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EFFECTS OF EXPLICIT INSTRUCTION ON STUDENTS' ACHIEVEMENT AND ATTITUDE TOWARDS BASIC SCIENCE

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EFFECTS OF EXPLICIT INSTRUCTION ON STUDENTS' ACHIEVEMENT AND ATTITUDE TOWARDS BASIC SCIENCE

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Abstract

Basic science, a major aspect of Basic Science and Technology is a core subject in the junior secondary school in which the method of teaching over the years has been a major challenge in this 21st century. An important tenet of Explicit Instruction is maximizing and encouraging meaningful learning. Ausubel's learning theory emphasized that knowledge is acquired primarily by direct exposure rather than through discovery. Subject concepts are presented, followed by the details and then being specific. Poor achievement in basic science, as well as attitude towards basic science, may deprive students' from benefiting in basic science. This study investigated the effect of explicit instruction on students' achievement and attitude towards basic science. The sample comprised 156 basic science students from intact classes of two randomly selected Junior Secondary Schools in Lagos State. Quasi-experimental pre-test post-test non-equivalent research design was involved. Two instruments: Basic Science Achievement Test (BSAT) and Basic Science Attitude Scale (BSAS) were used for data collection. The data collected were analyzed using Descriptive statistics and ANCOVA while the hypotheses were tested at 0.05 level of significance. The Study revealed that Explicit Instruction improved the achievement and attitude of students towards basic science. It was also found that there was no significant effect of gender on the achievement and attitude of students towards basic science. Based on these findings, it was recommended among others that explicit instruction should be adopted in teaching basic science students. The study, therefore, will help teachers/lecturers to inculcate the habit of being direct and explicit in science classes more especially in practical classes so that students will be guided towards achieving meaningful learning.

Introduction

Science has been accorded a prime position worldwide within. It is the bedrock for further technological advancement. Science has been defined by different authors according to their understanding. Science is often an intriguing and satisfying endeavour that requires creativity, skill and insight and based on this, Fape (2007) defined science as rationally structured knowledge about nature which embraces systematic methods of positive attitudes for its acquisition, teaching, learning and application. Science is a systematic process of obtaining knowledge and skills as a result of understanding the way things behave (from the study of the physical and natural world) directly or indirectly through observation and experimentation.

Science education is a field that is concerned with sharing science contents and processes with persons that are not originally seen as part of the scientific community. The target person(s) in

question may be children, college students or even adults within the society. According to Berube (2008), the field of science education consists of science content, some social sciences and some teaching pedagogy. According to Onwu (1993), the objectives of science education in Nigeria is to prepare students to observe and explore the environment to explain simple natural phenomena and to develop scientific attitudes such as curiosity, critical reflection and objectivity and also to enable students to apply the skills and knowledge gained through science to solve an everyday problem in the society. To enable us with this objective to be achieved, basic science was included as one of the core subjects. The general aim of basic science and technology education is to enable students to use their senses and hands to explore their environment. Thus, the above objective, which aimed at the interest of the students and meeting societal needs, brings us to the topic of this study. The major goal of science education is to develop scientifically literate individuals that can delve into rational thought and actions. The objectives of science education in Nigeria according to Maduekwe (2006) is the need to equip students with necessary skills and attitude to observe and explore their environment, explain simple natural phenomenon critically and objectively and then applying the knowledge and skills gained through science to everyday life and to solve problems in the society. In recent times, there has been this zeal to develop technologically and scientifically, especially developing countries like Nigeria since the world is now scientifically inclined and all functioning life depends more on science.

Science comprises the basic discipline or subjects such as Physics, Chemistry, Biology and Mathematics at senior secondary school but at primary and lower secondary, it is integrated science (basic science). Basic science is important at this stage because we can reach a large number of school children thereby introducing them to science at an early stage for subsequent further studies which is one of the efforts of United Nations Educational Scientific and Cultural Organization (UNESCO) towards integrated science. Basic science at upper basic education helps students to have first-hand theoretical and practical knowledge which is very essential for the future study of core subjects like Biology, Chemistry and Physics. This statement as further explained by Ekundayo (2012) maintains that Basic Science is important for students to get along with scientific concepts, principles, theories and laws which are further explained in the core sciences.

In scientific practices, engaging students in activities helps to improve their experimentation skill, social discourse and ability to evaluate knowledge and carry out an investigation (Bybee, 2011). Concerning this, the emphasis is placed on science and technology Education by the Federal Republic of Nigeria in her National Policy on Education (FRN, 2013) as a bedrock for building the nation socio-economically and to help her to meet up with the changing global culture of Science and Technology. To buttress the emphasis on Science and Technology Education in the national policy on Education. Basic science has been made as a compulsory subject for all Nigerian Students at the basic education level which will enable a large number of students to be exposed to basic science at this stage to get to them at a young age which is a very fertile stage and this was aided by the 6-3-3-4. Bybee (2011) pointed out that the current push towards sciences practices agitates that students should be actively involved through hands-on and laboratory work so that learning of science-related subjects can be made concrete. Ali (2012) identified that students' tensions and difficulty arise when they sense that during interaction with their science teachers in the classroom, they cannot give meaning to some scientific concepts, make conceptual connections, explain viewpoint and ask questions. Poor achievement in sciences from various empirical studies (Ferdinard, 2007; Betiku, 2001; Omole, 2003; Adeniji, 1998; NECO and WAEC Chief Examiners reports, (2005, 2007) respectively has brought concern to all stakeholders, including researchers. Many factors have led to the

unstable performance of students in basic science. They include school-teacher characteristics, teaching methods (strategy), social incentives, among others (Olatoye, 2003; Ogunkole, 2008). Therefore if these factors are looked into critically and thoroughly, there will be an improvement of students' attitude towards science and basic science in particular. The poor achievement could be linked to strategies of teaching as mentioned above. According to Omole (2003), poor achievement in basic science is due to methods adopted by teachers and the strategies used in science teaching which among other factors led to the loss of interest in science at the junior secondary school level and ultimately poor performance of students. For us to attain technological and scientific advancement, we need nothing short of good achievement in basic science, which can be achieved with the aid of the right teaching strategy-use by teachers. This implies that the mastery of basic science concepts might not be fully achieved if there is a flaw in the method of delivering its content. The teaching of basic science cannot be effective if the strategy used by the teacher does not have a positive outcome in students.

According to Archibong (2007), the interest which students show in science subjects depends on the teaching methods and materials which in turn affect their attitude and achievements. O' Banon (2002), categorized teaching methods into two approaches- students-centred and teacher-centred approaches. Teacher – centred approaches are methods where the teacher serves as a possessor of knowledge. They include lecture/expository, demonstration, discussion, recitation while student-centred approaches present the teacher as a guide and facilitator in the learning process. These methods include collaborative, cooperative, discovery. The processing and usage of information is the crux of the matter than its basic content. The teachers' involvement with students as a facilitator would bring about questioning, guiding, disciplining, validating, monitoring, motivating, encouraging, suggesting, modelling and clarifying (Mckenzie, 2005). To overcome the problem associated with poor achievement in basic science, there is a need to strive for a balance of effective teaching strategies such as explicit instruction, discovery and simulation method of instruction.

Explicit instruction is also known as direct instruction is one of the teaching strategies, which is systematic, direct, engaging and success-oriented and it has been shown to promote achievement for all students. Research on effective teaching practices has identified most of the components of explicit instruction as essential for positive students' outcome (Rosenshine &Stevens 1986; Ellis & Worthington, 1995). It encompasses everything that happens in the classroom including planning and design, delivery and management, evaluation/assessment. It also incorporates a step by step explanation, modelling, engaging in guided practice, practising the skill or element independently in a variety of applications, support in making connections of new to previous learning, teachers explanation as to the importance, usefulness and relationships of a new skill or cognitive strategy and consistently eliciting students interest (Rupley, Blair &Nichols, 2009). The primary goal of direct instruction is not only to increase the number of students learning but also to increase the quality of that learning by involving a stepwise background knowledge and explicitly applying it and linking it to new knowledge. This way, meaningful learning occurs which can be transferred and then applied by students. Explicit instruction is systematic, relentless, engaging and successful, as it aims at teaching for mastery (Archer & Hughe, 2011). The instruction is tailored specifically to students learning and attentional needs. It shares similar goals with other approaches to teaching such as constructivist, holistic or student-centred. It is an effective and efficient way of teaching. Not everyone who claims to be teachers is teachers because they lack the effective approach to transfer knowledge to the learners.

There is a poor achievement in basic science in Junior Secondary School Certificate Examinations (JSSCE) now BECE over the last five years (BSEB, 2017) as reported by Balarabe (2016) this could be as a result of the methods of instruction used by teachers in delivering instructional contents to the students in the classroom, gender insensitivity, inadequate exposure of students to activities and so on. The available literature on methods of teaching in science education suggested the need to employ new strategies to achieve this. The aim of the philosophy of integration cannot be achieved if effective teaching method to be used by teachers is not employed. Due to this, research effort has been made by researchers on issues relating to this. For instance, a study was carried out by Akpan (1996) which revealed that many students at the junior secondary school level have developed a negative attitude towards basic science. As a result, they do not benefit in the basic science curriculum (Afunwape, 2003; Afunwape and Olatoye, 2004; Odetoyonbo, 2004; Balogun, 1992; Olarewaju, 1999; Olagunju, 1995). This according to Afunwape and Olatoye (2004) has debarred many students from offering core science subjects at the senior secondary school level. Many researchers have worked on the attitude and achievement of students in other disciplines in which the recurring problem has been a phenomenon. Therefore, this study is geared towards investigated the effect of explicit instruction on students' achievement and attitude towards basic science.

Research Objective

The study investigated the effect of explicit instruction on students' achievement and attitude towards basic science. Specifically, the study examined;

1. the effect of treatment on students' achievement in basic science.
2. the effect of gender on students' achievement in basic science.
3. the interaction effect of treatment and gender on students' achievement in basic science.
4. the effect of treatment on the attitude of students towards basic science.
5. the effect of gender on the attitude of students towards basic science.
6. the interaction effect of treatment and gender on students' attitude towards basic science.

Research Questions

1. What is the main effect of treatment on students' achievement in basic science?
2. What is the main effect of gender on students' achievement in basic science?
3. What is the interaction effect of treatment and gender on students' achievement in basic science?
4. What is the effect of treatment on the attitude of students towards basic science?
5. What is the effect of gender on the attitude of students towards basic science?
6. What is the interaction effect of treatment and gender on students' attitude towards basic science?

Research Hypotheses

H_O1: There is no significant main effect of treatment on students' achievement in basic science.
H_O2: There is no significant main effect of gender on students' achievement in basic science.
H_O3: There is no significant interaction effect of treatment and gender on students' achievement in basic science.
H_O4: There is no significant main effect of treatment on the attitude of students towards basic science.

H_O5: There is no significant main effect of gender on the attitude of students towards basic science.
H_O6: There is no significant interaction effect of treatment and gender on students' attitude towards basic science.

Methodology

A quasi-experimental research design was adopted for this study. Specifically, the pretest, posttest, non-equivalent control group design was adopted for the study. The population of the study comprised all junior secondary school basic science students in Alimosho Local Government Area of Lagos State. A simple random technique was used to select two public coeducational schools from Alimosho Local Government Area which were randomly assigned to experimental and control groups in which intact classes of a sample of 156 students were used. Two instruments titled BSAT (Basic Science Achievement Test) and BSAS (Basic Science Attitude Scale) were used for data collection. The BSAT contained 21 multiple-choice questions adopted from Junior School Certificate Examination past questions and each item has one key and three distracters. The BSAS adapted from James Russel and Steven Hollander (1975) has three sections: the first section contained participants' biographic data; the second section contained the data about their parents; while the third section contained 14 statements on attitude towards basic science. The attitude statement is on a modified Likert scale with options ranging from undecided (UD.) disagree (D), strongly disagree (SD), agree (A) to strongly agree (SA). The validity of the research instrument (BSAT) was by content and face validity. It was subjected to screening by the supervisor and also experienced personnel in the field to validate its content. The questions of the BSAT were picked from past questions which were also validated using item difficulty. Table of the specification was constructed to adequately measure the behavioural and cognitive objectives. The topics taught were energy (heat), temperature and the kinetic theory of matter (boiling and evaporation). The cognitive objectives were limited to knowledge, comprehension and application of Bloom's cognitive domain because JSS2 basic science students were involved.
The BSAT was pilot tested and was administered to 50 students in another school different from the schools used for the research to determine the reliability. The reliability coefficient using Cronbach's alpha reliability coefficient was found to be 0.62 which means that there was a considerable high internal consistency. The reliability coefficient of the BSAS was 0.750. Thereafter, the instruments were administered with the help of two research assistants. The BSAS and the BSAT were administered to the students at the different schools to get their pre-attitude and pretest achievement scores. The first school was taught with the normal lecture method which involved introducing the topic and talking to them about the topic for discussion. The students only listened as the teacher did all of the talking.
The second school was taught with explicit instruction which involved a series of steps that might not all necessarily be carried out in one lesson. It involved presenting the topic to the students and clearly stating the objectives where the teacher clearly and in simple terms explained to the students, modelling for the student, a guided independent practice by the students from which he gets feedback. This feedback could be on the spot, asking the students questions or even giving them homework to elicit feedback and then, necessary measures could be taken where necessary.

Procedure for explicit instruction teaching strategy.

1. The teacher reviews the previous knowledge of the students.
2. The teacher establishes the topic and writes it on the board, specifying the objectives on the board.
3. The teacher presents the new topic/material to the students in small steps, using clear and simple language, giving examples and non-examples.
4. The teacher allows contribution from the students and elicits discussion as he goes round the class to get their attention.
5. The teacher models procedure for the students and guides them in carrying out the procedure.
6. The teacher allows them to work independently and intervenes where necessary to ensure successful and meaningful learning.
7. The teacher then gives the lesson note to the students with some assignment.

This was done for three weeks and at the end of the fourth week, the students were given the post achievement test and the post attitude questionnaire, after which the data were collected and organized accordingly for data analysis. The scores obtained from the pre-test and post-test were analyzed using mean and standard deviation for research questions and analysis of covariance (ANCOVA) for testing the hypotheses at 0.05% level of significance. ANCOVA was used to test the hypotheses because the experiment involves pre-testing of the subjects and it was also used to remove the effect of covariate or pre-test.

Result

Research question 1: What is the effect of treatment on student's achievement in basic science?

Table 2. Results of statistical analysis of pre-treatment and post-treatment achievement scores in basic science

Treatments	**pre-test**	**SD**	**Post-test**	**SD**	**N**	**Mean diff**
Conventional Method	8.73	2.405	10.49	3.124	78	1.76
Explicit Instruction	10.83	2.304	12.95	2.989	78	2.12

The data presented in table 2 revealed that the mean pretest achievement score of the experimental group (mean= 10.83; SD=2.304) was higher than pretest mean achievement score (mean= 8.73; SD=2.405) of the control group before the treatment. After the treatment, the mean posttest achievement score (mean= 12.95; SD=2.989) of the experimental group taught with explicit instruction was higher when compared with the mean posttest achievement score (mean= 10.49; SD=3.124) of the control group taught using conventional teaching method. The mean difference (2.12) of the experimental group exposed to explicit instruction was higher than the mean difference (1.76) of the control group. This result showed that explicit instruction was more effective than the conventional teaching method in improving student's achievement in basic science.

Research question 2: What is the influence of gender on the achievement of students' in basic science?

Table 3. Results of statistical analysis of pre-treatment and post-treatment achievement scores in basic science based on gender.

Gender	Pre-test	SD	post-test	SD	N	Mean difference
Male	9.88	2.32	11.68	3.41	65	1.80
Female	9.71	2.75	11.75	3.22	91	2.04

Table 3 revealed that the mean pretest achievement score of male students (mean= 9.88; SD= 2.32) was at par with the mean pretest achievement score of female students (mean= 9.71; SD= 2.75). After the treatment, the mean posttest achievement score of the male students (mean= 11.68; SD= 3.41) was also found to be at par with the posttest achievement score of the female students (mean= 11.75; SD=3.22), although the mean difference of the female students (2.04) was higher than the mean difference of the male students (1.80). Therefore, gender does not have any influence on the achievement of students in basic science.

Research question 3: What is the interaction effect of treatment and gender on students' achievement in basic science?

Table 4. Results of statistical analysis of the interaction effect of treatment and gender on achievement in basic science.

	Explicit Instruction				Lecture Method			
Gender	N	Pre-test	post-test	mean diff	N	pre-test	post-test	mean diff
Male	31	10.45	13.13	2.68	34	9.35	10.35	1.00
Female	47	11.09	12.83	1.74	44	8.25	10.59	2.34

Table 4 revealed that female students in the experimental group had a higher mean achievement score (mean= 11.09) in the pretest than the male students with a pretest mean achievement score of (mean= 10.45). After the treatment, the mean posttest achievement score (mean= 13.13) of male students was higher than the posttest mean achievement score (mean= 12.83) of the female students in the experimental group. The mean difference (mean= 1.74) of the female students was lower than the mean gain (mean= 2.68) of the male students in the experimental group.

Table 4 also revealed that male students in the control group had a higher mean achievement score (mean=9.35) in the pretest than the female students (mean= 8.25) before the treatment. After the treatment, the posttest means achievement score (mean= 10.59) of the female students was higher than the posttest mean achievement score (mean= 10.35) 0f male students. However, the mean difference of the male students (mean= 2.34) was higher than the mean difference (mean= 1.00) of female students, Therefore, explicit instruction is not gendered sensitive in improving students' achievement in basic science.

Research question 4: What is the effect of treatment on students' attitude towards basic science?

Table 5. Results of statistical analysis of pre-treatment and post-treatment attitude scores in basic science.

Treatments	pre-test	SD	post-test	SD	N	Mean diff
Conventional Method	42.78	6.262	39.97	8.801	78	-2.81
Explicit Instruction	42.66	6.791	41.29	8.253	78	-1.37

Table 5 revealed that the pre-attitude mean score of the experimental group (mean= 42.66; SD= 6.791) was almost the same with the pre-attitude mean score of the control group (mean=42.78; SD=6.262) before the experiment. The post-attitude mean score (X= 41.29; SD=8.253) of the experimental group was higher than the post-attitude mean score (X= 39.97; SD=8.801) of the control group after the administration of treatment. Results from the attitude scale show that the experimental group taught with explicit instruction had a mean difference (loss) of 1.37, which was lower than the mean difference (loss) (2.81) of the control group. Therefore, this result showed that explicit instruction was effective in improving students' attitude towards basic science.

Research question 5: What is the effect of gender on the attitude of students towards basic science?

Table 6. Results of statistical analysis of pre-treatment and post-treatment attitude scores in basic science based on gender.

Gender	pre-test	SD	post-test	S D	N	mean diff
Male	42.82	6.948	39.82	9.287	65	3.00
Female	42.95	6.167	41.22	7.945	91	1.73

Table 6 showed that the mean pretest attitude score of male students (mean= 42.82; SD= 6.948) was at par with the mean pretest attitude score of female students (mean= 42.95; SD= 6.167). After the treatment, the mean posttest attitude score of the male students (mean= 39.82; SD= 9.287) was also found to be lower than the posttest attitude score of the female students (mean= 41.22; SD=7.945), although the mean difference of the female students (1.73) was lower than the mean difference of the male students (3.00). Therefore, gender affects the attitude of students towards basic science.

Research question 6: What is the interactive effect of treatment and gender on students' attitude towards basic science?

Table 7. Results of statistical analysis of the interaction effect of treatment and gender on attitude in basic science.

	Explicit instruction				Lecture method		
Gender	N	Mean Pretest	Mean posttest	Mean difference	N	Mean pretest	Mean posttest	Mean difference
Male	31	43.61	41.74	-1.87	34	42.09	38.06	-4.03
Female	47	42.60	41.00	-1.60	44	43.32	41.45	-1.87

Data presented in table 7 revealed that female students in the control group had a higher pre-attitude mean score (mean=43.32) than the male students with a mean pre-attitude score of (mean= 42.09) before the treatment. After the treatment, the mean post-attitude score (mean=41.45) of female students was also higher than the mean post-attitude score (mean=38.06) of the male students. However, the mean difference (loss) (mean=-1.87) of the female students was lower than the mean difference (loss) (mean=-4.03) of the male students. The data also revealed that the male students in the experimental group had a higher pre-attitude mean score (mean=43.61) than the female students with a mean pre-attitude mean score of (mean=42.60) before the treatment. After the treatment, the mean post-attitude score (mean=41.74) of the male students was at par with the mean post-attitude score (mean=41.00) of the female students. However, the mean difference (loss) (mean=-1.87) of the male students was higher than the mean difference (loss) (mean=-1.6) of the female students. Therefore, gender is not sensitive in improving students' attitude towards basic science.

4.3. Test of Hypotheses

Hypothesis 1

There is no significant main effect of treatment on students' achievement in basic science.

Table 8. Summary of analysis of covariance (ANCOVA) for the test of significance of the main effect of treatment on students' achievement in basic science.

Source	**SS**	**df**	**MS**	**F**	**Sig.**	**Partial Eta**
Corrected Model	437.437[a]	4	109.359	13.337	.000	.261
Intercept	389.979	1	389.979	47.560	.000	.240
Pretest	198.370	1	198.370	24.192	.000	.138
Treatment	76.418	1	76.418	9.320	.003	.058
Gender	.270	1	.270	.033	.856	.000
Treatment*gender	17.659	1	17.659	2.154	.144	.014
Error	1238.153	151	8.200			
Total	23096.000	156				
Corrected total	1675.590		155			

a.R Squared = .261 (Adjusted R Squared =.241

A statistical test of Analysis of Covariance (ANCOVA) at 0.05% level of significance.

Table 8 showed that there was a significant main effect of treatment ($F_{(1, 151)}$=9.320, P<.05) on students' achievement in basic science, which favoured the experimental group exposed to explicit instruction. Thus, the null hypothesis of no significant main effect of treatment on students' achievement in basic science was rejected. Therefore, the mean achievement of the

experimental group exposed to explicit instruction and that of the control group taught with the conventional method as shown in table 2 was not due to mere chance but due to the effect of explicit instruction used to teach the experimental group.

Hypotheses 2

There is no significant main effect of gender on students' achievement in basic science.

Table 8. Summary of analysis of covariance (ANCOVA) for the test of significance of the main effect of treatment on students' achievement in basic science.

Source	SS	df	MS	F	Sig.	Partial Eta
Corrected Model	437.437[a]	4	109.359	13.337	.000	.261
Intercept	389.979	1	389.979	47.560	.000	.240
Pretest	198.370	1	198.370	24.192	.000	.138
Treatment	76.418	1	76.418	9.320	.003	.058
Gender	.270	1	.270	.033	.856	.000
Treatment*gender	17.659	1	17.659	2.154	.144	.014
Error	1238.153	151	8.200			
Total	23096.000	156				
Corrected total	1675.590		155			

a.R Squared = .261 (Adjusted R Squared =.241

A statistical test of Analysis of Covariance (ANCOVA) at 0.05% level of significance.

Table 8 showed that there was no significant main effect of gender on students' achievement in basic science. Therefore, the null hypothesis of no significant main effect of gender on students' achievement was accepted.

Hypotheses 3

There is no significant interaction effect of treatment and gender on students' achievement in basic science.

Table 8. Summary of analysis of covariance (ANCOVA) for the test of significance of the main effect of treatment on students' achievement in basic science.

Source	SS	df	MS	F	Sig.	Partial Eta
Corrected Model	437.437[a]	4	109.359	13.337	.000	.261
Intercept	389.979	1	389.979	47.560	.000	.240
Pretest	198.370	1	198.370	24.192	.000	.138
Treatment	76.418	1	76.418	9.320	.003	.058
Gender	.270	1	.270	.033	.856	.000
Treatment*gender	17.659	1	17.659	2.154	.144	.014
Error	1238.153	151	8.200			
Total	23096.000	156				
Corrected total	1675.590		155			

a.R Squared = .261 (Adjusted R Squared =.241

A statistical test of Analysis of Covariance (ANCOVA) at 0.05% level of significance. Table 8 also revealed that there was no significant interaction effect of treatment and gender on students' achievement in basic science ($F_{(1, 151)}$= 2.154, p>0.05). The null hypothesis of no significant interaction effect of treatment and gender on students' achievement in basic science was accepted. It can, therefore, be inferred that treatment and gender did not combine effectively to produce the desired change in students' achievement in basic science. In order

words, there was no differential effect of treatment over levels of gender on students' achievement in basic science and therefore it is due to chance.

Hypothesis 4

There is no significant main effect of treatment on students' attitude towards basic science.

Table 9. Summary of analysis of covariance (ANCOVA) for the test of significance of the main effect of treatment on students' attitude towards basic science.

Source	SS	df	MS	F	Sig,	Partial Eta
Corrected Model	39996.841[a]	4	999.210	20.727	.000	.354
Intercept	225.856	1	225.856	4.685	.032	.030
Pre-attitude	3697.395	1	3697.395	76.697	.000	.337
Treatment	64.986	1	64.986	1.348	.247	.009
Gender	58,802	1	58.802	1.220	.271	.00
Treatment*gender	55.835	1	55.835	1.158	.284	.008
Error	7279.332	151	48.207			
Total	268859.000	156				
Corrected total	11276.173		155			

a.R Squared = .354 (Adjusted R Squared =.337

A statistical test of Analysis of Covariance (ANCOVA) at 0.05% level of significance. Table 9 showed that there was no significant main effect of treatment ($F_{(1, 151)}$=1.348, P>.05) on students' attitude towards basic science. Thus, the null hypothesis of no significant main effect of treatment on students' attitude towards basic science was accepted. Although explicit instruction helped improve students' attitude towards basic science, it was not statistically significant.

Hypothesis 5

There is no significant main effect of gender on students' attitude towards basic science.

Table 9. Summary of analysis of covariance (ANCOVA) for the test of significance of the main effect of treatment on students' attitude towards basic science.

Source	SS	df	MS	F	Sig,	Partial Eta
Corrected Model	39996.841[a]	4	999.210	20.727	.000	.354
Intercept	225.856	1	225.856	4.685	.032	.030
Pre-attitude	3697.395	1	3697.395	76.697	.000	.337
Treatment	64.986	1	64.986	1.348	.247	.009
Gender	58,802	1	58.802	1.220	.271	.00
Treatment*gender	55.835	1	55.835	1.158	.284	.008
Error	7279.332	151	48.207			
Total	268859.000	156				
Corrected total	11276.173		155			

a.R Squared = .354 (Adjusted R Squared =.337

A statistical test of Analysis of Covariance (ANCOVA) at 0.05% level of significance. Table 9 showed that there was no significant main effect of students' attitude towards basic science, therefore, the null hypothesis of no significant main effect of gender on students' attitude towards basic science was accepted with 0.271 greater than 0.05.

Hypotheses 6

There is no significant interaction effect of treatment and gender on students' attitude towards basic science.

Table 9. Summary of analysis of covariance (ANCOVA) for the test of significance of the main effect of treatment on students' attitude towards basic science.

Source	SS	df	MS	F	Sig,	Partial Eta
Corrected Model	39996.841[a]	4	999.210	20.727	.000	.354
Intercept	225.856	1	225.856	4.685	.032	.030
Pre-attitude	3697.395	1	3697.395	76.697	.000	.337
Treatment	64.986	1	64.986	1.348	.247	.009
Gender	58,802	1	58.802	1.220	.271	.00
Treatment*gender	55.835	1	55.835	1.158	.284	.008
Error	7279.332	151	48.207			
Total	268859.000	156				
Corrected total	11276.173		155			

a.R Squared = .354 (Adjusted R Squared =.337

A statistical test of Analysis of Covariance (ANCOVA) at 0.05% level of significance.

Table 9 revealed that there was no significant interaction effect of treatment and gender on students' attitude towards basic science ($F_{(1, 151)}$=1.158, p>0.05). The null hypothesis of no significant interaction effect of treatment and gender on students' attitude towards basic science was accepted. It can, therefore, be inferred that treatment and gender did not combine effectively to produce the desired change in students' attitude basic science. Thus the effectiveness of treatment on students' attitude towards basic science does not depend on levels of gender.

Discussion

The results of the study highlighted six main findings. There was a significant main effect of treatment on students' achievement in basic science; there was no significant main effect of gender on students' achievement in basic science; there was no significant interaction effect of treatment and gender on students' achievement in basic science; there was no significant main effect of treatment on students' attitude towards basic science**;** there was no significant main effect of gender on students' attitude towards basic science, and there was no significant interaction effect of treatment and gender on students' attitude towards basic science.

The first finding showed that explicit instruction was efficient in improving the achievement of students in basic science than those taught with the conventional teaching method. Explicit instruction allows flexibility with students and it makes use of compensating approaches and change of tactics by the teacher when a procedure is not producing the desired outcome. The hallmark of this instruction is the extensive, supervised practice and feedback given under the ever-decreasing teacher structure and the gradual ownership to students as opposed to the conventional method where students are just passive learners and recipient of information and facts with no opportunity for feedback. The result of this study conformed to a meta-analysis conducted by Adams (1996), who found that the mean effect size per study using explicit instruction is more than 0.75 (effects of 0.75 and above in education are extraordinary) which

confirms that overall effect of explicit instruction practices is substantial. The authors, therefore, concluded that although explicit instruction is often described as a program for students in special education, the effect sizes calculated in the meta-analysis are nearly the same for students in general as well as those identified with disabilities. Students receiving explicit instruction in reading, mathematics, language and spelling achieved well in the basic skills. The results of this study were also supported by a meta-analysis conducted by Kroesbergen and Van Luit (2003), where the effect sizes of three methods of teaching mathematics were calculated: explicit/direct instruction, cognitive self-instruction, and mediated or assisted instruction. They found that explicit instruction was more effective for teaching basic mathematics and problem solving to students with learning difficulties than the other methods.

Findings from this study also revealed that there was no significant main effect of gender on students' achievement in basic science. Thus, both male and female had an equal chance of benefiting from the use of the instruction. This could be as a result of non-differential treatment of male and female students in the study. This result corroborates the findings of Abubakar and Oguguo (2011), who found no significant difference between the performance of boys and girls, as well as the findings of Udosoro (2011), who also found no significant difference between the performance of boys and girls. This contradicted the finding of Nwona (2013), who observed that male students do better in science, technology and mathematics. According to him, these subjects are masculine. In these reported researches, it is important to note that different methods were adopted for teaching. There is no single method of teaching that can bring all the desired outcome, but explicit instruction helps improve students' performance in basic science.

There was no significant interaction effect of treatment and gender on students' achievement in basic science. This finding thought of Marsh and Tapia (2002) that the differences in the achievement and will to learn is not based on gender. There was also no significant main effect of treatment on students' attitude towards basic science. A possible explanation is a duration for the study which might not have been enough to elicit a positive change in their behaviour. Change in attitude is a gradual process and takes time to be achieved.

There was no significant main effect of gender on students' attitude towards basic science. This result corroborates the findings of Adebunle and Aborishade (2014) who reported that both male and female have the same attitude towards Science. There was no significant interaction effect of treatment and gender on students' attitude towards basic science. This result agreed with the findings of Pell and Manganye (2007) that the attitude of students towards science is not dependent on gender.

Conclusion

The attainment of the goal of science education is largely dependent on many factors which include the instructional strategy used and this is not negotiable as it is very important. Basic science is an activity-oriented subject therefore, an instructional strategy that accomplishes this should be implemented. The school administrators and teachers should develop the attitude of students in trying to meet up or cover the syllabus, and also ensure that the objectives are met and that scientific skills are inculcated in the students. This can be achieved by using explicit instruction that involves a step by step procedure in presenting the lesson to the students. If science is properly taught to the students from the lower level as "basic science", it will better lay a solid foundation for learning science at a higher level and improve their attitude towards basic science which will also help to achieve the goal of integrating science. Explicit instruction

was effective because it not only involves students actively, but other methods were embedded in this method to bring about the positive change

References

Abubakar, R.B., & Oguguo, O.D. (2011). Age and Gender as predictors of Academic Achievement of College Mathematics and Science Students, in "Instructional conference on teaching, learning and change". *Institution association for teaching and learning (IATEL).*

Adams, G.L., & Engelmann, S. (1996). Research indirect instruction. *Educational Achievement Systems*. 25 Years beyond DISTAR: Seattle, WA.

Abebunle, S.O., & Aborishade, O.J. (2014). Gender Comparison of Attitude of Senior Secondary School Students towards Mathematics in Ekiti State, *Nigeria. European Scientific Journal*, *10*(19)153-160.

Adeniji, M.K. (1998). A comparison of the actual and preferred classroom learning environment in Biology and Chemistry as perceived by high school students. *Journal of research in Science Teaching.* Retrieved August 12, 2012 from http://www.ed.vive.evu/EPEPes<ea/92/doc/math at.

Adeyemi, T.O. (2008). Predicting Student's performance in Senior Secondary Certificate examinations from performance in Junior Secondary School Certificate Examination in Ondo state, Nigeria. *Humanity and Social Science Journal, 3*(1), 26-36.

Afunwape, M.O. (2012). Teacher and School factors as predictors of Students' Achievement in Integrated Science. *African Journal of Educational Research, 9*(12), 89-96

Afunwape, M.O., & Olatoye, R.A. (2004). Students Integrated Science Achievement as a predictor of later achievement in Biology, Chemistry and Physics. *Journal of Science Teachers Association of Nigeria* (JSTAN), 39(12), 11-16.

Akinsola, M. K., & Olowojaiye, F. B. (2008). Teacher Instructional Methods and Student Attitudes towards Mathematics. International Electronic Journal of Mathematics Education *3*(1)45 50.Retrievedfromhttps://www.researchgate.net/publication/26530028_Teacher_Instructional_Methods_and_Student_Attitudes_towards_Mathematics

Akpan, B.B. (1996). Towards a reduction in the content of our Primary and Secondary science Curricula. *Journal of Science Teachers Association of Nigeria, 31*(1&2), 1-5

Ali, T. (2012). A case study of the common difficulties experienced by a high school student in Chemistry classroom in Gilgit- Baltistan (Pakistan). *Journal of Research in Science Teaching*, 40, 464-486 Doi:10.1177/2158244012447299

Archer, A.L., & Hughes C.A. (2011). Explicit Instruction: Effective and efficient teaching (what works for special- needs Learners). *Journal of Special Education, 36*(4),186-205. New York, NY: The Guilford Press.

Archibong, A.U. (2009). The Relative Effectiveness of the Activity-based Approach and Lecture method on the Cognitive Achievement of Integrated Science *Students. Journals of science teachers' association of Nigeria,* STAN *3*(2), 37-42.

Balogun, T.A. (1992). Integrated Science Teaching concepts, problems and progress. Keynote address delivered at the Regional workshop on Integrated Science teaching, University of Ibadan.

Balaraba, M. (2016). Effects of Psycho-Social factors on Student's Academic Achievement in Basic Science. *Journal of Research in Science Teaching*, *5*(1), 234-240.

Bybee, R.W. (2011). Scientific and Engineering in k-12 classroom: Understanding a framework for k-112 Science Education.

www.nsta.org/about/standardsupdate/resources/201112_framework Bybee.pdf, (accessed July 2013).

Berube, C.T. (2008). The Unfinished Quest: The plight of Progressive Science Education in the age of standard charlotte, NC. The information age, Inc. *International Education Journal.*Comparative.

Betiku, O.F. (2001). Differential performance of newly introduced topics in senior secondary mathematics for teacher education. *A journal of the Association of Teacher Educators in Nigeria, 2*(2), 117-112.

BSEB, (2016). Benue State Examination Board Statistics unit Report on Students' Achievement in Basic Science in zone B BSEB of Benue State Markurdi:

Ellis, E.S., & Worthington, L.A. (1994). Research synthesis on effective Teaching Principles and the Design of quality tools for Educators. University of Oregon: Center to Improve the Tools of Educators.

Ekundayo, M.B. (2012). Teaching Science in Africa. Salem: Mede Nigeria Limited'

Federal Government of Nigeria (2013). National Policy on Education. Lagos: NERDC Press.

Ferdinard, J.B. (2007). Teachers' Effectiveness and internal efficiency in Primary Education. *Research and Curriculum Studies, 2*(1), 2-6 http://www.edu/edupolicies/schls/such/op/employa.

Maduekwe, A.N. (2006). 'Perspective on Teachers Education and ICTs in the Language classroom', V.B Owhotu, (ed). *An introduction to Information Technologies in Education.* Lagos: Sibon books ltd. 23-25.

Marsh, G.E., & Tapia, M. (2002). Feeling Good About Mathematics. United States: Department of Education.

Mckenzie, M. (2005). A second thought on the post-critical inquiry. *Environmental Education Research, 11*(4), 453-463.

Nwona, H.A., & Akogun, N.A (2015). Breaking Gender Barrier in Science, Technology and Mathematics Education. *Nigeria Journal of Research in Education*. 98-108.

Nyaumwe L, Bappoo R, Buzuzi G & Kasiyandima O. (2004). Students' perceptions of factors and Gender differences that influence their Achievement in 'O' level Mathematics in Mashonaland Central Region. *The Zimbabwe Bulletin of Teachers Education, 13*(1), 21-39.

O'Bannon. (2002). Planning for Instruction (Instructional Method). http://www.feutked/rbonannon/in/strategies rhythm.

Odetoyinbo, B.B. (2004). Teacher and Student factor as correlates of Achievement in Integrated Science. *Journal of Science Teachers Association of Nigeria*. (JSTAN), *39*(1&2), 17-22.

Ogunkola, A.S. (2008). Education: An unprofitable Industry in Nigeria. A Postgraduate school Interdisciplinary Research Discourse, University of Ibadan: University Press.

Olagunju, A. M. (1995). "The New Senior Secondary School Biology Core Curriculum in Nigeria", A Paper Presented at the National Conference of the N. A. E. M. T., Asaba.

Olarewaju, A.O. (1999). Evaluation of the Teaching of Integrated Science in Lagos and Ondo state Junior Secondary Schools. 4th STAN Conference Proceedings.

Omole, A.E. (2003). Task on Government Technology. www.Vanguardngr.com.

Onwu, A.N. (1993). Identification of major areas of Students' difficulties in Senior Secondary School Certificate Chemistry syllabus. Unpublished Med. Project. University of Nigeria Nsukka science education.

Owolabi, A.M. (2003). Using Improvised materials to enhance the teaching of Basic Science in Primary Schools. *Proceedings of Science Teachers Association of Nigeria. 5*(1), 1-6.

Robertson, I. J. (1987). Girls and Boys and practical Science. *International Journal of Science Education*, 9, 505–518.

Rosenshine, B., & Stevens, R, (1986). Teaching functions in M.C. Wittrock (Ed). *Handbook of research on teaching* (3rd edition) 376-391. Newyork: McMillan.

Rupley, W.H., Blair, T.R., & Nichols, W.D. (2009). Effective reading instruction for struggling readers: The role of direct/explicit teaching. Reading and writing Quarterly 25, 2-3.

Serbessa, D.D. (2006). The tension between Traditional and Modern teaching-learning approaches in Ethiopian primary schools. *Journal of international cooperation in Education*, *9*(1), 123-140. Available at http:/home.hiroshima-u.ac.jp/cie/wp-content/uploads/2014/03/9_1_10.pdf.Accessed 19 March 2017.

Smail, B., & Kelly, A. (1984). Sex differences in Science and Technology among 11-year-old schoolchildren: II – affective. *Research in Science & Technology Education*, 2, 87–106.

Uduosoro, U.J. (2011). Perceived and actual learning difficulties of Students in Secondary School Mathematics. *International Multidisciplinary Journal, Ethiopia, 5*(5), 357-366

Umoh, G.G. (2006). Path to Quantitative Education*: A standard book for Students, Teachers and Educational Administrators.* Uyo: Inala Ventures and Publishers.

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