Impact of Advance-Organizer on Academic and Performance in Recycling Solid-Waste-Concept Among Senior Secondary Chemistry Students, Zaria, Kaduna State, Nigeria

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Abstract— This study investigated the Impact of Advance Organizer on Academic Performance in Recycling Solid Waste Concepts among Senior Secondary Chemistry Students in Zaria, Kaduna State, Nigeria. A total of 75 students selected from two Secondary Schools in Zaria Metropolis were used as the study samples from a population of 1,018 students from ten (10) secondary schools. The two schools selected were found to be academically equivalent. One of the schools served as control group (N=35) and the other served as the experimental group (N=40) which was exposed to Lecture Enriched with Advance-Organizers while the control group was exposed to lecture method alone for period of five weeks. Pretest, posttest, post-posttest quasi experimental and control group design was adapted. Research Instruments was developed by the researcher and validated. Recycling Concept Performance Test (RCPT) with a reliability coefficient of 0.86. Two research questions and hypotheses were formulated. To test the level of significant differences, the research questions were answered using descriptive statistic that is mean and standard deviation, while the null hypotheses were analyzed using t-test at $p \leq 0.05$ significant level. The major findings from the study Include: students taught Recycling Solid-waste Concept of Chemistry using lecture enriched with Advance-Organizer recorded were significantly better in their academic performance as compared to those taught using lecture method alone: and that the use of lecture enriched with advanced organizer is gender-friendly. Recommendations were made from the findings of the study such as secondary school teachers should be trained and retrained to use lectures Enriched with the Advance Organizer in order to enhance and boost students' learning and academic performance in chemistry concepts.

Keywords— solid waste concept, senior secondary, chemistry, recycling, impact, organizer.

INTRODUCTION

With the advent of modern science, the world is in every second being transformed into a favourable living environment. The impact of science on economic development, increased standard of living, and improved communication in every aspect of life has made it mandatory for every nation to ensure that the intellectually gifted of its citizens take to science and science related courses. Science has been described as a human activity practiced by scientists. Asogwa, (2018) noted that science is concerned with making sense out of the environment. It is also a human endeavour to the development and comfort of the modern world. The foundation of such development is the primary and secondary schools where the young scientists are groomed. Science education helps students adjust to technological devices that affect their daily life and that science has come to be recognized as the axle on which development and progress of both the individual and the nation depends (Asogwa, 2018). Science comprises of subject like biology, geography, chemistry, geology, mineralogy, metrology and physics. But the three main science subjects that are taught in senior secondary level in Nigeria are Biology, Chemistry and Physics. Chemistry is compulsory for science oriented students and a requirement for admission into Nigerian University as stated in JAMB Brochure (2013).

According to Ababio (2007), Chemistry is a branch of science that plays central role in the life of humans; as it is through the knowledge of chemistry that raw materials are extracted and processed into different finished products. It also involves the study of matter, its composition, its behaviour, its properties and transformation. The importance of science is anchored on chemistry as one of the core basis for scientific and technological development. Chemistry as a course is one of the basic requirements for some technological courses everywhere and is compulsory for science oriented students. That may be why Ogenyi (2015) reported that chemistry is undoubtedly described as one of the pivot subjects for technological development. These descriptions and assertions indicate the significant position accorded to chemistry as a veritable tool for sustainable science and technological development. Chemistry contributed immensely to the betterment of

the human condition in engineering plastic, paint, antibiotics, cleaning agents, medicine, drugs and environmental issues (Oloyede, 2011). He observed that the study of Chemistry aids students in acquiring manipulative skills, process skill and development of initiative. In spite of the important and the crucial role played in our daily life, Report has shown that students' performance in chemistry has been persistently poor. (WAEC Report, 2016).

A recent analysis by the West Africa Examination Council (WAEC) shows that from 2010 to 2016, less than 40% of all the candidates who sat for chemistry passed at credit level in grades 1-6. Majority of the candidates' score are often below minimum or acceptable mark; inferring that Minds-on and Hands-on experiences in learning chemistry concepts are gradually becoming ineffective and outdated. Ogenyi (2015) observed that in a country like Nigeria, the teaching and learning of sciences using activities/process skill methods have been a neglected fact. He further noted that this makes Chemistry difficult for the learner and as a result the learner perceived Chemistry as difficult and an abstract subject that should be learnt only by rote learning (Cramming). Science Teachers' Association of Nigeria (STAN) showed that students' poor performance in chemistry has evoked much research that aimed at evolving means of redressing the situation (STAN). Obeka (2010) observed that among other factors, poor academic performance recorded in science could be attributed to teaching techniques which do not allow students improve their academic performance and demonstrate their ability.

According to Ogenyi (2015), if learners and teachers must understand concepts in Chemistry and if concept learnt must be retained for problem solving in chemistry; which requires constructing new ideas from what is already there in the child's mind, then careful consideration must be given to the manner by which teachers, subject matter, and learners interact. Another reason for student's poor performance in chemistry may be connected to the way chemistry teachers introduce their lesson at the beginning of each topic or unit; hence there is need for teachers to change their pattern of introduction. For instance, in the course of classroom interaction, teachers fail to combine lecture method with other strategies which are very effective in improving student's academic performance. Obeka (2010) agreed that persistent use of lecture method makes students passive rather than active learners and that, it does not promote insightful learning and long-term retention of some abstract concepts. Olajide (2009) observed that enriching lecture method with analogy is effective in improving students' performance and retention. Thus, there is need to use Advance organizers as an enrichment of lecture teaching techniques when students lack subsuming or prior knowledge. Also, it should be borne in mind that most concepts in chemistry are abstract, very wide and students tend to forget when learning massive amount of concepts (Ogenyi, 2015). It will be of great help if teachers thus make learning more meaningful.

In essence, advance organizer is a brief, general statement informs of text, map graphic, visual or hyper media prepared and used by the teacher to help students link what they already know (prior knowledge) with the new lesson, before presenting the new materials or introducing the new lesson. Advance Organizers according to Ausubel (1960) introduces subsuming concept that enhance integration of new concepts. It also acts as prior knowledge; and is quite good at organizing information, so that learners can easily understand the concept taught to them. Atomatofa (2013) described advance organizers as extremely well designed and thought out unit outlines, presented before the actual topics to be learned. It is also notable that advance organizer is designed to prepare students on how to think about the lessons to come, giving some details about terminology and connections but not giving the entire unit content. Advance organizers provide principles and ideas to the students' cognitive structures directly, and also help the learners to integrate new materials with what they already know; it "prepares" the learners for new information (Bency & Nagarajan, 2015).

Learner's existing cognitive structure, however, is the foremost factor, which determines whether new material will be meaningful and how well it can be acquired or retained (Agbenyeku, 2012); hence, when this change occurs in the development of the learner's thinking, it helps him or her to relate concepts previously learned to the new materials, enabling him or her to quickly organize his or her thoughts. So the researcher intends to determine whether advance organizers has any impact on the academic performance of senior secondary school chemistry students in recycling solid-waste concept. As there have been persistently poor performance of students in chemistry, and waste generation and its effects on health, quality of environment and landscape have become burning national issue in Nigeria, material improvisation and development of psychomotor domain of learning is essential; recycling being an obvious solution to solid waste problem (Zuwahu, 2012). It has become imperative to intimate the students about the consequence of indiscriminate dumping of waste in the environment and the benefit of recycling them, which

will help to inculcate in students the habit of turning waste into wealth.

Momodu, Dimuna and Dimuma (2011) defined recycling as the recovery of materials that would otherwise be buried in the landfills. Recycling is also an obvious solution to solid waste management. Solid waste consists of every items that is used and then thrown away such as paper, glass, plastic, bottle water can, drink containers, textile, and vegetable matter, metal (biodegradable and non-biodegradable). Waste generation is part and parcel of almost every society. However, in Nigeria waste generation has grown significantly over past decade, amounting to millions of tons. The urban centres are experiencing continuous population growth, leading to enormous generation of solid waste (Zuwahu, 2012). Clearing the mounting heaps of solid waste from the environment is a constant challenge to everyone well-meaning citizen (Momodu, Dimuna & Dimuna, 2011). The health consequences of accumulated solid waste such as outbreak of disease epidermis, unattractive site, and unpleasant odors, as a result of decomposition, are noticeable and the waste dumps can be breeding site for bacteria, disease transmission agent such as files, mosquitoes, and rats or dangerous animals like snakes and scorpions. Besides all these, some of the waste are dumped in drainage systems, results to flooding during rainy season (Attah, 2012).

Hence, there is need to inculcate in students, the habit of managing waste, which helps to reduce the harmful impacts of waste on the environment and also for students to have the attitude of learning through practice and turning waste to wealth which will make them acquire skills to become self-reliant, even after they graduate from school. This is in line with the objective of chemistry curriculum as provided in the National Policy on Education: that the learner should be able to use the knowledge and skills acquired to solve problems in everyday life by applying the knowledge, principles and skills acquired to technological and industrial development (FME, 2014). Over the years, curricular development aspect of chemistry has focused more on theoretical delivery or rote learning, which makes instructions teacher-centered while the students become passive learners as their interest are neglected (Jimoh, 2009). Thus, recycling of solid waste concept needs to be presented to the learner in a way that touches his or her sub consciousness which can trigger quick recalling of the concept being taught or learnt, thereby enhancing performance; but how gender compatible would it be?

Gender inequality in education has remained a perennial problem of global scope (UNESCO, 2003). In general, there has been inequality in the opportunities for boys and girls in later life translated into unequal access to education, health and employment (Reid, 2003). Kahle (2004) in the study of gender differences in re-inscribing gendinaries among students, observed that the level of participation of girls in science, technology and engineering activities is low. Also, Ona and Ugwu (2010) in their studies to determine the factors which predict performance in secondary school sciences, asserted that sex is a very good predictor of performance at secondary school level. Similarly, the findings of Reid (2003) revealed significant, in the aspect of gender difference, in favour of boys, in Physics achievement. He also, observed that there is gender inequality in science, technology and mathematics.

Bichi (2002) noted that, gender bias is still a very common issue in Nigeria educational system and should be discouraged. According to him, gender stereotype should be discouraged in Nigeria educational system and the societies at large, so as to give everyone equal opportunity to participate freely in the learning process. This study therefore examines the impact of advance organizers on interest, retention and performance of students in recycling solid-waste concept among senior secondary chemistry students in Zaria, Kaduna State Nigeria.

RESEARCH QUESTIONS

The following research question are set to guide the study:

1. What is the difference between the mean academic performance scores of student taught recycled solid waste concepts in chemistry using lecture enriched with advance organizers and those taught using lecture methods alone?
2. What is the difference between the mean academic performance scores of male and female students taught recycled solid waste concepts in chemistry using lecture enriched with advance organizers at senior secondary schools?

Null Hypothesis

Based on the research questions stated, the following null hypotheses (Ho) are formulated for testing at $P \leq 0.05$.

- $H0_1$: There is no significant difference between the mean academic performance scores of students taught recycled solid waste concept using lecture

enriched with advance organizers and those taught using lecture methods alone.

- $H0_2$: There is no significant difference between the mean academic performance scores of male and female chemistry students taught recycled solid waste concepts using lecture enriched with advance organizers.

METHODOLOGY

The research design employed in this study is pretest posttest, post-posttest quasi-experimental and control groups design as proposed by Kerlinger (1973) involving two groups (the treatment and a control) on students' academic performance in chemistry. Intact chemistry classes was used. As it was not easy to have complete randomization of the subjects, since it would disrupt school organization. The samples were grouped into two: the control and experimental groups. The experimental group (X1) was taught using lecture method enriched with advance organizers while the control group (X2) was taught using conventional lecture method. To carry out this research, the Recycling Concept Performance Test (RCPT) was adapted from the past questions of the West African Examination Council (2010-2016). The statistical tools of t-test was used to analyze the data collected. The target population for this study was drawn from public senior secondary students (SSII) within Zaria metropolis who were offering chemistry. There were ten (10) public senior secondary schools owned by State Government which were co-educational in the area, with a total Chemistry student's population of 1018 (634 males and 384 female students) and an average age of 17 years. The instrument for data collection, Recycling Concept Performance Test (RCPT) consisted of 40 questions (7 fill in the blank spaces and 33 multiple choice chemistry test items with four options A-D) from which the students would select the correct answer. The test items of the RCPT were distributed to cover all the topics taught using Test Blue Print, for the duration of the research. To ascertain the internal consistency of the RCPT items, a pilot version of the test was administered to SSII chemistry students in a school other than the ones that were used in the study. The instrument (RCPT) was developed by the researcher and validated by two lecturers with a minimum rank of senior lecturer and qualification of PhD in Science Education Department of Ahmadu Bello University Zaria and three chemistry teacher at senior secondary school level. The Table of specification for Recycling Concept Performance Test based on Bloom 's Taxonomy (1956) but developed by the researcher in 2016, was employed. It took into consideration all the six educational taxonomy of Bloom to ensure equal distribution of the items over the units. The experts are expected to check whether the instruments is ambiguous in nature, are in conformity with the chemistry and it process specification, whether the instrument test what it is meant to measure in chemistry and it process. The modification and corrections was effected in producing the final version of the RCPT. The reliability coefficient was found to be 0.86 which shows the instrument is reliable. The ability of the instrument was determined using Pearson Product Moment Correlation Coefficient (PPMCC). The test was administered once to thirty (30) students within a week as recommended by Gall, Brog and Gall (2006). The result of co-efficient gave r- value of 0.86 which indicated high correlation between the tests. The result obtained therefore showed the suitability of the test items for the study. This was done to determine the impact of the treatment. The mean academic scores of the groups were analyzed statistically using t-test as $P < 0.05$ alpha level of significant. The teacher presented the Advance Organizer to the students to link their prior knowledge (what the learner already known) with the new task.

RESULT AND DISCUSSION

The result obtained from the study was analyzed using t-test statistics. The result obtained are presented in table 1, 2, 3 and 4.

Research Question One: What is the difference between the mean academic performance scores of students taught recycling solid-waste concept in Chemistry using lecture enriched with advanced organizers and those taught using lecture methods alone?

Table 1: Mean and Standard Deviation of Students' Academic Performance in Recycling Solid-Waste Concept of Experimental and Control Groups

Group	N	Mean	S.D.	Mean Diff.
Experimental	40	34.26	6.11	13.82
Control	35	20.44	8.25	

Table1 showed that the mean academic performance scores of the experimental group are higher than those of the control group. This means that the experimental group performed better than the control group. The mean academic performance scores for the experimental and control groups were 34.25 and 20.44 respectively. The mean difference is 13.82. This showed that there is positive impact of lecture enriched with advanced organizers on the academic performance of SSII chemistry students taught recycled solid waste concept than those taught using lecture method alone. To determine whether the mean difference is significant or not, null hypothesis was formulated and tested.

Table 2: Result of t-test Analysis of the Mean Academic Performance Scores of Experimental and Control Groups

Group	N	Mean	SD	Df	t-cal	Sig(P)	Remark
Experimental	40	34.26	6.11	73	12.33	0.01	*S
Control	35	20.44	8.25				

* Significant at P<0.05

Table 2 results, revealed that p-value is equal to 0.01 which is significant. The calculated p-value of 0.01 is less than 0.05 level of significant at degree of freedom 73. The calculated mean academic performance scores were 34.26 and 20.44 for experimental and control groups respectively. Thus, there is significant difference between the mean academic performance scores of SS II chemistry students taught using lecture enriched with Advance organizer and taught using lecture method. The null hypothesis of no significant difference is rejected. The result indicated that lecture enriched with Advance organizers improved students' academic performance significantly in recycled solid waste concept in chemistry than lecture method only.

Research Question Two: What is the difference between the mean academic performance scores of male and female students taught recycled solid waste concept in chemistry using lecture method enriched with advance organizers?

Table 3: Mean and Standard Deviation of Male and Female Students Academic Performance in Recycling Solid Waste Concepts of Experimental Group

Group	Gender	N	Mean	S.D	Mean diff.
Experimental	Male	25	34.26	5.88	0.02
	Female	15	34.28	5.80	

Table 3 showed that the mean academic performance scores of male and female chemistry students taught using lecture method enriched with advance organizer were 34.26 and 34.28 respectively with a mean difference of 0.02. However, to determine whether the mean difference is significant or not, null hypothesis was formulated and tested.

Table 4: Results of t-test Analysis of Academic Performance Mean Scores of Male and Female Students in Experimental Groups

	Variable	N	Mean	SD	Df	t-cal	Sig (P)	Remark
Experimental	Male	25	34.26	5.88	38	0.08	0.98	NS
	Female	15	34.28	5.80				

* Significant at P<0.05

The result in Table 4.12 showed there is no significant difference between the mean academic performance scores of male and female chemistry students taught recycled solid waste concept using lecture enriched with advance organizer. The calculated P-value of 0.98 is greater than p=0.05 level of significance, at df =38. Since the calculated p-value is greater than the 0.05 level of significance chosen hence, there is no significant difference. Consequently, the null hypothesis which stated that there is no significant difference between the mean academic performance scores of male and female chemistry students taught recycled solid waste using lecture enriched with Advance organizer is retained and this implies that advance organizer strategy is gender friendly in teaching recycled solid waste concept of chemistry.

DISCUSSIONS

The result of the analysis presented in Table 1 and 2 showed that the students taught using enriched lecture method with advance organizer had a higher mean academic performance scores than the students taught with lecture method alone. This indicated that the use of enriched lecture with advance organizer, that the lecture method has been improved and this can be adapted to enhance students learning of recycling solid waste concepts. This significant performance with the use of enriched-lecture method could be due to the fact that advance organizer facilitates access to all human knowledge in a friendly and efficient way which is in line with the study of Okey and Avwiri (2014) in their work which supported the view that advance organizer improves academic performance of students, facilitates access to all human knowledge, anytime and anywhere in a friendly, efficient and effective way. It could also be

that the use of advance organizer stimulated change and created conducive learning environment, and made learning more meaningful and responsive to specific need of learners.

Agbenyeku (2012) equally supporting this finding expressed that access to advance organizer could stimulate changes and creates conducive learning environment and make learning more meaningful and responsive to localized and specific needs of learners. In addition, the use of lecture enriched with advance organizer improved performance of learning because it makes the learning more concrete and there are better interactions through the activities involved. With advance organizer, students were active and participated more in the learning process than in the lecture method alone. The result of the analysis presented in Table 3 and 4, showed that there is no significant difference between the mean academic performance scores of male and female students taught using lecture enriched with advance organizer. This indicated that the use of advance organizer strategy is gender friendly. The finding conforms to that of Okey and Avwiri (2014) who observed in their study that both male and female who were taught using advance organizer performed equally good in the mean academic performance scores. Other researcher Kahle (2004) opined that the interactive nature and the entire "fun state" involved in using advance organizer in learning process quickly bridges the gender gap in teaching and learning process. Though the gender friendly nature of the use of advance organizer was opposed by Bency and Nagaraja (2015) who revealed that due to attractiveness and bridging nature of the advance organizer, it is more female friendly than male. However, the differences in observation of these studies may be due to location differences of the study. Therefore, with the empirical evidence in this study, it showed that the use of lecture enriched with advance organizer is gender friendly in learning recycling solid waste concept of chemistry, therefore showing that the use of enriched lecture with advance organizer increases attention and retention ability towards chemistry concepts because it bridges the gap of what the students already know with the new materials to be learnt, thereby making the learning concrete, more interesting and less boring.

CONCLUSION

Based on the findings of this study, it was concluded that Students taught using lecture enriched with advance organizer performed better academically than those taught using lecture method. Lecture enriched with advance organizer has the potential of boosting/increasing senior secondary school chemistry students' interest level, enhanced academic performance and is gender friendly.

RECOMMENDATIONS

Based on the findings of this study, the following recommendation are made:

1. Chemistry teachers should adopt the use of lecture enriched with advance organizer in teaching chemistry concepts because it boosts interest, academic performance and retention ability in students and is gender friendly.
2. Heads of Department of Science at senior secondary school level should encourage the use of lectures enriched with advance organizer since it has an ability of visualization and reorganization of science facts in handling concepts.
3. Curriculum planners and curriculum development bodies in Nigeria like NERDC should design programme and policies that will incorporate the use of lecture enriched with advance organizer in teaching and learning of science concepts, since it has the potential of bringing about meaningful learning and improved academic performance.
4. Professional associations like Science Teachers Association (STAN), Mathematics Association of Nigeria (MAN) and Research Centers like Nigerian Educational and Research Development Council (NERDC) should incorporate lecture enriched with advance organizer in their science curricular at senior secondary schools and encourage the use of the method by teachers.
5. Workshops and seminars should be organized by Secondary Education Board, STAN, NERDC and all stakeholders of education in order to train teachers for effective implementation of the use of lecture methods enriched with advance organizer.

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