Effects of Advance Organizer Teaching Strategy on Students' Gender and Retention in Secondary School Basic Science in Ekiti State, Nigeria

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ABSTRACT: *The study investigated the effects of Advance Organizer teaching strategy on students' gender and retention in secondary school Basic Science in Ekiti State, Nigeria. Specifically, the study investigated the difference in the performance and retention of students exposed to Advance Organizer teaching strategy based on students' gender. The study adopted non-equivalent pre-test post-test design. The population consisted of 12, 033 Basic Science students in Ekiti State while the sample consisted of 88 J.S.1 students (intact class size) drawn from two public secondary in the state. The sample was selected using multistage sampling procedure. The research instrument 'Basic Science Performance Test (BSPT)' was used to collect relevant data for this study. The face and content validity of the instrument was ensured while the reliability of the instrument was determined using split-half which yielded reliability co-efficient of 0.78. The data were analyzed using inferential statistics of t-test at 0.05 level of significance. The findings of the study showed that the two groups (Advance Organizer and Conventional) were homogenous at the commencement of the experiment. The use of Advance Organizer teaching enhanced performance and retention of students in Basic Science than the Conventional strategy. However, Advance Organizer is not gender biased in students' academic performance and retention. Based on the findings of the study, it was recommended among others that the use of Advance Organizer teaching strategies should be encouraged in Basic Science class in Junior Secondary Schools so as to enhance academic performance and retention of students in Basic Science. It was also recommended that Basic Science teachers should update their knowledge so as to accommodate the use of Advance Organizer teaching strategy.*

Key Words: *Advance Organizer, gender, retention, teaching Strategy and Academic Performance*

Introduction

The importance of Basic Science in everyday life can never be over emphasized. It serves as the bedrock which provides the required training in scientific skills to meet the growing needs of the society. It is the fundamental knowledge acquired through Basic Science at the upper basic level that leads to the transformation of the world through dramatic advances in almost all fields including Medicine, Engineering, Electronics and Aeronautics among others (Guyana, 2018).

According to Chukwuneke & Chinkwenze (2012), basic science formerly known as Integrated Science is the first form of science a child comes across at the secondary school level. Basic science is a core subject in the National curriculum at the upper basic level. All students from upper basic I-III classes must offer and study the subject. Basic Science is considered the bedrock of all science subjects at the Senior Secondary School (SSS) level. The subject prepares students at the upper basic level for the study of core science subjects (biology, chemistry and physics) at the Senior Secondary School (SSS) level (Oludipe, 2012).

The application of scientific knowledge acquired through Basic Science, as reported by Guyana (2018) has helped many countries like China and India to transform from poor feudal type economies to become economic and industrial power houses and in several ways compete effectively with developed countries. Basic Science is of great importance because early experiences in science help students to develop problem-solving skills that empower students to participate in an increasingly scientific and technological world (Guyana, 2018).

Prakash (2012) opined that basic science is the type of science which provides unique training of students in observation, reasoning and experiment in the different branches of science; it also helps students to develop a logical mind. Basic Science enables students to be systematic and enables them to form an objective judgment. Basic Science, if taught according to its philosophy, equips students with the necessary introductory scientific and technological knowledge and skills necessary to build a progressive society. This forms the bedrock on which scientific and technological studies rest (Ochu & Haruna, 2014).

The term "teaching approach" refers to the general pedagogy and management style used for classroom instruction. A teacher's choice of teaching approach should not only be based on what fits/suits

him or her but also putting into consideration the subject area, schools mission statement, class demography, etc. The choice of teaching approach according to Wikipedia may also depend largely on the information that the teacher or instructor intends to pass across to the students in his/her class, the skill that is to be taught, and it may be influenced by the attitude and level of enthusiasm of the students. Science lessons that are not interesting will not be able to motivate pupils to learn and subsequently will affect their scientific thinking skills and curiosity (Elvis, 2013)

The primary purpose of teaching at any level of education is to bring a fundamental change in the learner. To facilitate the process of knowledge transmission, teachers should apply appropriate teaching methods that best suit specific objectives and level exit outcomes. In the traditional epoch, many teaching practitioner widely applied teacher-centered method to impart knowledge to learners comparative to student-centered methods. Until today, questions about the effectiveness of teaching methods on students learning have consistently raised considerable interest in the thematic field of educational research. Moreover, research on teaching and learning constantly endeavor to examine the extent to which different teaching methods enhance growth in student learning (Elvis, 2013). Safdar (2010) stated that "how to learn is equally important with what to learn but how to teach (teaching strategy) is more important than what to teach". Teachers make a difference. Some teachers reliably elicit greater gains than others because of differences in how they teach (Tennyson & Volk, 2015).

Teaching methods involve different activities of the teacher and the learners such as questioning, explanation, demonstration or direction. The activities can be referred to as skills or techniques. Thus, teaching methods involve different techniques and methods among which are lectures, cooperative learning, inquiry-oriented learning or inquiry-based methods with mobile devices for learning, self-directed study, computer-assisted testing/assessment (Sung, Chang & Liu, 2015). The use of these techniques vary with different teaching methods and also on many factors such as type of learning objectives, nature of the subject, age of students, number of students in a class among others (Aniaku, 2012). Quite remarkably, regular poor academic performance by the majority students is fundamentally linked to application of ineffective teaching methods by teachers to impact knowledge to learners (Elvis, 2013). Substantial research on the effectiveness of teaching methods indicates that the quality of teaching is often reflected by the achievements of the learners.

Problem-life learning as a teaching method is fast becoming increasingly popular in education institutions as a tool to address the inadequacies of traditional method of teaching since its approaches do not encourage student to participate in the learning process. However, more recently there is an argument in education industry to adopt a learner-centered paradigm shift while other schools of thought are advocating participatory methods of teaching (Saijad, 2011). There are various methods of teaching Basic Science but there is no single method of teaching that is absolute in meeting the learning needs of every individual learner in the classroom With the use of a variety of teaching and learning methods in classroom, it is anticipated that pupils' interest in science will be enhanced when the teaching is students' centered. Enekwechi (2016) asserted that teaching approaches in which learners are actively involved would likely lead to meaningful learning and not rote learning.

Teaching and learning process is a mandatory part of education. Efforts are being made to enhance the quality of teaching and learning science. Similarly, efforts are being made to improve the learning of students in Basic Science through the application of variety of teaching and learning strategies (UzZaman, Choughry & Qamar, 2015).

An Advance Organizer is information presented by an instructor that helps the student organize new incoming information Mayer as quoted by UzZaman et al (2015). This is achieved by directing attention to what is important in the coming material, highlighting relationships and providing a reminder about relevant prior knowledge (Woolfolk, Winnie & Shapka, 2010). An Advance Organizer is a tool used to introduce the lesson topic and illustrate the relationship between what the students are about to learn and the information they have already learned. They are used during expository instruction, which is the use of an expert to present information in a way that makes it easy for students to make connections from one concept to the next (James, Wirtz & Tiffany, 2019).

An Advance Organizer is a statement of inclusive concepts to introduce and sum up material that follows (Miriam, Pamela & Jacquelyne, 2014). Ausubel quoted by Samuel, Anthony & Zachariah (2013) defined an Advance Organizer as a cognitive instructional strategy used to promote learning and retention of new information. An Advance Organizer is information that is presented prior to the learning that can be used by the learner to organize and interpret new incoming material. In explaining meaningful learning, Ausubel introduced the concept of subsumption model as a pedagogic device in which central and highly

unifying ideas are stated in terms already familiar to the learner, to which the learner can relate new ideas by subsumption.

Advance Organizer enhances the learning of the students; these can also be called as linking agents, as they link the previous knowledge to the newly learnt knowledge. It is designed to indicate the relevant prior knowledge of a learner and it is usually presented at a higher level of abstraction, generality and inconclusiveness than that of the planned lesson. There are several additional benefits of Advance Organizer to students across the curriculum (Dell'Olio, 2012). That the flexibility of Advance Organizer make it easy to appropriately modify them for students with special needs, and that they explicitly inform students what they will be learning thus reducing the possible stress of the unknown which has been shown to negatively impact student achievement (Konecki & Schiller) as quoted by (UzZaman et al, 2015). Advance Organizer are beneficial to encourage students to directly participate in their learning and to be self-reflective throughout the lesson. At the start of the unit teacher can use the Advance Organizer to facilitate whole class discussion about upcoming information, getting students thinking and talking about what they already know UzZaman et al, 2015).

The use of Advance Organizers has been argued by researchers to link previous knowledge with the new learning. Some researchers believed that the gap between prior knowledge and new learning can be closed and students are able to understand better and retain more when organizers are used. The use of Advance Organizers is not a teaching method on its own but a teaching strategy needed to help clarify the science concepts the students are trying to attain. Studies have revealed that Advance Organizers favours higher achievement and retention abilities and facilitate acquisition of more scientific concepts.

Advance Organizer is a tool or mental learning aids that help students integrate new information with their existing knowledge. They are devices that activate relevant schemes or conceptual learning patterns to enable new information more readily subsumed into the learners existing cognitive structures. Mayer opined that giving students a diagram before listening to a passage leads to better retention of materials; recall was enhanced for conceptual information in the lesson. Advance Organizer is used to provide support for new information. Teachers are to start with a "Big picture" of the incoming content. Ausubel as quoted by Samuel et al, (2013). Advance Organizer takes different forms such as cards, maps, descriptions with pictures, flowcharts, story maps, Venn-diagrams and questions, orals and visuals (Owoeye, 2017).

In the work of Wachanga, Arimba and Mbuga as quoted by Ranaweera (2018), it was found out that the use of advance organizer teaching approach enhances chemistry learning in mole concept topic. Results of several studies have revealed the efficacy of using advance organizers in teaching students. Research findings revealed that when teachers focus their advance organizers on content that is most important and not what they think will be most interesting to students, the students always do better. Studies carried out by Lin and Chen as well as Adejumo as quoted by Atomatofa (2013) revealed that Advance Organizers were of facilitative effects on student achievement than the Non-Advance-Organizer group. However there are still controversies on the effects of advanced organizers on achievement and retention of scientific concepts. Some researchers found out that there were no effect of advanced organizers on students' achievement and retention of scientific concepts (Ranaweera, 2018).

The studies of Umesh (2017) revealed that, the teaching of science by the Advance Organizer Model is better than by the conventional methods of teaching of science, Advance Organizer Model of teaching appealed to the students very much and they felt encouraged to learn the subject matter with interest which was presented to experimental group during the experiment. The results of the experimental design prove the superiority of Advance Organizer Model over the traditional method, the mean achievement score of the experimental groups were highly significant than the mean score of the controlled group at post - test which could have not come by chance. It is statistical proof of the superiority of the experimental method and not only the mean scores were higher on the whole achievement test but they were significantly higher on the test items based on the material presented through the Advance Organizer Model.

Retention is the term used to describe the remembering of a fact or an idea after a passage of time (Ayoola, 2016). It is by the demonstration of such recall that learning could be judged to have taken place. Permanent and meaningful learning is the target of our educational endeavour while understanding and retention are the products of meaningful learning when teaching is effective and meaningful to students. Meaningful learning is deemed to have taken place if after passage of time; the students can recall and apply information which he/she has been taught previously. Bennet and Rebello (2012) defined retention as having the information stored in long-term memory in such a way it can be easily retrieved. Farrant (2002) believed that increase in knowledge lies solely on the ability to remember. He further explained that if an individual could not grasp and keep hold of what was taught and learnt, it would seem like trying to fill a

bucket without bottom with water. This implies that students' participation in a lesson is a basis for understanding, achievement and retention.

Ausubel compared meaningful learning to rote learning, which refers to when a student simply memorizes information without relating that information to previously learned knowledge. As a result, new information is easily forgotten and not readily applied to problem-solving situation because it was not connected with concepts already learned. Rote learning is a memorization technique based on repetition. The idea is that one will be able to quickly recall the meaning of the material by repeated practices. Some of the alternatives to rote learning include meaningful learning, associative, and active learning. In rote learning, students acquire knowledge, recall it but they are not able to use this knowledge for solving problems of the daily life (UzZaman et al, 2015).

Based on previous studies like Blair and Simon (2014) among others, researches indicated that retention over time especially in varied contexts-boots both encoding (how well knowledge is stored) and retrieval (how well knowledge can be remembered) of information. Also, by allowing students to repeatedly practice fundamental skills, and apply their knowledge to different types of problem, it maximizes students understanding and commitment of key procedures and rules to long-term memory (retention). They observed that there is growing realization that poor learning and retention of science concepts may be related to inability of students to link previous learning with present one. It is noteworthy that, without retention, there can be no transfer of knowledge to other fields of endeavours. Blair and Simon (2014) opined that when students were able to link previous learning with present one, retention has taken place.

Studies conducted across Africa countries including Nigeria have reported disparity in the education of girls and women in science and technology (Ogunleye & Babajide, 2019). Also, Ogunleye & Babajide (2019) reported that more girls are found in Biology and Chemistry than in Physics departments of higher learning. This accounted for females' low contribution in the areas of Engineering, Medicine, and Technology and by extension the development of nations. To this end, he proposed same institutional strategies to promote gender equity. Adelodun and Asiru, (2015) reported on the relationship between self-efficacy and students' achievement in schools, finding out that there is no significant relationship between self-efficacy and academic performance however, there is a gender significant difference between boys and girls-self-efficacy is documented to be higher in boys than girls.

Okwo and Otubor as quoted by Ogunleye and Babajide (2019) observed that gender has significant influence on science achievement while Babajide (2010) found that gender has no significant influence on achievement in science. Raimi, quoted by Ogunleye and Babajide (2019), that the effect of gender on students' performance in chemistry practical skills acquisition was not significant. He also found out that there was no significant interaction effect of treatment and gender on students' acquisition of practical skills in chemistry. Female students were also reported to have performed better than their male counterparts in computational skills. Also in the work of Ogunleye and Babajide (2019), it was revealed that there was gender difference in favour of boys in relation to practical skills in science. Girls in single sex schools performed better than their male counterparts in mixed schools. The findings of the study of Taylor and Francis (2017) showed that Advance Organizer Model was also effective to teach male and female students.

However, Aguele and Agwugah, Billings Hyde and McKinley, Kolawole, etc as quoted by Oludipe (2012), in their studies found that male students performed better than female students in the cognitive, affective and psychomotor skill achievements. There is a strong association between gender and response to science education.

Samuel and John as quoted by Elvis (2013) examined how the Cooperative Class Experiment (CCE) teaching methods affect students' achievement in Chemistry. They found that there was no significant difference in gender achievement between the experimental and control groups, but girls had a slightly higher mean score than boys did. More so, the girls taught through CCE method perform better than girls taught through the conventional teaching method in the post-test scores. Similarly, boys who were taught using CCE method performed significantly better than the boys in the control groups in the post-test scores. The researcher also pointed out that there was no significant difference in achievement between boys and girls exposed to CCE method, both performed significantly better than those taught through conventional lecture method.

Ajai and Imoko (2015) found that boys performed better than girls in both cooperative and competitive learning strategies when he conducted a research on the effects of competitive and cooperative learning strategies on Nigerian students' academic performance in mathematics. Asante (2010) and Ekweme (2013) etc found in their studies at various times, that male students achieved significantly better than female students in Science Education. Apata (2011); Dania (2014); Atovigba, Vershima, O'Kwu &

Ijenkeli (2012) pointed out that there is no significant gender difference in students' academic achievement and retention in various subjects while others found significant difference with either the boys or the girls performing better.

According to Wijesundera and Ramakrishna as quoted by Oluwatelure (2015), the issue of gender differences in achievement in school science is far from being resolved, and the inconclusiveness of studies conducted to date provides no solid basis on which changes can be made in teaching and learning. In many science, technology, engineering, and mathematics disciplines, women are outperformed by men in test scores, jeopardizing their success in science-oriented courses and careers. In studies held in advanced countries, New Zealand women were frustrated in trying to get promoted even with very good Curriculum vitae Brooks Oluwatelure (2015).

Studies conducted in countries of the North have shown that boys performed better than girls in Mathematics; (Fennema, Kaiser-Messmer) as quoted by (Ajai & Imoko, 2015). Asante (2010) quoted studies showing that boys generally achieved higher than girls on standardized math tests. However, an interesting body of international literature suggests that female students perform better than male students (Arnot, David & Weiner) was quoted by (Ajai & Imoko, 2015). A large scale study in the U.S.A. revealed that girls have reached parity with boys in mathematics performance, including at high school where a gap existed in earlier decades. They affirmed that girls are doing better than boys even for tasks that require complex problem solving.

In Nigeria, in spite of the enormous role that Basic Science plays in providing a solid foundation for the mastering of basic concepts in science and technology for national development, and the efforts of government and other stakeholders in improving science education, results in Basic Science in most certified examination bodies like the results of examination conducted by National Examinations Council (NECO) and Ekiti State Ministry of Education, Science and Technology have not been satisfactory. The broad aim and expectations of any teaching and learning programme is productivity and positive-evaluated end-product (achievement).

Hence the need for Advance Organizer teaching strategy as it will enhance their performances because it encourage interaction among them, allows students to observe, think, reason, investigate and make conclusion on their own about what they see themselves.

Research Hypotheses

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

1. There is no significant difference in the achievement mean scores of students in experimental and control groups after treatment.
2. There is no significant gender difference in the academic performance of students exposed to advance organizer.
3. There is no significant gender difference in the retention mean score of students exposed to advance organizer

Methodology

This study adopted non-equivalent pretest, post – test design using an experimental group and a control group. The treatment (advance organizer) was applied to the experimental group. The teacher uses this strategy to teach students and determine the effect on students' performance in Basic Science subject.

The population for this study consisted of all 12,033 co-educational public junior secondary one (JSI) Basic Science students across the sixteen local government areas of Ekiti State. As at the time of this study, Ekiti State had a total of 191 public secondary schools. *(**Source**: Ekiti State Ministry of Education, Science and Technology, Ado, 2018).*

The sample for the study consisted of 88 junior secondary one (JSI) Basic Science students who were selected from two co-education public secondary schools across the sixteen LGAs of Ekiti State using multistage sampling procedure. At the first stage, two LGAs were selected from the sixteen LGAs using simple random sampling technique. The second stage involved the selection of two towns out of the two LGAs earlier selected using simple random sampling technique. The third stage is the selection of two co-educational public secondary schools in each of the town selected using simple random sampling technique. The last stage involved the selection of two intact JSI Basic Science class from each of the schools selected for the study.

The instrument titled: "Basic Science Performance Test (BSPT)" was used for this study. The research instrument was certified by professionals in Psychology, Test and Measurement and those in the field of Basic Science for face and content validities. The reliability of the validated BSPT instrument was

ensured through split-half method. This was carried out on a selected secondary school which was not included in the main study. The instrument was administered on 26 JSI Basic Science students outside the experimental group. The reliability of the instrument was determined by split-half procedure with the reliability coefficient of 0.78.

The experimental procedure was in four stages namely: pre-treatment stage, treatment stage, post-treatment stage and retention stage. At pre-treatment stage, the schools were randomly selected and assigned to experimental and control groups respectively. The research instrument was administered on Basic Science students in the selected school by the researchers, with the help of the Basic Science teachers in the school, who were trained to be the research assistants. The responses from the students were scored and analyzed using One –Way Analysis of Variance (ANOVA) in order to ensure that the groups were homogenous. The pre-treatment stage lasted a period of one week.

At the treatment stage, students in the experimental group were taught using pictorial advance organizer package while students in the control group were taught using conventional method of teaching (i.e. within the classroom). The students in the experimental groups were guided in the use and practice of the method. Two separate lesson notes (one for each group) were prepared in form of packages for each of the selected topics. The topics that were taught are types of human activities that affect environmental balance; ways in which a community/school can dispose refuse; concept of biodegradable and non-biodegradable materials; classification of materials found in refuse dump site into biodegradable and non-biodegradable materials and the need for environmental sanitation. The treatment stage covered a period of four weeks.

The post-treatment stage involved the re-arrangement and administration of BSPT items on the students. This is done in order to determine the effects of teaching strategies used in the study. The study from pre-treatment stage to post-treatment stage lasted for six weeks: the first week for pre-test, followed by four weeks for treatment and the last week for post-test. The retention was measured by administering the BSPT on the students two weeks after the whole exercise thereby making a total of eight weeks altogether.

The responses of the students to the research instrument were collated and analyzed using the inferential statistics t-test. All the hypotheses were tested at 0.05 level of significance.

Results and Discussion

Hypothesis 1: There is no significant difference in the achievement mean scores of students in experimental and control groups after treatment.

Table 1 : t-test analysis of achievement mean scores of students in experimental and control groups after treatment

GROUP	N	$\bar{X}$	SD	df	t_{cal}	t_{tab}	Result
Experimental	51	19.61	3.07	86	18.20	1.65	*
Control	37	10.68	1.45				

P < 0.05 (Result Significant at 0.05 level). * = Significant

As shown in table 1, when the mean score of students in the control and experimental groups after the treatments (posttest) were statistically compared, a *t-value* (t_{cal} = 18.20) with P < 0.05 alpha level was obtained, which was significant at 0.05 level. This implies that there exists significant difference between the control and experimental groups achievement mean scores after the treatment in favour of experimental group. Consequently, the null hypothesis which states that there is no significant difference in the achievement mean scores of students in experimental and control groups after treatment was rejected. As such, the conventional method of instruction used for control group can be said to be less effective compared with advance organizer strategy used to teach the experimental group.

Hypothesis 2: There is no significant gender difference in the academic performance of students exposed to Advance Organizer.

Table 2: t-test analysis of gender difference in the academic performance of students exposed to advance organizer

Variations	N	Mean	SD	df	t_{cal}	P
Male	30	19.63	2.85	49	0.07	0.94
Female	21	19.57	3.43			

P > 0.05

Table 2 shows that the t-cal value of 0.07 is not significant because the P value (0.94) > 0.05. This implies that null hypothesis is not rejected. Hence, there is no significant gender difference in the academic performance of students exposed to advance organizer.

Hypothesis 3: There is no significant gender difference in the retention mean score of students exposed to advance organizer

Table 3: t-test analysis of gender difference in the retention mean score of students exposed to advance organizer

Variations	N	Mean	SD	df	t_{cal}	P
Male	30	13.60	0.86	49	0.31	0.76
Female	21	13.52	0.87			

P > 0.05

Table 3 shows that the t-cal value of 0.31 is not significant because the P value (0.76) > 0.05. This implies that null hypothesis is not rejected. Hence, there is no significant gender difference in the retention mean score of students exposed to advance organizer.

Discussion

The first finding of this study revealed that the achievement means scores of students in experimental and control groups were statistically different after the treatment in favour of experimental group. By implication, therefore, the advance organizer teaching strategy was more effective in improving students' performance in basic science than the conventional mode of teaching. This finding is consistent with the work of Wachanga, Arimba and Mbuga as quoted by Ranaweera (2018) that the use of advance organizer teaching approach enhances chemistry learning in mole concept topic. It also agrees with the results of studies of Umesh (2017) that, the teaching of science by the Advance Organizer Model is better than by the conventional methods of teaching of science, Advance Organizer Model of teaching appealed to the students very much and they felt encouraged to learn the subject matter with interest which was presented to experimental group during the experiment.

The findings from this study further revealed that there is no significant gender difference in the academic performance of students exposed to advance organizer; and that gender has no significant effect on retention mean scores of students in Basic Science. This implies that male students are found to be as good as their female counterparts in retention in the two groups in this study. This is in agreement with the findings of Oludipe (2012), Babajide (2010) as well as Agbaje & Alake (2014). This is at variance with the findings of Taylor and Francis (2017) who agreed that male students performed and retained what they learnt better than their female counterparts in Basic Science.

Conclusion

Based on the findings of this study, it was concluded that, the two groups (advance organizer and conventional) were homogeneous at the commencement of the experiment. The use of advance organizer activities enhanced better performance of students in Basic Science than conventional strategy. Advance organizer is not gender biased.

Recommendations

Based on the findings of this study, the following recommendations were made.

- The use of advance organizer strategy should be encouraged in Basic Science class in secondary schools so as to enhance better academic performance of students in Basic Science.
- During Basic Science classes, there should be no discrimination between male and female students

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