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Upgrading Students' Achievement and Retention in Basic Science Using Analogy and Demonstration Strategies

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Abstract

The study determined the effects of analogy and demonstration teaching strategies on Basic eight students' achievement and retention in basic science in Buruku Local Government Area of Benue State, Nigeria. The study adopted a quasi-experimental design, specifically the pre-test, post-test control group design. One hundred and seventy-four basic eight students in four randomly selected schools were used for the study. A validated 20 items Basic Achievement Test (BSAT) was the instrument used for data collection. Reliability coefficient of 0.76 was established using Kuder Richardson Formula 20. Out of the four schools, two were assigned to experimental and two for control groups. Mean and standard deviations were used to answer the research questions and Analysis of Covariance (ANCOVA) was used to test the four hypotheses at P = 0.05 level of significance. The findings showed that analogy strategy was more effective in facilitating students' achievement and retention in basic science [$F_{1,171}$ =82.013, P<0.05] and [$F_{1,171}$ =46.200, P<0.05] respectively. The result also revealed that gender was not a factor in the achievement and retention of students in basic science [$F_{1,89}$ =0.06, P>.05] and [$F_{1,89}$ =0.39, P>0.05] respectively. Based on the findings, it was recommended that basic science teachers should be encouraged to use analogy strategy to teach basic science for effective leaning of the subject.

Keywords: Analogy strategy, Demonstration method, Basic science achievement, Retention, Basic science, Gender

1. Introduction

There has been a gradual paradigm shift in educational instructions from teacher to learner-centredness. This change according to Igboko and Ibeneme (2006) reflect a move away from information transmission view of education to that of knowledge construction, which was informed by current world realities such as globalization and rapid technological change. This makes the conventional teaching methods particularly lecture teaching which is teacher-centred, dogmatic and authoritative rather than being student-centred and facilitation of learning incapable of producing the effects required for coping with challenges posed by globalization and rapid technological development (Adejoh & Idachaba, 2010). To ensure knowledge construction, Owolabi (2007) affirm that science instruction has to be student-centred, activity oriented and focused on understanding rather than rote learning, simple recall of knowledge in order to pass examination. Science education as defined by Secil and Hayriye (2013) is a fundamental component of basic education that prepares students to live in the world increasingly defined by science and technology. Science is a systematic body of knowledge and the method or process of acquiring knowledge while technology is concerned with the tools and techniques for carrying out plans and designs, created by science (Abdulrazaq, 2012). Science education therefore is the teaching of the basic science concepts to students, making them become skillful in scientific process, developing their experimental skills, training them to be creative people, ensuring their understanding of the nature of science and developing their positive attitude towards science (Secil & Hayriye, 2013).

Due to the roles of science education in the development of individual and the society at large, the teaching and learning of science in Nigeria starts at the basic education level (FRN, 2008). At the lower (Basic 1-3) and middle (Basic 4-6)Basic levels, it is known as Basic Science and Technology. The following objectives are aimed at being achieved in Basic Science and Technology: Lay a sound basis for scientific, critical and reflective thinking and provide opportunities for the child to function effectively in the society within the limits of the child's capacity (FRN, 2008). At the upper (Basic 7-9) basic education level, Basic Science and Technology has been separated into two core subjects known as Basic Science and Basic Technology with the following objectives:

- Develop students in science and technology,
- Enable students to apply scientific and technological knowledge and skills to meet contemporary societal need,
- Enable students to take advantage of the numerous career opportunities provided by science and technology,
- Enable students to prepare for further studies in science and technology,
- Enable students to avoid drug abuse and related vices and
- Enable students to be safety and security conscious (Federal Ministry of Education (FME, 2012).

The attainment of these goals of Basic Science is a major concern of education policy makers. One way through which these objectives could be achieved is by the use of effective method of instruction whereby students would acquire the needed scientific knowledge and skills through meaningful learning and participatory activities. In support of this, Ogbeba and Eje (2014) state that, the teaching of science involves exposing students to opportunities to understand different types of concepts, principles and exposing students to direct physical materials that would make meaning to the cognitive framework. The implication for this is that, the teaching of Basic Science must be effective and meaningful to achieve its objectives. To achieve the objectives of Basic Science, instructional activities have to be, learner-centred for maximum, self-development and self-fulfillment and practical activity based, experiential and Information and Communication Technology (ICT) supported (FRN, 2008). A number of teaching strategies commonly used in Basic Science instruction are the conventional methods which include; lecture, demonstration, discussion and note-taking according to the report of Baseline Survey of Strengthening Mathematics and Science Education (SMASE) (2006). But the achievement and retention of Basic Science students in Basic Education Certificate Examination (BECE) in Benue State, conducted by Benue State Examination Board (BSEB) Makurdi, shows a poor performance results from 2009-2018 in Basic Science). Several reasons were attributed to this low achievement and retention. According to Olajide (2012) the conventional methods mostly used during instruction is the principal cause of students' failure and under-performance. The author maintained that Basic Science as an inquiry based subject is being taught using conventional methods, making what would have been a student-centred classroom becoming a teacher-centred one. This has serious implications for cognitive achievement in Basic Science. In addition, the SMASE) (2006) revealed that, the achievement of Basic Science students is only average. According to SMASE (2006), this average achievement is largely due to the use of inappropriate teaching methods particularly the lecture method adopted by the science teachers. This method encourages rote learning and allows little scope for the students to develop an inquiring mind.

As important as the reasons for low or average achievement could be, what should be of great concern is how this undesirable situation could be redressed. It is therefore worthwhile for more research to be conducted to identify suitable teaching methods for teaching Basic Science so that students should be able to comprehend and achieve success grades in certificate examinations on their own as well as acquires basic science process skills and competences. Current studies on how students learn science have revealed new ideas and innovative instructional approaches that have proved more effective. Some of such instructional strategies include; the use of analogy, inquiry, cooperative learning, problem-solving and constructivism (Nwagbo & Obiekwe, 2010). Analogy teaching strategy was developed to enhance mental activities of students in the learning of scientific concepts or topics or conceptual schemes. It is a process of identifying similarities between two concepts or topics. According to Glynn (2008) an analogy is a comparison of something unfamiliar with something familiar in order to explain

a shared principle. Analogy is like a bridge that span the gap between what the teachers wants the students to learn and what the students already know. It builds on the framework of the learners' existing knowledge so they are not starting from the scratch. In using analogy strategy, it assumes that students already have some knowledge relevant to a new experience they are about to encounter and that students are ready and willing to do the mental work necessary to create connections. In an attempt to address the problem of students' difficulties in understanding science and technology concepts, Okoronka (2009); Ololrukooba, Lawal and Jiya (2012) and Secil and Hayriye (2013) carried out a research studies on the use of analogy teaching strategy. The authors independently found out that analogy strategy was effective in enhancing students understanding of the difficult concepts. In another experiment carried out by Gentner and Gentner (1983) on teaching electricity concepts using analogy strategy, the authors found out that analogy strategy was only partially effective in enhancing students' understanding of the concept. This shows that, analogies would not always yield positive results. Glynn (2008) reported that, analogies in some circumstances can block learning. If analogies are made up without an attentive analysis, it may result in misunderstanding and misconceptions in students.

Demonstration teaching method according to Ada (2010) means showing and telling, it involves displaying. The teacher does the showing and telling. In showing anything, the sensory impact onlookers are extremely vivid. In the hands of knowledgeable teacher, demonstration becomes a very helpful instructional tool. Demonstration can provide sensory impact that the written or spoken word cannot provide. It can be made interesting to students and can be used as an alternative teaching strategy to spare the students from the boredom of the often used lecture note. Demonstration can be administered in various forms, for example pure demonstration with no explanation, demonstration with explanatory comment, half demonstration with half lecture or lecture most of the time with some demonstration. Demonstration method was found to be an effective method of teaching science in a research works by Okochi (2008) and Alobi and Fahewe (2016). The authors' findings indicate demonstration method to be superior in promoting achievement scores of students when compared with lecture method.

Academic achievement refers to intellectual and skills attained by a student in a particular subject measured by scores obtained on achievement test. Akem (2006) defined academic achievement as excellence in all academic disciplines in class as well as extracurricular activities measurable by a test. Closely related to achievement in science is retention in science learning. Retention is the level at which an individual is capable of recalling an acquired knowledge at any given time. Achievement is a function of retention. To improve students achievement level in science means to improve the level at which they retained the concept learnt in science (Olom, 2008). Retention and recall of learned information is a function of training the mind to do so, when such aneed arises (Imoko & Anyagh, 2012).

Poor achievement in science manifests in poor retention and failure in retention results in poor achievement in internal and external examinations in the country (Imoko & Anyagh, 2012; Achor & Ukwuru, 2014). It is what is retained that remains the actual learning after a long time. This implies that any good pedagogical strategy used in education to improve students' achievement in science should be able to improve their retention ability in the subject. Therefore, there is need to investigate the teaching strategy that would enhance students' achievement and retention in Basic Science. Gender in relation to achievement and retention has been an issue of interest and concern to researchers in education. There are varying opinions on whether males or females achieve better than the other (Okereke & Onwukwe, 2011; Achor & Abuh, 2020). Gender refers to the socially, culturally constructed characteristics and roles which are ascribed to males and females in any society (Okeke, 2008). There are divergent views based on research findings. For instance, Afuwape and Oludipe (2008) state that, there is no significant difference in the achievement of male and female students in integrated science. But Jegede (2007) found that the female students show higher anxiety towards the learning of science. In other studies, Okereke and Onwukwe (2011; Achor & Abuh, 2020) showed that the male students achieved better than the female students in science, while Zembar and Blume (2011) and Achor and Gbadamosi (2020) revealed that there is no significant difference in science achievement between males and females students. These show that the issue of gender in science achievement has not been resolved. The need to find new techniques in the classroom which can be combined with gender to bring about understanding of difficult or abstract science concepts and ultimately lead to improved achievement and retention of learners informed this study.

2. Statement of the Problem

Over the years, there has been an increasing concern about the poor performance of science students at both junior secondary school and senior secondary school levels in both internal and external examinations in the country. This poor performance trend has led to different authorities attributing it to different factors. Primary among these factors are; ineffective teaching strategies used by teachers, abstractness of some concepts or topics which make it difficult for learners to comprehend and learners' attitude towards the subject of science. The poor performance among learners has also created gender inequalities in the number of male and female students that choose to study science courses and subsequently go into science based professions. In order to improve students' achievement and retention in both males and females therefore other innovative teaching approaches need to be sought. A number of studies have been carried out to establish the effects of analogy on achievement of students in school subjects. Literature shows that many of these studies were executed in other subject areas other than Basic Science. Where studies have been conducted as reported in the literature, they were done outside Benue State and Buruku Local Government in particular. In spite of studies in instructional methodology to improve students' achievement over the years, poor achievement in science has persisted unabated. This implies that, research on a variety of teaching strategies that can enhance students' achievement and retention in Basic Science must continue.

Based on this reality therefore the problem of the study put in question is: what are the effects of analogy strategy and demonstration method on students' achievement in Basic Science?

3. Research Questions

The following research questions were raised and answered in study:

i. What are the effects of analogy strategy and demonstration method on students' achievement in Basic Science?
ii. What are the effects of analogy strategy and demonstration method on students' retention in Basic Science?
iii. What are the differences in male and female students' mean achievement scores when analogy teaching strategy is used in Basic Science?
iv. What are the differences in male and female students' mean retention scores when analogy teaching strategy is used in Basic Science?

4. Hypotheses

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

i. There is no significant difference between the mean achievement scores of students' taught Basic Science using analogy strategy and those taught using demonstration method.
ii. There is no significant difference between the mean retention scores of students taught Basic Science using analogy teaching strategy and those taught using demonstration method.
iii. There is no significant difference between the mean achievement scores of male and female students taught Basic Science using analogy strategy.
iv. There is no significant difference between the mean retention scores of students taught Basic Science using analogy teaching strategy.

5. Method

The research design of the study is quasi-experimental design. Specifically, it is non-randomized, pretest and post-test, control group design. Emaikwu (2013) referred to quasi-experimental research design as a design carried out in a classroom whereby, it is not possible to conduct a true experiment because the researcher does not have full control over the scheduling of experimental condition and randomization of subjects, as that would disrupt school work and activity. Hence, intact classes were randomly assigned to experimental and control groups. This is aimed at manipulating the independent. Emaikwu (2013) referred to quasi-experimental research design as a design carried out in a classroom whereby, it is not possible to conduct a true experiment because the researche4r does not have full control over the scheduling of experimental condition and randomization of subjects, as that would disrupt school work and activity. Hence, intact classes were randomly assigned to experimental and control groups. Basic eight (B8) students in 20 government approved secondary schools in Buruku local government area (Ministry of Education Makurdi, 2015) form the population. Government approved secondary schools were selected to ensure uniformity and standard. The names of government approved secondary schools in Buruku LGA were presented.

The sample for this study was made up of 174 students comprising of 97 males and 77 females from four government grant-aided secondary schools in Buruku local government area. This makes up 14.3% of the population. Nworgu (2006) maintains that 10% and above representative sample of a population of 1000 and above is ideal. The sampling technique adopted in selecting the four secondary schools as sample in this study is the stratified random sampling. The researcher identified and placed the twenty secondary schools according to their two main geographical zones that make up the local government area. The researchers then found out secondary schools that have science facilities like laboratories and offer all the three science subjects (Physics, Chemistry and Biology) at the senior secondary level in the two regions. Six schools were identified to offer all the three sciences subjects in each of the zones. Among the six secondary schools in each of the zone identified, two schools were randomly selected in each zone and was randomly assigned to the experimental group making a total of two schools for the experimental group and two schools for the control group. In all, 174 students participated in the research comprising 92 students for the experimental group and 82 students for the control group.

5.1 Instrument and Validation

One instrument was used for data collection in the study. The instrument was the Basic Science Achievement Test (BSAT), along with two types of lesson plans: One for the experimental group using analogy strategy and the other for control group using demonstration strategy. Section B of BSAT consists of a 20-item multiple choices objective test. Each item has option A to D and each correct answer attracts one mark. No mark was given for blank response or answer. There was no negative marking. Thus, the maximum possible score on the test is 20 and the minimum is 0. The instrument was also constructed to elicit response that would help test the effectiveness or otherwise of the learning facilitator (analogy) that is being investigated. The researchers gave the instruments the supervisor, who evaluated the instrument to ensure relevance, accuracy and adequacy to the study as well as the appropriateness of the instrument, in measuring the objectives which they were design for. The instrument was then given to three experts; two in science education and the other in Mathematics education in the Department of Curriculum and Teaching, Benue State University for validation. In order to calculate the reliability of the research instrument the pilot testing was carried out on 35 Basic 8 students in one of the schools within the area of study. However, the school was not one of those designated for the main study. The reliability of BSAT was calculated using Kuder Richardson 20 and the value was 0.76. The two science teachers who taught Basic Science in the school were trained for two days on how to use the prepared lesson plans for the study. In addition, the Basic Science Achievement Test was subjected to item analysis. This helped the researcher to assemble the final, BSAT package of 20-item which was used during the experiment. The BSAT was later rearranged to form Basic Science Retention Test (BSRT) which was administered during retention test. This was done to avoid the effect of previous knowledge of BSAT on the performance in BSRT.

5.2. Method of Data Collection and Analysis

Basic Science Achievement Test (BSAT) was used for pre-test, posttest and retention test to collect data. The items were reshuffled after use. A 20-item BSAT comprehensively developed based on table of specification was used. The conduct of the study took place during the normal Basic Science lesson periods. The normal time-tables of the schools were followed. For effective conduct of the study, four research assistants were trained to assist the researcher in teaching the experimental group and control group. the four research assistants are graduates of Integrated Science Education teaching in those schools. Three days were used for training of the research assistants. The first contact with the research assistants was on introduction, presentation and explanation of the analogy teaching strategy and demonstration method. The second and third contacts were used for training the research assistants in micro-teaching using the lesson plans for the experimental and control groups. This is to ensure homogeneity of instructional situations across all groups. The research assistants were to give many relevant examples to aid comprehension of the learning topic. After the evaluation of the lesson, assignment relating on the next topic were given students to find out vital information concerning the next topic to be treated. This is to enable the students participate actively during the instruction. Week five was used for administration of post test of Basic Science Achievement Test. Week six was used for marking the posttest and making analyses of the result and week eight was for administration of the delayed posttest (Retention Test). The researcher computed the mean and standard deviation to answer the research questions. The hypotheses were tested at 0.05 level of significance using Analysis of Covariance (ANCOVA). This is because it enables the researcher to use the pretest scores as controller for the initial difference across groups as well as increase the precision due to the extraneous variable thus reducing the error variance.

6. Results

The analyses and interpretation of data were done according to research questions and hypotheses using mean, standard deviation and analysis of covariance.

6.1 Research Question One

What are the effects of analogy strategy and demonstration method on students' achievement in Basic Science?

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

Group	Pretest			Posttest		
	N	$\bar{x}$	SD	$\bar{X}$	S.D	Mean Gain
Analogy Strategy	92	7.23	1.65	16.22	1.44	8.99
Demonstration	82	6.90	2.18	13.83	1.91	6.93
Mean Difference		0.33		2.39		2.06

Table 1 reveals that the pretest mean achievement scores of students in the experimental group was 7.23 with a standard deviation of 1.65, while the control group had mean and standard deviation scores of 6.90 and 2.18 respectively. The pretest mean achievement difference was 0.33 which suggests that the two groups were of the same cognitive level before the treatment.

However, the posttest mean achievement difference was 2.39 in favour of the experimental group indicating the experimental group gained more than the control group. The result also showed that the mean posttest achievement scores of the students in the experimental group was 16.22 with a standard deviation of 1.44 while the control group had the mean achievement score of 13,83 and standard deviation of 1.91. This implies that though both groups improved in in their performance after the treatment, students in the experimental group gained by mean achievement difference of 8.99 while those in the control group gained by 6.93 which is less than the mean gain in experimental group. The difference in mean achievement of the two groups was 2.06 in favour of the experimental group. This answered the first research question.

6.2 Research Question Two

What are the effects of analogy strategy and demonstration method on students' retention in basic science?

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

Group		Pretest		Retention Test		
	N	$\bar{x}$	SD	$\bar{x}$	S.D	Mean Gain
Analogy Strategy	92	7.23	1.65	14.65	1.72	7.42
Demonstration	82	6.90	2.18	12.84	1.64	5.94
Mean Difference		0.33		1.81		1.48

Table 2 reveals that the mean retention scores of students in the experimental group were 14.65 with a standard deviation of 1.72 while the students in the control group had mean retention scores of 12.84 and standard deviation of 1.64. The mean difference between the two groups was 1.81 in favour of the experimental group. This suggests that although both groups improved in their retention scores after the treatment, students in the experimental group gained by mean retention of 7.42 while those in the control group gained by 5.94 which is less than the mean gain in experimental group. The difference in mean retention gain was 1.48. This means that students exposed to analogy teaching strategy retained better than those exposed to demonstration but this has to be subjected to hypothesis testing to confirm if the difference is significant.

6.3 Research Question Three

What are the differences in male and female students' mean achievement when analogy strategy is used in basic science?

Table 3: Mean Achievement and Standard Deviation Scores of Students based on Gender in Experimental Group

Group		Pretest		Posttest		
	N	$\bar{x}$	SD	$\bar{x}$	S.D	Mean Gain
Analogy Strategy	52	7.35	1.73	16.25	2.26	8.90
Demonstration	40	7.05	1.52	16.20	1.43	9.15
Mean Difference		0.33				0.25

Table 3 shows mean and standard deviation scores for achievement of male and female students using analogy strategy in the experimental group. the result shows that the mean achievement scores of male and female students were 7.35 in pretest with a standard deviation of 1.73 and 16.25 for posttest with a standard deviation of 2.26 while the mean achievement scores of female students were 7.05 in the pretest with a standard deviation of 1.52 and 16.20 for posttest with a standard deviation of 1.43. The result further revealed that male students gained by 8.9 in their achievement while the female gained by 9.15 implying that female students performed slightly higher by means gain achievement of 0.25.

6.4 Research Question Four

What are the differences in male and female students' mean retention when analogy strategy is used in basic science?

Table 4: Mean Retention and Standard Deviation Scores of Students based on Gender in Experimental Group

Group		Pretest		Retention		
	N	$\bar{X}$	SD	$\bar{x}$	S.D	Mean Gain
Analogy Strategy	52	7.35	1.73	14.81	1.96	7.46
Demonstration	40	7.05	1.52	14.45	1.64	7.40
Mean Difference						0.06

Table 4 shows mean and standard deviation scores for retention of male and female students exposed to analogy teaching strategy in the experimental group. The result shows that the mean retention scores of male students were 14.81 with a standard deviation of 1.96. The mean retention scores of female students were 14.45 with a standard deviation of 1.64. The result also revealed that male students performed slightly higher by means gain retention of 0.06 than their female counterparts.

6.5 Hypothesis One

There is no significant difference the mean achievement scores of students taught Basic Science using analogy strategy and those taught using demonstration method.

Table 5: Summary of Analysis of Covariance (ANCOVA) of Experimental and Control Groups' Achievement Scores in Basic Science

Scores of Variance	Sum of Squares	Df	Mean Square	F	Sig
Corrected model	303.283[a]	2	151.642	62.257	.000
Intercept	1423.007	1	1423.007	584.222	.000
Pretest	78.013	1	78.013	32.029	.000
Method	199.763	1	199.763	82.013	.000
Error	416.510	171	2.436		
Total	40050.000	174			
Corrected total	719.793				

Table 5 shows the ANCOVA analysis of the data collected from the posttest scores of students taught basic science using analogy strategy and those taught using demonstration method. From the analysis, $F(1,171) = 82.013$, $p<0.05$. Hence, the null hypothesis was rejected. This means that there is a statistically significant difference between the mean achievement scores of students taught basic science using analogy strategy and those taught using demonstration method in favour of those taught using analogy strategy. This further indicates that there was higher improvement in the achievement scores of the experimental group than students in the control group.

6.6. Hypothesis Two

There is no significant difference the mean retention scores of students taught Basic Science using analogy strategy and those taught using demonstration method.

Table 6: Summary of Analysis of Covariance (ANCOVA) of Experimental and Control Groups' Achievement Scores in Basic Science

Scores of Variance	Sum of Squares	Df	Mean Square	F	Sig
Corrected model	191.402[a]	2	95.701	35.076	.000
Intercept	1274.894	1	1274.894	467.267	.000
Pretest	49.251	1	49.251	18.051	.000
Method	126.052	1	126.052	46.200	.000
Error	466.557	171	2.728		
Total	33789.000	174			
Corrected total	657.960	173			

Table 6 shows the ANCOVA analysis of the data collected from the retention scores of students taught basic science using analogy strategy and those taught using demonstration method. From the analysis, $F(1,171) = 46.200$, $p < = 0.05$. Hence, the null hypothesis was rejected. This means that there is a statistically significant difference in the retention scores of students taught basic science using analogy strategy and those taught using demonstration method. This further indicates that there was higher improvement in the retention scores of the experimental group than students in the control group.

6.7 Hypothesis Three

There is no significant difference the mean achievement scores of male and female students taught Basic Science using analogy strategy.

Table 7: Summary of Analysis of Covariance (ANCOVA) of Achievement Scores of Male and Female Students Experimental group in Basic Science

Scores of Variance	Sum of Squares	Df	Mean Square	F	Sig
Corrected model	54.598[a]	2	27.299	16.750	.000
Intercept	748.141	1	748.141	459.033	.000
Pretest	54.471	1	54.471	33.422	.000
Gender (posttest)	0.092	1	0.092	0.056	0.813
Error	145.054	89	1.630		
Total	24396.000	92			
Corrected total	199.652	91			

Table 7 shows the ANCOVA analysis of the data collected from the achievement scores of male and female students taught Basic Science using analogy strategy. From the analysis, $F(1, 89) = 0.06$, $p > 0.05$. Hence, the null hypothesis was not rejected. This means that there is no statistically significant difference in the mean achievement scores between male and female students taught Basic Science using analogy teaching strategy. This further indicates that there was slightly improvement in the achievement scores of male and female students in the experimental group after being taught using analogy strategy.

6.8 Hypothesis Four

There is no significant difference the mean retention scores of male and female students taught Basic Science using analogy strategy.

Table 8: Summary of Analysis of Covariance (ANCOVA) of the Retention Scores of Male and Female Students in Experimental and Control Group

Scores of Variance	Sum of Squares	Df	Mean Square	F	Sig
Corrected model	36.315[a]	2	18.158	6.30	0.003
Intercept	651.791	1	651.791	226.388	0.000
Pretest	33.813	1	33.813	11.744	0.001
Gender	1.118	1	1.118	0.388	0.535
Error	256.239	89	2.879		
Total	20073.000	92			
Corrected total	292.255	91			

Table 8 shows the ANCOVA analysis of the data collected from the retention test scores of male and female students taught basic science using analogy strategy. From the analysis, $F(1, 89) = 0.39$, $p>0.05$. Hence, the null hypothesis was not rejected. This means that there is no statistically significant difference between the retention scores of male and female students taught basic science using analogy instructional strategy. This further indicates that there was a slight difference improvement in the retention scores of male and female students in basic science after being taught analogy teaching strategy.

7. Discussion of Findings

The findings revealed that the mean achievement scores of students taught basic science using analogy strategy was significantly higher than those taught using demonstration method. This finding agreed with that of Okoronka (2009), Okigbo and Okeke (2011) and Olorukooba, Lawal and Jiya (2012) who carried out studies to determine the effect of using analogy teaching strategy on students' achievement in science subjects. These results indicated that students taught using analogy strategy had significantly higher scores that those taught using conventional method. The reason(s) for higher achievement of students taught using analogy strategy may likely be that the students were actively engaged and involved in the teaching and learning process. This created meaningful classroom interaction for exchange of ideas which facilitated easy understanding, visualization and remembering of concepts. Another reason for the higher achievement of students taught using analogy teaching strategy could be because students were captivated; more focused, attentive and interested in what they were doing to the extent that students voluntarily practiced analogy based activities, used it and even formed theirs. This no doubt offered learners opportunity for better understanding which enhanced their achievement. The result also indicated a significant difference in mean retention scores of students taught basic science using analogy strategy with those taught using demonstration method. This finding agree with that of Olorunkooba, Lawal and Jiya (2012), Imoko and Anyagh (2012) and Achor and Ukwuru (2014), whose studies confirmed that students' centred teaching method lead to students improved retention.

The experimental group retained what they learnt in basic science more than the control group because the knowledge they acquired was anchored since the experimental group learnt from pre-existing knowledge to new knowledge. This facilitates learning of the new concepts. Also the analogies based activities being practiced by the experimental group might contribute to providing anchorage for the knowledge gained. Ausubel (1964), meaning learning theory provides that availability of anchoring ideas facilities meaningful learning and retention. Another finding of the study is in the area of gender in basic science. The finding revealed a no significant difference in the mean achievement scores of male and female students taught basic science using analogy teaching strategy. This result is in agreement with the finding of Okigbo and Okeke (2011) who found no significant difference between the mean achievement scores of male and female students taught using analogy strategy. The no significant difference between male and female students could be attributed to the fact that equal opportunities were provided to both male and female students in participating actively using analogy strategy in connecting new and unfamiliar concepts to what they already knew. This confirms with UNESCO (2008) report that if male and female students are given equal opportunity, they will perform equally well. The result of this study shows that the assertion that males perform better than female students or vice versa is only a sex-stereotype assumption. As Gyuse (1990) contended, the determinant factors of students' achievement in science are a complex function of all of a child's innate ability, namely cognitive ability on one hand and environmental influence of both home and school on the other hand. Thus, this result of no significant difference in achievement of male and female students could be as a result of equal classroom interaction or participation opportunities provided by the analogy strategy for both male and female students. This implies that if female and male students are given equal opportunities in the learning process using innovative teaching methods such as the use of analogy, the educational inequality in our educational system in respect to gender difference especially in science will be addressed.

Another finding on gender in this study was that there was no significant difference between the mean retention scores of male and female students taught basic science using analogy. This finding disagreed with the findings of Imoko and Anyagh (2012) and Achor and Ukwuru (2014) who found that male students retained higher than female students. A possible reason for this finding could be that, with the use of analogy teaching strategy both male and female students are provided with equal learning experiences that strengthened their retention on concepts learnt.

8. Conclusion

The following conclusions are made based on the findings of this study. Analogy strategy is more viable in enhancing meaningful learning in basic science. Analogy strategy is capable of reducing gender gap when used in teaching. In the light of the discovery brought up by the investigation, it is hereby recommended that Basic Science teachers should be encouraged to use analogy for teaching to obtain high achievement and retention in basic science. More so, it is necessary to train and retrain basic science teachers through workshops and seminars on how to effectively use analogy strategy in teaching. Ministry of Education and relevant agencies like Teaching Service Board, State Universal Basic Education Board in conjunction with the faculty of education in the universities could be used to organize the workshops. Again teacher training institutions should include analogy strategy in their basic science method course content. This

will ensure that training of the pre-service basic science teacher on the use of analogy strategy as a teaching strategy. While curriculum planners and authors of basic science textbooks should illustrate the application of analogy in the basic science curriculum and basic science texts. This will help both teachers and students to become used to the strategy so as to improve achievement and retention.

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