EFFECT OF TWO INSTRUCTIONAL STRATEGIES ON THE ACADEMIC ACHIEVEMENT OF STUDENTS IN CHEMISTRY IN SECONDARY SCHOOLS IN KWALI, FCT, ABUJA

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Abstract

The study investigated the effect of two Instructional strategies on the academic achievement of students in Chemistry in secondary schools in Kwali Area Council, Abuja. The study had two research objectives which were translated into research questions and research hypotheses. The population of the study was 8,721 SS 2 students of chemistry and 160 students were sampled through purposive sampling. The study was tested using a quasi-experimental research design. Simple percentage analysis was used to examine the research questions, and Analysis of Covariance analysis (ANCOVA) was used to analyze the research hypotheses According to the study, the ASEI teaching strategy increases students' academic achievement in chemistry more than lecture method, the use of ASEI teaching strategy demonstrated that gender did not have any significant influence on the students' achievement of students. It was recommended that educational institutions should emphasize the importance of using the ASEI teaching technique to enhance students' achievement.

Keywords: Activity, Students, Experiment, Improvisation, gender, lecture method

INTRODUCTION

The development of any nation depends largely on the level of its scientific and technological literacy. Chemistry which is one of the sciences is indispensable to technological advancement. In Nigeria, the current obvious situation in Chemistry is the staggering decline in the academic achievement of learners at all levels of our education system (Nenty,2010). The implications for this trend which has persisted for decades are threat to the technological and scientific development of the nation, especially now that the entire world is driven by scientific and technological advancement. In an attempt to provide a paradigm, shift in Nigeria, the Department of Technology and Science Education (DTSE) and the Japan International Cooperation Agency (JICA), reached an agreement in 2006 to re-establish a system of retraining

for serving teachers in the areas of mathematics and science education. Other beneficiaries of the In-service Education and Training (INSET) include countries like Kenya, Ghana, Uganda, Malawi and Egypt among others.

This initiative in Africa has produced the Strengthening Mathematics and Science Education-Western, Eastern, Central and Southern Africa (SMASE-WECSA) network. The Federal Government of Nigeria (FGN) officially joined the SMASE-WECSA Association in 2004 and subsequently became interested in adopting/adapting and promoting student-centered method of teaching through the ASEI (Activity, Student Centered, Experiment and Improvisation) movement approach for excellence in mathematics education since mathematics teachers are more concerned with traditional lecture method of teaching which educationists believe that it does not promote meaningful learning of mathematics leading to poor performance in the subject (FME,2006).

The concept of ASEI.

According to SMASE Nigeria (2006) ASEI is an acronym for Activity, Student- centered, Experiment, and Improvisation. It is a teaching and learning approach which aims at making teaching and learning more pupil- centered. It is therefore, a paradigm shifts from 'banking style/chalk and talk' approach to 'activity based/student centered approach'. ASEI as an intervention strategy that takes cognizance of how students learn. students do not simply copy the science world rather they construct their own meaning out of it. They must be provided with the opportunity to construct scientific knowledge through the interaction of their observation, prior knowledge and mental processes. The four principles, which form the basis for the ASEI pedagogical paradigm (SMASE 2006) are:

1. student-focused learning: active students' involvement in the teaching and learning process where the teacher guides and gives them opportunity to express opinions, explain ideas based on prior experiences and verify their opinions/ideas through suitably designed activities.

2. experiment/Research based approach: scaled down, investigative experiments which are simpler, more relevant to specific lesson objectives, and enable pupils to discover or reinforce new concepts/ideas; rather than those prescribed in text books.

3. activity-oriented teaching: carefully selected activities to enhance pupils' participation, interest, understanding and retention of knowledge.

4. improvisation: teacher innovativeness to enhance students' interest, participation and learning; drawing from locally available resources and student's real life experiences.

The impact of ASEI principles on teachers and Students

The lesson elicits great interest and responsiveness among pupils, they gradually attain the desired attitude and the level of understanding and retention of knowledge is increased since ASEI lesson through PDSI approach, among other things is easy to prepare, easy to use and is teacher friendly as advocated by SMASE (2006) and (Fatokun et al. 2019).

Merits and Challenges of ASEI Strategy.

During SMASE 1ST post impact survey (2012), merits of ASEI strategy as well as the challenges connected to the strategy were identified. The report revealed that ASEI strategy

i. gives room for students' participation, Generates and sustains students' interest in chemistry.

ii. increases understanding, retention and application of chemistry concepts in real life experience and also arouses curiosity.

iii. develops cognitive and affective skills (minds-on activities), as well as psychomotor skills (hands-on activities).

iv. develops process skills such as observation, record keeping, analysis and interpretation of data and also takes care of the needs of pupils' individual differences.

v. simplifies attainment of learning objectives and encourages the use of locally made materials.

The challenges of ASEI are as follows:

i. teachers' workload is increased

ii. a lot of time is required for planning

iii. syllabus coverage is hardly attainable

iv. funding constraints

v. resistance by teachers to the new strategy.

Ways of solving the Challenges

At the end of the report, some suggestions were made on how to manage the perceived challenges as follows:

i. proffer storage and maintenance of materials

ii. constant practice by the teachers involved.

iii. sensitizing curriculum developers and other stakeholders

iv. development of improvisational skills.

ASEI as a paradigm shift is not a new method of teaching; rather it is a rallying point for teachers to consciously focus on the pupil who is the main player in the teaching/learning process. Whenever a teacher looks at a lesson plan or observes a lesson being taught, he/she should easily make a quick evaluation by simply answering the question: is it an ASEI lesson? To succeed in attaining the ASEI condition in the classroom, every teacher has to go the Plan, Do, See and Improve (PDSI) way.

Concept of Lecture Method

Mike (2013) asserted that during lectures, students attempt to solve problems, synthesize or inter-related information for only 1% of their time, while 78% of the lecture time was spent on passive thoughts about the subject and irrelevant thoughts. Mike (2013) further stated that the best way to learn to solve problems is to be given problems that have to be solved. The best way to develop critical skills is to practice using the canons of criticism.

Lecture Method is a series of actions or activities planned by the instructor and systematically provided to the learner to enable him receive and process the information; retain and recall it in order to be able to use it to tackle emerging life tasks and problems. The lecture method was one of the most effective and efficient ways to disseminate information and has often been used, because many instructors are poor lectures and learners' poor participants in the traditional setting. This type of instruction has allowed learners to be passive in the classroom, learners not knowing how to be active participants in lecture, have relied on transcription, copying direct from the textbooks or chalkboard, memorization and repetition for learning. Researchers like (Wanjohi

2016) supported the use of lecture method but emphasized that the problem arises from the way lectures are used, not from their inherent inability to promote significant learning. In practice, most lectures do not engage learners or motivate them to take responsibility for what and how they learn (Andala and Ng'umbi 2016). Tao (2001) affirmed that when learners that have learned using lecture are tested in class, they tend to be proficient in using the knowledge in immediate problem solving activities. He based this observation on lack of conceptual understanding of the concepts and referred to the practice as 'rote' learning which may produce the correct answer without the ability to reason as to why a particular concept has been used.

Lecture methods can be more useful to promote learning fully if used interactively with other learning methods such as the use of power point the interactive approach by telling, showing, asking and providing learners with the opportunities to self-explore topics and lessons. The actual techniques to have been identified to work include: the use of flash cards, brain storming, think in pairs and sharing, demonstrations, cooperative learning and independent study among others Andala and Ng'umbi (2016). Learners may benefit from interactive teaching by learning to construct their own understanding and meaning while learning to reason, solve problem and think critically.

Gender Disparities

Although, Owoso (2013) contended that it is better to look beyond gender characteristics into the interaction between individual learner's specific characteristics and particular features of instructional treatment in order to determine the reasons for discrepancies in academic performance. The controversy as to which of the sexes would have better academic performance

therefore, continues. Thus, the trait-treatment interaction theory suggests that there is a connection between personality traits of the learner and variables of the instructional situation and that the effect of learning must be interpreted as the result of that interaction (Owoso, 2013). These differences may present an understanding into the reasons why the result of the current study may be affected by gender of the learning students on civic education.

Gender, as a concept, has captured the interest of science and technology educators in Nigeria. Students' gender has been subject of discussion in the domain of educational research. Some findings report that males do better in competitive learning while female do better in cooperative learning settings leading to single- sex schooling advocacies due to perceived male domination and potential and by extension affirming gender differences effect on students' achievement in science subjects (Ogunkola & Garner-O'Neale, 2013). Studies on gender differences and students' achievement, revealed gender disparity in science in favour of males' students, others reported females' superiority and others zero disparity (Udo & Udofia, 2006; Udo, 2011). The study was based on Piaget's theory and Brunner's theory respectively.

In a way to improve the academic achievement of students in chemistry, the researcher investigated the effect of two instructional strategies on the academic achievement of students in the Federal Capital Territory, Abuja.

Statement of the Problem

According to Strengthening Mathematics and Science Education(SMASE) 2012, the use of teacher centered approach of teaching by mathematics teachers does not give room for adequate students' participation in the class room activities and they find it difficult to arouse the interest of the students during instruction, so that they appreciate the subject, learn the concept very well and

apply the knowledge acquired in real life situations. Incompetence of the teachers to improvise relevant teaching materials is also a problem especially where the conventional ones are not available; as such the stated objectives of the lesson could not be achieved.

Therefore, to solve the problems mentioned the new approach of teaching and learning of Chemistry has to be adopted. The teacher must ensure that their lesson is activity based, student centered, there is room for experimentation and finally improvises all the necessary and relevant materials that will facilitate the learning of the concept to be taught. Boniface (2018) reported that insignificant factor that reduces learning of mathematics and other related science subjects is the recipe book style that limits students' opportunity to experience ownership, creativity and development of effective learning. Hence, the researcher feels it necessary to conduct a study on the effects of two instructional strategies on academic achievement of students in Chemistry in Kwali Area Council, Abuja.

Objective of the Study

The main purpose of this research was to determine the effects of two instructional strategies on academic achievement of students in Chemistry in Kwali Area Council, Abuja.

The study's objectives are as follows:

1. ascertain the mean difference between the achievement scores of chemistry students taught using ASEI teaching strategy and conventional teaching method.
2. determine the mean difference between the achievement scores of male and female students taught chemistry using ASEI teaching strategy.

Research Questions

The study gives responses to the research questions.

1. What is the mean difference in the achievement scores of senior secondary school students taught chemistry using ASEI teaching strategy and conventional teaching method?
2. What is the mean difference between the achievement scores of male and female senior secondary school students taught chemistry using ASEI teaching strategy?

Research Hypotheses

The following null hypotheses were formulated and tested at 0.05 level of significance**.**

$H0_1$: there is no significant difference between the achievement scores of senior secondary school students taught chemistry using ASEI teaching strategy and conventional teaching method

$H0_2$: there is no significant difference between the mean achievement scores of male and female students taught chemistry using ASEI teaching strategy.

Methods and Materials

A quasi, pre-test, post-test control group design was adopted for this research. The research design for this study is a non-equivalent group quasi-experimental design. The population for the study was 8,721 SS 2 chemistry students in 9 Government Senior Secondary Schools in Kwali (FCTSEB) Abuja. The sample size for the study 160 SS2 science students, 95 of whom were males and 65 of whom were females in their intact classes. 74 students were in the experimental group while 86 students were in control group.

The Chemistry achievement test (CAT) was adopted for data collection. Two lecturers from the University of Abuja's Department of Science Education and a measurement and evaluation expert from the University of Agriculture, Makurdi validated the CAT. Chemistry Achievement Test

(CAT) components were trial tested on 30 students from Community secondary school Okpo in Kogi state. these were not part of the study.

Kuder Richardson formula-21was used to ascertain the reliability of CAT. This gave co-efficient value of 0.87. The administration of instrument was done in two phases. The first phase is pre-test, which was administered to the students two weeks before the treatment. After the administration of the pre -test, students were taught on the selected topics on electrolysis and its laws for four weeks in the intact classes. Descriptive statistics of Mean and Standard Deviations were used to answer all the research questions. Inferential statistics of Analysis of Covariance (ANCOVA) was used to test all the hypotheses at 0.05 significant levels.

Results

Research Question 1

What is the mean difference in the achievement scores of senior secondary school students taught chemistry using ASEI teaching strategy and lecture method?

TABLE 1: Mean Achievement Scores and Standard Deviation of Students in Experimental and Control Groups

Groups	**N**	**Pretest**		**Posttest**	
		Mean	SD	Mean	SD
Experimental	74	54.11	4.53	83.57	5.78
Control	86	53.50	4.36	61.63	6.06
Mean Difference		0.61		21.94	
Total	**160**				

Table 1 shows that in Pretest, the experimental group had a mean achievement score of 54.11 with a standard deviation of 4.53, while the control group had a mean achievement score of

53.50 with a standard deviation of 4.36. The Table also shows that in the Posttest, the experimental group had a mean achievement score of 83.57 with a standard deviation of 5.78, while the control group had a mean achievement score of 61.63 with a standard deviation of 6.06. From the Pretest and Posttest scores, the mean gain for the experimental group was found to be 29.46 while the mean gain for the control group was 8.13. The mean difference between the achievement scores between the experimental and control group in pretest was 0.61 while their mean difference in posttest was 21.94

Research Question 2

What is the mean difference between the achievement scores of male and female students taught chemistry using ASEI teaching strategy?

TABLE 2: Mean Achievement Scores and Standard Deviation of Male and Female Students in Experimental Group

Groups	**N**	**Pretest**		**Posttest**		**Mean Gain**
		Mean	SD	Mean	SD	
Male	42	56.26	2.81	83.24	6.71	26.98
Female	32	51.28	4.84	84.00	4.32	32.72
Mean Difference		4.98		-0.76		
Total	74					

Table 2 shows that in the Pretest, the male students in the experimental group had a mean achievement score of 56.26 with a standard deviation of 2.81 while the female students had 51.28 as their mean achievement score with a standard deviation of 4.84. In the Posttest, the male students in the experimental group had a mean achievement score of 83.24 with a standard

deviation of 6.71 while the female students had 84.00 as mean achievement score with a standard deviation of 4.32.

From the Pretest and Posttest scores, the mean gain for the males was found to be 26.98 while the mean gain for the females was 32.72. The mean difference between the male and female pretest achievement scores was 4.98 while their mean difference in posttest was 0.76.

Research Hypotheses

Research Hypothesis 1

$H0_1$: there is no significant difference between the achievement scores of senior secondary school students taught chemistry using ASEI teaching strategy and conventional teaching method

TABLE 3: Summary of Analysis of Covariance (ANCOVA) of Experimental and Control Groups' Attitude Ratings towards Chemistry

Source of Variance	Sum of Squares	Df	Mean Square	F	Sig
Corrected Mode	11058.311[a]	2	5529.155	222.121	.000
Intercept	17057.523	1	17057.523	685.246	.000
Pre-Attitude	10.672	1	10.672	.429	.514
Group	11055.688	1	11055.688	444.136	.000
Error	3908.133	157	24.893		
Total	356939.000	160			
Corrected Total	14966.444	159			

Table 3 shows the results of an ANCOVA analysis of data from the attitude inventory of students taught chemistry using the ASEI teaching technique against those taught using the lecture teaching method.

The null hypothesis was rejected based on the results of the study, $F(1,157) = 444.136$, $p0.05$.

This suggests that there is a statistically significant difference in the mean attitude evaluations of students taught using the ASEI teaching strategy against those taught using the lecture method toward chemistry, favoring the ASEI teaching strategy. This also suggests that the experimental group's attitude rating was higher than the control groups.

Research Hypothesis 2

$H0_{2:}$ there is no significant difference between the mean achievement scores of male and female students taught chemistry using ASEI teaching strategy.

There is no significant difference between the mean achievement scores of male and female students taught chemistry using the ASEI teaching strategy.

TABLE 4: Summary of Analysis of Covariance (ANCOVA) of Male and Female Students' Achievement Scores in Chemistry

Source of Variance	Sum of Squares	Df	Mean Square	F	Sig
Corrected Model	87.110[a]	2	43.555	1.316	.275
Intercept	3481.857	1	3481.857	105.239	.000
Pretest	76.566	1	76.566	2.314	.133
Gender	4.316	1	4.316	.130	.719
Error	2349.053	71	33.085		
Total	519218.000	74			
Corrected Total	2436.162	73			

Table 4 shows the ANCOVA analysis of the data collected from the posttest scores of male and female students taught chemistry using the ASEI teaching strategy. From the analysis, $F(1, 71) = 0.130$, $p>0.05$, therefore, the null hypothesis was accepted. This means that there is no

statistically significant difference in the achievement scores of male and female students taught chemistry using the ASEI teaching strategy. This further indicates that there was an almost equal improvement in the achievement scores of male and female students in chemistry after being taught using the ASEI teaching strategy.

Discussion of Findings

The findings of the study revealed that the use of ASEI teaching strategy improved students' achievement in chemistry significantly. The result in Table 1 shows that, before treatment was carried out, the mean achievement scores of students in the experimental and control group were 54.11 and 53.50 respectively with corresponding standard deviations of 4.53 and 4.36, whereas, after the treatment, the mean achievement scores of students in the experimental and control group were 83.57 and 61.63 respectively with corresponding standard deviations of 5.78 and 6.06. The difference in the achievement scores of experimental and control groups before and after the treatment were 0.61 and 21.94 respectively. This clearly shows that students in the experimental group improved in their achievement scores more than the students in the control group. Furthermore, from the test of hypothesis results in Table 3, the p value of .00 showed that there was a significant difference in the achievement scores of students in the experimental and control groups in chemistry. This confirms that using ASEI teaching strategy improves students' achievement in chemistry significantly. The finding is in concord with Kahare (2011) in the Impact of strengthening of chemistry and science in secondary education programme on the teaching and learning of physics in mixed day secondary schools in Lari district, central province, Kenya who found out that the use of ASEI improves students' achievement.

Similarly, results in Table 2 shows that before treatment, the mean achievement scores of male and female students were 56.26 and 51.28 respectively with corresponding standard

deviations of 2.81 and 4.84, whereas, after treatment, the mean achievement scores of male and female students became 83.24 and 84.00 respectively with corresponding standard deviations of 6.71 and 4.32. The difference in mean achievement scores of the male and female students before and after treatment were 26.98 and 32.72 respectively indicating that the achievement scores of male and female students do not differ significantly after being taught chemistry using the ASEI teaching approach. This was also further confirmed by the test of analysis in Table 4 which gave a p-value of 0.16. This is a confirmation that there was no statistically significant difference in the achievement scores of male and female students taught chemistry using the ASEI teaching approach. This finding corroborates that of Ogunkola & Garner-O'Neale, (2013) that there is no significant difference in the achievement of male and female students in the experimental group.

Conclusion

The ASEI teaching strategy increases students' academic achievement in chemistry more than lecture method, the use of ASEI teaching strategy demonstrated that gender did not have any significant influence on the students' achievement of students in chemistry.

Recommendations

Educational institutions should emphasize the importance of using the ASEI teaching technique to enhance students' achievement. Teachers should adopt the use of fascinating or attractive instructional materials that will enhance the attitude of students positively.

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