



Impact of ASEI-PDSI Teaching Approach on Upper Basic Students' Performance and Retention in Basic Science in Bauchi State, Nigeria

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ABSTRACT

The purpose of this study was to determine the impact of the ASEI-PDSI teaching approach on upper basic students' performance and retention in Basic Science. The study employed a pre-test post-test quasi-experimental research design with 168 upper basic II students as a sample of the study. The experimental group was taught using the ASEI-PDSI teaching approach, while the control group was taught using the traditional teaching method. Basic Science Performance Test (BSPT) and Basic Science Retention Test (BSRT) were used as instruments for data collection. Mean and standard deviation was used to answer the research questions while analysis of covariance (ANCOVA) was employed to test the hypotheses at a 0.05 level of significance. The reliability of BSAT was determined using the Kuder-Richardson formula 20 (K-R20) and the reliability coefficient of 0.76 was obtained. The findings of the study revealed that students taught Basic science using the ASEI-PDSI teaching approach performed and retained the learned concepts significantly higher than those taught using the conventional teaching method and there was no significant difference in the retention ability of male and female students when taught Basic science using ASEI-PDSI teaching approach. Based on these findings it was concluded that the ASEI-PDSI teaching approach has an impact on students' performance and retention and it is a gender-friendly instructional approach that might close the gender-retention gap in Basic science.

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INTRODUCTION

The use of ineffective teaching strategies has been one of the greatest challenges confronting the teaching and learning of science subjects. This makes it necessary for educational scientists and psychologists to find promising instructional strategies to improve the teaching and learning of science subjects and to enable learners cope with the needs of the time and prepare them to compete effectively in this dynamic world of science and technology. This is because provision of effective science and technology education remains the only essential way for attainment of social and economic development of every nation. This fact is re-emphasized in the National Policy on Education (FRN, 2014) that science and technology

education should provide the learners with the adequate knowledge and skills that would ensure efficient sustainability in world of scientific and technological advancement.

Science according to Muhammad et al., (2021) involves a systematic study of natural phenomena and it is study allows the learners to experience the richness and the excitement of the natural world as they engage in inquiry, critical thinking and the demonstration of skills. The purpose of science is to transform the environment towards improving the quality of life, thereby, making world a better place for everyone. The role of science literacy in building national prestige, health, agriculture, security, and economy cannot be overemphasized this is testified by Adeniran et al., (2018) who



concluded that, science literacy is the backbone of every nation's scientific and technological development. Similarly, UNESCO (2017) reported that science education should provide the learners with adequate knowledge, attitude, principles and skills that would ensure sustainability of societies. Therefore, provision of effective science and technology education is the only way-out for every nation to meet up the national prestige so as to attain social and economic development. In view of the roles of science education to the national economic and social development, science education curriculum is developed at every level of Nigerian educational system.

The science education subject at the upper basic (junior secondary I-III) level of education is Basic science.

Basic science was previously called integrated science and it is a first form of pure science subject students come across at upper basic level of education in Nigeria. Basic science according to Joseph and Okere (2018) is the foundation on which further scientific studies rest. Therefore, it prepares the learners for studying the core science subjects (biology, chemistry and physics) at senior secondary level and higher institutions of learning. Agu and Samuel (2018) maintain that, for a successful study of science subjects at senior secondary level of education, students had to be well groomed in Basic science at the upper basic level. This implies that Basic science is the fundamental subject on which science is built and its curriculum is purely science. In view of this, the subject received great attention in the basic education curriculum.

Despite the role of Basic science as the foundation for grooming future scientifically literate Nigerians and development of the nation at large, students' performance in the subject has not been encouraging. The problem of students' poor performance in Basic science according to (Okwara et al., 2019; Afuwape & Olugbuyi, 2019; Bash et al., 2020) is as a result of teachers' application of conventional method of teaching which does not help the learners to participate actively and apply their creative minds during the instructional process. The conventional method of teaching is teacher-centered in nature with little or no emphasis on the learners. This means that it does not encourage the learners to develop skills of creativity, critical thinking and problem solving. This resulted to the learners'

inability to understand, dig deeper, retained what was learned, answer questions from the topics treated and meaningfully apply what was learned to the solution of problems in real life situation. Odoh and Apine (2019) concluded that when conventional method applied in teaching Basic science, it does not facilitate meaningful learning and what is expected in term of achievement or performance from the learners as designed in the curriculum. This makes students to perceive Basic science as an abstract and very difficult subject. Thereby, many students lose interest in Basic science.

Basic science curriculum according to Ogwah et al., (2021) is an activity based and learner-centered curriculum. Therefore, the curriculum require effective application of activity based teaching approaches that are learner friendly and make the learning meaningful and interesting to the students, this might likely enhances students' achievement, performance, retention, and interest in Basic science. Similarly, UNESCO (2017) states that students' performance in Science, Technology, Engineering and Mathematics (STEM) subjects can be enhanced through effective application of instructional approaches that are activity-based and learner-centered. In a nutshell, curriculum of Basic science advocates for the application of teaching and learning approaches that are result oriented, activity-based and learner-centered. This necessitated the need for Basic science teachers to identify and apply innovative, activity-based and learner-friendly instructional approach that might facilitate students' performance and retention. The ASEI-PDSI teaching approach is one of such innovative approaches that aim at remedying the ineffectiveness of conventional teaching method and enhance the students' academic performance and retention.

The acronym ASEI stands for Activity, Student-centered, Experiment and Improvisation, it is an effort that facilitates a paradigm shift from a traditional teacher-centered teaching methodology to learner-centered teaching approach. The PDSI stands for Plan, Do, See and Improve. The PDSI promote the continuous progress in the students learning skills. According to Winrose et al., (2019) effective implementation of ASEI requires proper Planning, Doing, Seeing and Improvement (PDSI) as a process of evaluating the students' behavioural changes as planned



and answering the questions on how the activity is being conducted in relation to the targeted objectives. Mpewe (2018) revealed that effective application of ASEI-PDSI approach in teaching and learning enables learners to learn independently and construct knowledge.

ASEI-PDSI teaching approach emphasized on learner-centered teaching approach where the learner is viewed as the center of the teaching and learning processes, it provides the learner with the opportunity to actively participate and apply their creative mind during teaching and learning processes, where the teacher's role is that of a guide and facilitator instead dominating the teaching and learning processes. According to Strengthening of Mathematics and Science Education (SMASE, 2012) the improvisation in ASEI aims at making the innovative use of local and available resources and materials from the learners' immediate environment and real life experiences to enhance teaching and learning and designing simple experiments to enhance learner's interest, curiosity and active participation.

The active participation of learners in teaching and learning processes yields capabilities, such as independent-learning, social interaction, healthy competition and self-evaluation among the learners this enhances their performance and results to meaningful learning instead of rote learning. As a result of such learning capabilities, Ogwah et al., (2021) reported that Science Teachers Association of Nigeria (STAN) has recommended the effectiveness of ASEI-PDSI teaching approach in Basic science teaching and learning. Similarly, Ifeanyi and Benard (2017) maintain that the features of an ASEI-PDSI lesson are activity-based, student-centered and experimental based approach. Such features call for learners' active participation in the teaching and learning processes.

Purpose of the Study

Purpose of the study was to examine the relative impacts of ASEI-PDSI approach of teaching on upper basic students' performance and retention in Basic science. Specifically, the study sought to find out the:

1. Impact of ASEI-PDSI approach on students' performance in Basic science.
2. Impact of ASEI-PDSI approach on students' retention in Basic science.

3. Impact of ASEI-PDSI approach on male and female students' retention in Basic science.

Research Questions

The following research questions are formulated to guide this study.

1. What is the mean performance scores of students taught Basic science using ASEI-PDSI teaching approach compared with those taught using conventional teaching method?
2. What is the mean retention scores of students taught Basic science using ASEI-PDSI teaching approach compared with those taught using conventional teaching method?
3. What is the mean retention scores of male students compared with female students when taught Basic science using ASEI-PDSI teaching approach?

Hypotheses

The following null hypotheses are postulated to be tested at 0.05 level of significance:

- H₀₁:** There is no statistically significant difference in the mean performance scores of students taught Basic science using ASEI-PDSI teaching approach and those taught using conventional teaching method.
- H₀₂:** There is no statistically significant difference in the mean retention scores of students taught Basic science using ASEI-PDSI teaching approach and those taught using conventional teaching method.
- H₀₃:** There is no statistically significant difference in the mean retention scores of male and female students when taught Basic science using ASEI-PDSI teaching approach.

METHODOLOGY

The study employed a pre-test, post-test quasi-experimental research design. The sample for the study was 168 upper basic II students from two randomly selected upper basic schools in Bauchi metropolis. Experimental group was taught using ASEI-PDSI teaching approach, while control group was taught using conventional teaching method. Basic Science Performance Test (BSPT) and Basic Science Retention Test (BSRT) were the instruments used for data collection from the subjects. The BSPT consisted of 30 multiple choice objective questions drawn based on the topics treated



during the study and covered the lower and higher order levels of Blooms' taxonomy of learning domains. The items in BSPT were reshuffled in term of numbering and the correct options and re-administered as BSRT. Pre-test was administered to both the experimental and control groups before the experiment, the groups were taught for the period of 4 weeks then post-test was administered. Two weeks after the post-test the BSRT was administered to both groups. The reliability of BSPT was determined using Kuder-Richardson formula 20 (K-R20) and the reliability of 0.76 was coefficient obtained. Data

from the study was analyzed using mean and standard deviation (SD) to answer the research questions while, the hypotheses were test at 0.05 level of significance using analysis of covariance (ANCOVA).

RESULTS AND DISCUSSION

Research question one: What is the mean performance scores of students taught Basic science using ASEI-PDSI teaching approach compared with those taught using conventional teaching method?

Table 1: Performance Mean Scores and Standard Deviation of Students of Experimental and Control Groups

Group	N	Pre-test		Post-test		Mean difference
		Mean	S. D	Mean	S. D	
Experimental	82	28.50	3.95	47.88	4.99	14.22
Control	86	29.38	4.59	33.66	6.89	

Result from table 1 reveals the performance mean score of students of experimental and control groups. From the table, students of experimental group have performance mean score of 47.88 after exposure to treatment while, their counterparts of control group have performance mean score of 33.66. The mean performance difference between the experimental and control group was 14.22 in favour of students of experimental group. This revealed that students of experimental group had higher performance score as a result of their exposure to ASEI-PDSI

teaching approach than their counterparts of control group who were taught using conventional teaching method. This implies that student's performance in Basic science can be enhanced by application of ASEI-PDSI teaching approach.

Research question two: What is the mean retention scores of students taught Basic science using ASEI-PDSI approach compared with those taught using conventional teaching method?

Table 2: Retention Mean Scores and Standard Deviation of Students of Experimental and Control Groups

Group	N	Post-test		Retention		Mean difference
		Mean	S. D	Mean	S. D	
Experimental	82	47.88	4.99	50.59	4.66	16.52
Control	86	33.66	6.89	34.07	6.86	

Result from table 2 reveals the retention mean score of students of experimental and control groups. From the table, students of experimental group have retention mean score of 50.59 while, their counterparts of control group have 34.07, with a mean retention difference of 16.52 in favour of experimental group students. This revealed that students in the experimental group have higher retention score in Basic science as a result of their exposure to ASEI-PDSI

teaching approach. This implies that student's retention of learned Basic science concepts can be enhanced by application of ASEI-PDSI teaching approach as a medium of instruction.

Research question three: What is the mean retention scores of male students compared with female students when taught Basic science using ASEI-PDSI approach?



Table 3: Retention Mean Scores and Standard Deviation of Male and Female Students of Experimental Group

Gender	N	Post-test		Retention		Mean difference
		Mean	S. D	Mean	S. D	
Male	43	47.53	4.72	50.33	4.32	0.54
Female	39	48.25	5.32	50.87	5.04	

Table 3 shows the retention mean scores of male and female students of experimental group. The table revealed that male and female students have retention mean scores of 50.33 and 50.87. The mean retention difference of 0.54 between male and female students, though the difference was very small and was in favour of female students. This implies that when ASEI-PDSI teaching approach was applied in Basic science class male and female students retained the learned concepts almost at the same level. The significance of the difference between

male and female students' retention mean scores was further determined by testing the null hypothesis.

Hypothesis one:

There is no statistically significant difference in the mean performance scores of students taught Basic science using ASEI-PDSI teaching approach and those taught using conventional teaching method.

Table 4: Summary of Analysis of Covariance of Experimental and Control Groups Students' Performance Mean Scores in Basic Science

Source	Type III Sum of Squares	Df	Mean Square	F	P	Partial Eta Squared	Decision
Corrected Model	10387.881a	2	5193.941	206.387	.000	.714	
Intercept	1174.047	1	1174.047	46.652	.000	.220	
Pretest	1905.603	1	1905.603	75.721	.000	.315	
Group	9232.879	1	9232.879	366.878	.000	.690	Rejected
Error	4152.399	165	25.166				
Total	291481.000	168					
Corrected Total	14540.280	167					

Analysis of Covariance (ANCOVA) result in table 4 revealed that $F(1,165) = 366.878$, $P < 0.05$, partial $\eta^2 = 0.690$. Since the P-value of 0.000 is less than 0.05 level of significance with a high effect size (69%). This indicated that there was a significant impact of ASEI-PDSI teaching approach on students' performance in Basic science. Therefore, hypothesis one which states that there is no statistically significant difference in the mean performance scores of students taught Basic science using ASEI-PDSI teaching approach and those taught using conventional teaching method was rejected. This implies that there was statistically significant difference in the

mean performance scores of students taught Basic science using ASEI-PDSI teaching approach and those taught using conventional teaching method and the magnitude of the difference was 69% in favour of students taught using ASEI-PDSI teaching approach.

Hypothesis two:

There is no statistically significant difference in the mean retention scores of students taught Basic science using ASEI-PDSI approach and those taught using conventional teaching method.



Table 5: Summary of Analysis of Covariance of Experimental and Control Groups Students' Retention Mean Scores in Basic Science

Source	Type III Sum of Squares	Df	Mean Square	F	P	Partial Eta Squared	Decision
Corrected Model	16051.334a	2	8025.667	1145.746	.000	.933	
Intercept	164.648	1	164.648	23.505	.000	.125	
Posttest Group	4601.699	1	4601.699	656.939	.000	.690	
Error	297.760	1	297.760	42.508	.000	.799	Rejected
Total	1155.785	165	7.005				
Corrected Total	315410.000	168					
Total	17207.119	167					

Analysis of Covariance (ANCOVA) result in table 5 revealed that $F(1,165) = 42.508$, $P < 0.05$, partial $\eta^2 = 0.799$. Since the P-value of 0.000 is less than 0.05 level of significance with a high effect size (80%). This indicated that there was significant impact of ASEI-PDSI teaching approach on students' retention in Basic science. Therefore, hypothesis two which states that there was no statistically significant difference in the mean retention scores of students taught Basic science using ASEI-PDSI approach and those taught using conventional teaching method was rejected. This implies that there was statistically significant difference in the mean retention scores of students taught Basic science using ASEI-PDSI teaching approach and those taught using conventional teaching method and the magnitude of the difference was 80% in favour of students taught using ASEI-PDSI teaching approach.

Hypothesis three:

There is no statistically significant difference in the mean retention scores of male and female students taught Basic science using ASEI-PDSI teaching approach.

Table 6: Summary of Analysis of Covariance of Male and Female Students' Retention Scores in Basic Science

Source	Type III Sum of Squares	Df	Mean Square	F	P	Decision
Corrected Model	1441.516a	2	720.758	181.114	.000	
Intercept	88.439	1	88.439	22.223	.000	
Posttest Gender	1435.414	1	1435.414	360.695	.000	
Error	.083	1	.083	.021	.886	Not Rejected
Total	314.387	79	3.980			
Corrected Total	211584.000	82				
Total	1755.902	81				

Analysis of Covariance (ANCOVA) result in table 6 revealed that $F(1,79) = 0.021$, $P < 0.05$. Since the P-value of 0.886 is greater than 0.05 level of significance, this indicated that when ASEI-PDSI teaching approach was applied in teaching Basic science, gender has no effect on retention of learned Basic science concepts. Therefore, hypothesis three which states that

there was no statistically significant difference in the mean retention scores of male and female students taught Basic science using ASEI-PDSI teaching approach was not rejected. This implies that there was no statistically significant difference in the mean retention scores of male and female students taught Basic science using ASEI-PDSI teaching approach. Therefore, ASEI-PDSI



teaching approach was a gender friendly strategy as both male and female students retained the learned Basic science concepts equally.

DISCUSSION OF FINDINGS

The finding from this study revealed that, students taught Basic science using ASEI-PDSI teaching approach perform significantly higher than their counterparts taught using conventional teaching method. This finding agreed with the position of (Mwelese & Atwoto 2014; Katiambo et al., 2019; Ogwah et al., 2021) in their separate studies found that students taught using ASEI-PDSI teaching approach perform higher than their counterparts taught using conventional teaching method. Based on this finding it was established that, ASEI-PDSI teaching approach has more impact than conventional teaching method in enhancing students' performance.

The finding revealed that, students taught Basic science using ASEI-PDSI teaching approach retained the learned concepts significantly higher than their counterparts taught using conventional teaching method. This finding is in accord with that of (Samuel, 2018; Adeniran et al., 2018; Muhammad et al., 2021) found that students of experimental group retained the learned concepts higher than their counterparts of control group. This revealed that, ASEI-PDSI teaching approach has more impact than conventional teaching method in enhancing students' retention of learned Basic science concepts. Based on this finding, it was established that, ASEI-PDSI teaching approach enhances retention of learned concepts better than conventional teaching method.

The finding also revealed that, there was no significant difference in male and female students' performance scores when taught Basic science using ASEI-PDSI teaching approach. This finding is in agreement with that of (Ogbeba & Agernor, 2016; Okwara et al., 2019; Oyeniyi, 2020) who in their separate studies found that gender has no effect on male and female students' retention. This revealed that male and female students are capable of competing when ASEI-PDSI teaching approach is used as medium of instruction and that retention is a function of orientation not gender. Therefore, ASEI-PDSI is a gender-friendly instructional approach that can be used to close the gender-retention gap in Basic science. However, this finding contradicted that of (Akpoghol et al., 2016; Chibabi et al., 2018) who

found significant difference in retention mean scores of male and female students.

The likely explanation for these findings may be connected to the fact that ASEI-PDSI teaching approach encourages students to actively participate in the instructional processes by experimenting, improvising, reflecting on what was learned and design solution to the problems themselves.

CONCLUSION

Based on the findings and discussion from this study, it was deduced that; ASEI-PDSI teaching approach enhances students' performance and retention and it is a gender-friendly instructional approach that might close the gender-retention gap in Basic science. ASEI-PDSI teaching approach provides the students with opportunity to actively participate in the teaching and learning processes irrespective of gender. Therefore, any observed differences in male and female students' retention may have occurred as a result of other factors not related to gender.

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