4%, 65.5%, 69.5%, 68.3%, 69.74%, 70.85%, 89.90% and 71.50% respectively.

Federal Capital Territory (FCT) in particular is not exempted. Students also perform poorly in Mathematics in the Federal Capital Territory. For instance, data from the Federal Capital Development Authority (FCDA) Department of Education on WASSCE yearly analysis on percentages of students with credit in Mathematics from 2011, 2012, 2013, 2014, and 2015, 2016, 2017 and 2018 are 9.2%, 21.4%, 32.2%, 17.7%, 30.2%, 49.4%, 61.83% and 52.11% respectively.

In addition, the WAEC Chief Examiner's Reports of 2012, 2013, 2014, 2015, 2016 and 2017 show that majority of students performed poorly in geometry, number & numeration and algebra. To be specific, they poorly attempted manipulation of decimals and fractions, geometrical construction, graphs, commercial arithmetic, circle geometry and its applications, logical reasoning, omission of essential details and unit, premature approximation and modular arithmetic (Akanmu, 2017). Akanmu suggested that teachers should use instructional materials during lessons so as to reinforce the learning of mathematical concepts.

Gardner (2010) noted that the issue of possible factors affecting retention of students has been a great concern to all. Both school and non-school factors have been pin-pointed. However, researchers' evidences have consistently implicated teaching method as a major factor in students' retention in Mathematics (Alio & Nneji, 2017). Radhakrishan cited in Thomas (2009) stated that, to respond to the on - going global reform in the educational and technological development of the society, teachers should be the best mind of any country and Mathematics should be the tool to achieve the national set goals. Recent researches on effective Mathematics teaching focused on instruction that promotes students involvement on activity- based learning which is superior to so many other expository teaching methods.

The National Mathematical Centre (NMC, 2012), noted that students' poor learning outcomes in both internal and external examinations in Mathematics is due to teachers' methods of teaching rather than the contents of the curricular for school Mathematics. Rooms are not given for interaction and sharing of ideas among the learners. Salami and Popoola, (2017) opined that students' interest and retention in Mathematics have continued to decline in Nigeria year in year out.

Sequel to this, there is a wide spread concern among parents and education stakeholders about the methods used in teaching Mathematics at the secondary school level in Nigeria. The inadequacy of the conventional teaching models to improve students' Retention has become a source of concern to many educators in Nigeria (Adetula & Ale, 2005). They also asserted that one of the most persistent and

compelling problems besetting retention in the learning of Mathematics in Nigeria is consistent use of lecture method.

Lecture method can be regarded as a process whereby the teacher delivers verbally a prepared body of knowledge to his students who listen and jot down points from the teacher. It is basically a teacher centered approach which encourages one way communication, though it can be used to communicate to a large crowd of students orally or through electronic media like radio or television. However, the major disadvantage in using lecture method is that it makes the students passive participants in the teaching- learning process. As a result of the disadvantages of the lecture method, teachers are now being requested to move away from it and embrace the activity based learning strategies (Orji, 2007).

Activity- oriented learning is a procedure where students actively engage in the lesson rather than just sitting, listening and absorbing the lesson. The emerging paradigm of Mathematics teaching is based on the approaches which make teaching more learner-centered and activity-based as against didactic and teacher-centered methods of teaching (Godwin, 2017).

ASEI-PDSI (Activity Students Experiment Improvisation - Plan Do See Improve) teaching approach is considered an effective approach for ensuring the quality of Mathematics and science lessons and their steady improvement and growth. ASEI, which is the acronym for Activity, Students, Experiment and Improvisation, is a key word in the Strengthening Mathematics and Science in Education (SMASE) project for lesson innovation. ASEI lesson is made possible through PDSI (Plan, Do, See, Improve) practice. This teaching approach involves students actively participating in the entire Mathematics classroom activities. These activities will help learners to be familiar with objects in real life which have a relationship with concepts learned in Mathematics classroom. The way they perceive those objects will have implications for how they grow and learn related concepts in the classroom.

Mwelese and Atwoto (2014) stated that, without taking away the important role played by the teacher, it is helpful to remember that what the student does is actually more important in determining what is learnt, than what the teacher does. The goal of teaching is to make students learn. The teacher's role is to create conducive atmosphere for learning and facilitate this process to assist learners make the required progress. ASEI-PDSI is the type of teaching approach which can stimulate learners' sense organs in classroom especially when teaching such Mathematics topics that pose difficult for students to understand (JICA, 2014).

Odili (2006) noted that when students are involved in the learning process, even if they forget what the teacher said, they would remember what he/she did. Active participation in classroom activities reinforces and enhances retention which leads to recall of information when needed and consequently lead to good academic retention.

Mathematics concepts need to be presented to the learners in a way or method that touches their sub consciousness which can trigger quick recalling of the concept being taught or learnt. Using such a teaching method, where the learners are exposed to the material before diving into the abstract concept of the topic will help to concretize the concept in the learners' memory. Therefore, both high ability and low ability learners would be able to collaborate in terms of understanding, explaining and retaining of the concept they have learnt in the Mathematics class, which will eventually promote retention in schools among all students.

Mathematics students comprise male and female. The noticeable agreement is that gender is an important factor in Mathematics learning (Zhang, 2006). The causes of gender differences also fall into groups. Some researchers believe that gender differences in Mathematics can be mainly attributed to physical, mental and other factors (Geary, Sauzts, and Liu, 2000); others suggest that external factors like social and cultural factors are dominant causes of gender differences (Fan & Li, 2008). Some researchers are of the opinion that females have no obstacles in participating in Mathematics learning, both in physical and mental aspects, while some have the view that gender issue has no significant effect on the learning of Mathematics. Impact of gender on students' retention in Mathematics is still therefore an unsettled issue till date.

Very few experimental studies in Nigeria focused on this innovative approach termed ASEI-PDSI teaching method, which countries like Japan, Solomon islands, Serbia, Turkey, Mexico, Costa Rica, Argentina, Honduras, Brazil, Paraguay, Botswana, Ghana, Kenya and so on, have affirmed that it improves students' Retention and retention in Mathematics (Mwelese & Atwoto, 2014). Most especially, there was no evidence of any published experimental research on the effects of the ASEI-PDSI teaching approach on secondary school students' Retention in Mathematics in Abuja. This prompted this research to confirm the efficacy of the teaching method in the teaching and learning of Mathematics in Nigerian secondary schools. The study consequently was designed to ascertain the effects of ASEI-PDSI teaching approach on secondary school students' Retention in Mathematics in Federal Capital Territory (FCT), Abuja, Nigeria.

Research Questions

The following research questions were raised to guide the study:

1. What is the difference in the mean Retention scores of secondary school students taught Mathematics with ASEI-PDSI teaching approach and those taught with the conventional approach?
2. What is the difference in the mean Retention scores of male and female students taught Mathematics using ASEI-PDSI teaching approach?
3. What is the interaction effect of ASEI-PDSI teaching approach and genders on students' mean Retention scores in Mathematics.

Research Hypotheses

The following null hypotheses were tested at 0.05 level of confidence.

$H0_1$: There is no significant difference in the mean Retention of students taught Mathematics using ASEI-PDSI teaching approach and those taught using conventional method.

$H0_2$: There is no significant difference in the mean Retention scores of male and female students taught Mathematics using ASEI-PDSI teaching approach.

$H0_3$: The interaction effect of ASEI-PDSI teaching approach and gender on students' mean Retention scores in Mathematics is not statistically significant.

Methodology

The research design adopted for the study was the Quasi-experimental Research Design (non-equivalent pre-test, post test, control group design). Simple random sampling method was used to select schools for the study, FCT was stratified along the six Area Councils from which Kwali Area Council was selected using simple random sampling. To select Schools, among the 17 co-educational schools in Kwali Area Council, purposive sampling technique was used to select two junior secondary schools in Kwali Area Council. Co-educational secondary schools were considered in order to provide for male and female gender which was of interest to this study. From the two selected schools in the Area Council; one school was assigned, to experimental group while the other school was assigned to control group using simple random method. Using simple random sampling method, the first school that was picked was assigned experimental, while the other school was the control group. The first picked school that was assigned experimental while the second served as the control school. From each of the selected schools, lucky dip was used to select an intact class among one of the junior secondary three (JS3) classes. Thus, class 3A in Junior Secondary School, was selected as experimental class (group), while class 3B formed the other intact class, which served as the control group for the study.

Mathematics Retention Test (MRT) developed by the researcher was used for the study. The Mathematics Retention Test (MRT) had items in geometry and mensuration, statistics, numbers and numeration, trigonometry and algebra, drawn from the Nigerian national Mathematics curriculum for junior secondary school students published by the Nigerian Educational Research and Development Council (NERDC) and in the scheme of Work for JS3 in the Federal Capital Territory (FCT) Abuja, Nigeria. There are 40 items of the MRT, that was developed for the purpose of collecting data for evaluating the students as pre-test and post-test with four options (A, B, C, and D). The 40 multiple choice objective items were selected from 45 questions, item difficulty index (IDI) and item discriminating power (IDP) was calculated for all the items, before acceptance. To ensure the content validity of the test, a table of specification (test blueprint) was used. This helped to ensure that the objectives chosen for instruction were the ones chosen for testing. To further ensure the face validity of the MRT and the lesson plans for the experimental and control groups, they were given to two Mathematics education experts and an expert in Measurement and Evaluation in National Mathematical Centre, Abuja and University of Abuja respectively. The experts rating of the instruments on their appropriateness served as the logical validity of the instrument through consensus opinions.

The MRT was pilot tested in a school not involved in the study to establish its reliability. The reliability of the test instrument was determined using split-half method. The correlation coefficients of the tests were calculated using the Pearson Product Moment Correlation Analysis (PPMCA). A correlation coefficient of 0.90 index was obtained which was considered high enough and suitable for gathering data. Statistical Package for the Social Sciences (SPSS) version twenty-one (21) was used to analysis the data collected for the study. Descriptive statistics was mean and standard deviation, which was used to answer the research questions, while Analysis of Covariance (ANCOVA) was the inferential analysis, which was used to test the hypotheses at 0.05 confidence level. Analysis of Covariance (ANCOVA) was considered appropriate because it helped to eliminate the unwanted variance from the dependent variable and helped to reduce the error term. Secondly, ANCOVA also helped to test the interaction effects on dependent variables that may exist during baseline pretest score.

The treatment of the ASEI-PDSI teaching approach and the conventional method lasted for about ten weeks for the experimental and the control group. The treatment session followed the school timetable adopting the school scheme of work, where Mathematics was taught four to five times a week because some days were having double period. The researcher trained the research assistants for period of one week. The research assistant was the students' regular Mathematics

teacher. The lesson plan was prepared by the researcher for the experimental and the control class. The treatment for the experimental and control group were having about 4 periods in a week. And each period were having about 40 minutes per period. The treatment lasted for about 10 weeks, making a total of 160 days which is equivalent to 6,400 minutes.

Presentation of Results and Interpretation

Research Question 1 What is the difference in the mean Retention scores of secondary school students taught Mathematics with ASEI-PDSI teaching approach and those taught with the conventional approach?

Table 3: Summary of Pretest, Post-test mean and Standard Deviation of Mathematics Retention Test (MRT)

Variable		**Pretest**		**Posttest**		**Mean gain.**
Group	N	Mean	SD	Mean	SD	
Control	80	39.88	13.39	45.15	13.06	5.27
Experimental	76	32.96	11.39	58.10	17.29	25.14
Mean Difference		**6.92**		**12.95**		

Table 3 shows the pretest mean, posttest mean and standard deviations for the experimental and control groups. The pretest mean scores were 39.88 and 32.96 in favour of the control group with mean difference of 6.92. But after the treatment, post test scores were 45.15 for control and 58.10 for the experimental group with mean difference of 12.95 in favour of the experimental group. This implies that the students exposed to ASEI-PDSI teaching approach had more improvement than their counterparts. However, the posttest mean scores of both groups show that both groups improved on their mean scores after the treatment.

Research Question 2: What is the difference in the mean Retention scores of male and female students taught Mathematics using ASEI-PDSI teaching approach?

Table 4: MAT mean difference and standard deviation of male and female students taught Mathematics using ASEI-PDSI teaching approach

Group	**Sex**	**N**	**Mean**	**SD**
	Male	36	69.72	18.31
Experimental	Female	40	67.45	17.45
	Mean Difference		0.27	

Table 4 shows the mean and standard deviation of Mathematics Retention test scores of male and female students in the experimental group. The male students had a mean score of 67.72 as against 67.45 for the females, with standard deviation of 18.31 and 17.45 respectively. This shows that the female students had less variation. The difference in the mean Retention scores of both male and female students taught Mathematics using ASEI-PDSI teaching approach is 0.27.

Research Question 3: What is the interaction effect of ASEI-PDSI teaching approach and genders on students' mean Retention scores in Mathematics

To answer Research Question 3, hypotheses were tested.

Testing of Hypotheses

Table 5: Two way analysis of covariance (ANCOVA) results on Mathematics retention test (MRT) of the control and experimental groups in Pretest and Post tests.

Source	Type III Sum of Squares	Df	Mean Square	F	Sig (P).	Partial Eta Squared
Corrected Model	30215.619[a]	4	7553.905	29.188	.000	.428
Intercept	38910.439	1	38910.439	150.346	.000	.491
Pretest	425.084	1	425.084	1.642	.202	.010
Teaching method	25895.939	1	25895.939	100.059	.000	.391
Gender	2.984	1	2.984	.012	.915	.000
T/ method *Gender	9.535	1	9.535	.037	.848	.000
Error	40373.760	155	258.806			
Total	541146.000	156				
Corrected Total	70589.379	155				

a. R Squared = .428 (Adjusted R Squared = .413)
b. Computed using alpha = .05

Research Hypothesis (Ho1)

HO_1: There is no significant difference in the mean retention score of students taught Mathematics using ASEI-PDSI teaching approach and those taught using conventional method.

Table 5 refer: Two way analysis of covariance (ANCOVA) results on MRT of the control and experimental groups in Pre and Post tests shows F (155) =100.059, where p-value = 0.000 is less than 0.05 level of significance. Therefore, the null hypothesis which states that there is no significant difference in the mean retention score of students taught Mathematics using ASEI-PDSI teaching approach and those taught using conventional method is rejected. A significant difference exists in the achievement in favour of the experimental group.

Ho_2 There is no significant difference in the mean Retention scores of male and female students taught Mathematics using ASEI-PDSI teaching approach.

Table 5: The two way analysis of covariance (ANCOVA) results of the difference in retention of male and female students in experimental group. The F (155) =0.012, where p-value = 0.915 is greater than 0.05 level of significance. Therefore, The null hypothesis which states that there is no significant difference on the mean retention scores of male and female students taught Mathematics using ASEI-PDSI teaching approach stands accepted. It can therefore, be concluded that there is no statistically significant difference on the mean retention scores of male and female students taught Mathematics using ASEI-PDSI teaching approach.

Research Hypothesis (Ho3)

H03: The interaction effect of ASEI-PDSI teaching approach and gender on students' mean Retention scores in Mathematics is not statistically significant

Tables 5 above refer: two way Analyses of Covariance (ANCOVA) results of the difference in Retention of male and female students in experimental group. The F (155) =0.037, with p-value of 0.848 is greater than 0.05 level of significance. Therefore, The null hypothesis which states that there is no significant difference on the mean Retention scores of male and female students taught Mathematics using ASEI-PDSI teaching approach stands accepted. It can therefore, be concluded that there is no statistically significant difference on the mean Retention scores of male and female students taught Mathematics using ASEI-PDSI teaching approach

Discussions of Findings

The results of the descriptive statistics indicated that the experimental group gained higher mean scores on ASEI-PDSI teaching approach than the control group. The difference between the pretest and the posttest ASEI-PDSI teaching approach mean scores of the students in the control and experimental group were 10.50 and 34.98 respectively. This signifies that students that were exposed to ASEI-PDSI teaching approach improved better than their counterparts who were not exposed to ASEI-PDSI teaching approach treatment. The ANCOVA results showed that there was a significant difference in the mean scores of ASEI-PDSI teaching approach on students exposed to the treatment and those not exposed to the treatment. Thus, the students exposed to the treatment retention were significant in favour of the ASEI-PDSI teaching approach. Thus, the improvement correspond with the positions of Mwelese and Atwoto, (2014) who opined, that students taught with the ASEI-PDSI teaching approach had a better view and attitude towards Mathematics than those taught with the conventional approach. These lends support from other researcher alike who posits that ASEI-PDSI teaching approach can be developed over time

through INSET training program Centre for Mathematics, Science and Technology Education in Africa (CEMASTEA, 2014). The implementation of ASEI-PDSI teaching approach gives the students opportunity to learn from things around them. This finding also supports the research findings of Ayiego, Mang'are, Ngome and Mandilah (2015) that ASEI-PDSI teaching approach by teachers of Mathematics in Vihiga County, easily improved the perennial poor performance in Mathematics at National examinations level in Kenya. He further opined that with ASEI-PDSI teaching approach, students' can create awareness and familiarize with hands-on, minds-on and mouth-on activities. In addition, the research assistants in this study reported that the students were very excited at the treatment and this also leads to positive behaviour of the students in the classroom and further enhance cooperation among classmates and teachers.

The difference between the pretest and the posttest mean MRT scores of the students in the control and experimental group were 5.27 and 25.14 respectively. The result of the ANCOVA also indicated that there was a significant difference in the mean retention scores in favour of ASEI-PDSI teaching approach in the experimental group. The results showed that the students exposed to ASEI-PDSI teaching approach had improvement and retained better than the control group. The finding of this research study lend acceptance to many researchers on their findings that ASEI-PDSI teaching approach improve achievement and also assist students to retained better in school subjects (Onchong'a (2013), Mwelese and Atwoto (2014), Ayiego, Mang'are, Ngome and Mandilah (2015). Also, result of this study support that, ASEI-PDSI teaching approaches have positive relationship with students' academic achievement and retention in Mathematics and science alike as opined by Wafubwa, (2014). However, it has been reported that teachers' use of ASEI-PDSI teaching approach in their lessons is inadequate due to poor supervision from head teachers during implementation in Mathematics lessons. Teacher responds on inadequacies on implementations were due to constraints on pressure to cover the syllabus and lack of adequate time for lesson preparation (Wafubwa, 2014). For a better improvement on the side of the teachers, efforts should be made to further improve teachers understanding in using the ASEI-PDSI teaching approach; the ministry of education should organize INSET training both for the teachers and students. (Onchong'a, 2013).

MRT scores showed that, the male students in the experimental group had a higher mean posttest of 67.72 and the female students had 67.45 mean score, while the male students' in the control group scores were 49.28 and the female mean scores were 48.51 respectively. However, both the male and the female students in the experimental group had improvements in their mean MRT scores above their counterparts in the control group. The ANCOVA results also showed that there was

no significant difference in the Mathematics retention test scores of males and females. These findings correspond with the findings of Hedges and Nowell cited in Olasehinde & Olatoye, (2014) who found no or slight gender differences in overall Mathematics achievement. The finding of this research study on gender lend acceptance on the research work of Obi, Agwagah, and Agah, (2014) who reported that retention have been unstable between male and female students. Some of the results were in favour of boys than girls, while others showed that gender has no significant effect on students' ability in understanding mathematical concepts. As a result of these variations, the issue has remained inconclusive.

Table 5, hypothesis 3, also showed the significant of null hypothesis on the interaction effect of ASEI-PDSI teaching approach on gender of students' group mean retention scores in Mathematics. This findings corresponds with Iliyasu, (2009) which results obtained revealed that the strategy had significant impact on performance of pupils in the experimental group when compared with that of the control group. Iliyasu, (2009) further results stressed that performance of pupils when comparison was made between male and female revealed in-significant difference in the performance of pupils from rural and urban areas when taught with ASEI-PDSI strategy.

This is in contrast with the findings of Olaleye and Olosunde, (2012) whose findings revealed that there was a significant difference between male and female. This implies that there is a clear effect of the independent variables on interaction. They further stressed that all the independent variables termed psycho- social variables as determinant on interaction of male and female taken together could effectively influence gender in Mathematics.

However, ASEI-PDSI teaching approach can enhance junior secondary school students' Mathematics retention and so is a solution to students' dismal performance in Mathematics. Again, it also shows no gender bias on retention when taught Mathematics using these teaching approaches. The approach is a paradigm shift from teacher centered approach to learners' centered pedagogy and have been found to encourage the culture of continuous improvement.

Conclusion

The result of this study provides empirical evidence, that the use of ASEI-PDSI teaching approach enhanced students' retention in Mathematics more than the use of conventional teaching method. Further, students taught Mathematics using ASEI-PDSI teaching approach on experimental group performed better than their counterpart taught same concepts in Mathematics using conventional method. There was no significant difference of gender on retention of students taught Mathematics using ASEI-PDSI teaching approach.

Recommendations

The following recommendations were made based on the findings of this study:

1. Since the use of ASEI-PDSI teaching approach enhances retention of students in Mathematics, the Mathematics teachers should employ it in classroom teaching and learning.
2. Workshops/Seminars should be organized by government, private, associations, NGO's for Mathematics teachers to enable them learn the innovative method since it is reported from the findings that ASEI-PDSI teaching approach has positive effect in the teaching and learning of Mathematics concepts both in Nigeria and in other countries.
3. Mathematics teachers should be advised and encouraged to attend INSET training both in Nigeria and outside the country to gain wider experience on the application and effectiveness of ASEI-PDSI teaching approach in Mathematics. This will enable them appreciate and use the ASEI-PDSI teaching approach to promote effective teaching and learning in Nigeria. To achieve this, the federal, state, local government, private individuals, organizations and Alumni associations in Nigeria should endeavour, as a matter of dedication to provide schools with needed training on how to develop ASEI-PDSI teaching approach lesson note and its implementation in Nigerian schools.

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