ISSN: 2277-9655
Impact Factor: 4.116

IJESRT

INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY

GENDER AND LEVELS OF ATTAINMENT OF SCIENTIFIC LITERACY AMONG SCIENCE STUDENTS UNDER CONSTRUCTIVIST INSTRUCTIONAL MODEL

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DOI: 10.5281/zenodo.56906

ABSTRACT

The study investigated levels of attainment of scientific literacy by junior secondary (8th grade) male and female students. Quasi-experiment of non- equivalent control group design was used. A total of 162 students were selected by purposive sampling of four coeducational schools out of twenty three in Ohafia Local Government Area, Abia state, Nigeria. In each of the four schools, an intact class was randomly selected. These were randomly assigned, two to experimental and control groups. Research questions were answered using mean and standard deviations and the hypotheses tested using ANCOVA. TOSL instrument for data collection had parts A and B. Reliability Coefficient of part A was established using Spearman rank order correlation and B using Kuder-Richardson formula 20(K-R). The internal consistencies were 0.69 and 0.72. The findings showed that constructivist instruction enhanced students' attainment of scientific literacy irrespective of their sexes. Based on the findings recommendations were made.

KEYWORDS: Scientific Literacy, Constructivist instruction, Gender.

INTRODUCTION

Science, Technology, Engineering and Mathematics (STEM) Education has transformed people's lives socially, economically, morally and politically. Relevance in the 21st century technology-driven economy demands effective STEM education. This means that students' acquisition of relevant knowledge, skills and attitudes will enable them develop their full capacities, solve everyday life problems, improve their lives and their environment, participate fully in decision making relating to their community and development. It will also enable them to compete favorably in the global arena. It is obvious that these requirements of an effective STEM education are attributes of Scientific Literacy. Scientific Literacy is the ability of individuals to live autonomous lives in a scientific and technological world, (Mbajiorgu, 2008). Hurd (1998) and Zollman (2011) defined scientific literacy as a civic competency required for rational thinking about science and technology, in relation to personal, social, political, economic problems and issues that one meets throughout one's lifetime. National Science Education Standards (2005) sees scientific literacy as specific types of abilities which include: understanding the key concepts and principles of science in relation to one's life; knowing how scientific ideas develop in order to comprehend phenomena and changes in the natural world; understanding the relation of science and related technologies in contemporary society. These indices of scientific literacy are inculcated in the learners using appropriate teaching methods that represent the exact scientific exploring process.

However, science teaching in most Nigerian secondary schools is predominantly content based rather than application. Scientific knowledge and theories are directly told the students from their textbooks hence students cannot think of constructing their own knowledge. Effective STEM education should involve students in direct scientific activity

and appreciation of the complex relationships between science and society. Effective STEM education should also ensure the fostering of positive attitude towards science and scientific literacy acquisition. There is the need to ensure adequate attainment of reasonable levels of scientific literacy by all students irrespective of their sexes.

The attainment of scientific literacy by all (males and females) is a contemporary goal of science, which should be achieved in all nations of the globe including Nigeria. That is the focal point of the World Declaration on Education for All in Jomiten, Thailand in 1990 (UNESCO, 2000) and was similarly emphasized and further adapted in the World education forum in Dakar, Senegal in 2000.

In Nigeria, following her endorsement of international protocols on Education for All (EFA) and the Millennium Development Goals (MDGs), and their subsequent translation and adoption as National Economic Empowerment and Development Strategies (NEEDS), it became imperative to update existing curricula of the nation to cater for dynamic global changes. To this end, school curricula including the Basic Science curriculum were reviewed and re-structured in 2006.

For the Basic Science curriculum used in Nigerian primary and junior secondary school levels (grades 1-9) the contemporary global development called for the infusion of relevant contents bordering mainly on human and environmental sustainability. In the upper Basic (i.e. the last three years of Basic Education), the theme "Science and Development was added to expose all students (males and females) to development in science and technology alongside skills acquisition that will enable them face challenges, make informed decisions, develop survival strategies and learn to live effectively within the diverse global community of the 21st century, National Educational Research and Development Council (NERDC, 2007).

However, studies have shown that cognitive achievement in science related tasks as well as acquisition of skills can be influenced by gender in favour of boys (Ige and Arowolo, 2003; Madu, 2004). In contrast to the above findings (Ibe, 2013) observed that if given equal opportunities in science and technology curriculum and instruction, every student would perform well in terms of attainment of a reasonable scientific literacy levels irrespective of gender.

Gender refers to socially constructed roles and socially learned behaviors and expectations associated with males and females (Oakley, 1996; Okeke, 2000 and World Bank Policy Report, 2001). Males and females are biologically different although all cultures interpret and elaborate their biologically inherent differences into a set of social expectations about what behaviors and activities are appropriate for them and what rights, resources and even power they possess. In Nigeria, gender gaps occur in treatment of males and females which put females in a corner that has deterred their progress and achievement in schools. Some gender related problems in curriculum implementation has been identified by Nwagbara (2009) as follows: discriminatory attitude of parents, gender stereotyping, cultural and religious factors, gender biased curriculum in favour of males and females high dropout rates in Nigerian schools. These result to low performance in the classroom on the part of the females which often result to psychological and emotional battering. However, some studies have indicated that the use of innovative strategies that are inquiry based, can improve achievement in science (Nworgu 2004), skills acquisition (Ibe and Nwosu, 2004) and enhanced scientific literacy (Okoro 2000; Ibe, 2013).

However, in some discussions of scientific literacy, the term is used as a goal that one completely achieves or does not. That is, a person is either scientifically literate or not. It is much more appropriate to recognize that each individual occupies a position somewhere along a continuum of scientific literacy for different scientific concepts. Accordingly, the task for the classroom teacher is to move students to different positions that imply a richer understanding of science.

Biological Science Curriculum Studies (BSCS, 1993) described a four level continuum used in this study. The levels are: (1) Nominal level whereby students are literate in name only. At this level, students recognize scientific terms as being related to natural phenomena but cannot provide valid explanations of the terms.(2) At functional level, students can define scientific terms correctly but that ability is based on memorization of facts while (3) at structural level, they can construct appropriate explanations based on experiences in the classroom. (4) At the multidimensional level, students can use scientific knowledge gained in solving real world problems that may require interdisciplinary approach.

ISSN: 2277-9655
Impact Factor: 4.116

Scientific literacy is not context free (Jekins, 1997). It becomes meaningful when it addresses specific issues, aims at specific purposes and related to specific people. The amount of scientific conceptual knowledge an individual has acquired does not make the individual scientifically literate, rather, the amount of problem solving skills, communication skills, critical thinking skills and positive social cognition skills an individual has developed. These attributes of a scientific literate individual are inculcated using an effective teacher who can use appropriate activity oriented teaching methods.

Constructivist instruction, specifically the five phase Es model consists of Engagement, Exploration, Explanation, Elaboration and Evaluation was used in this study.

Constructivist Instructional Strategies are among the innovative inquiry and problem-solving approaches that emphasize the importance of prior knowledge in concept formation in an interactive classroom environment. It allows students to experiment and discuss in groups as they make meaning of tasks and set out to solve challenging problems (Nwagbo and Obiekwe, 2010). The Constructivist epistemology asserts that the tools available to a knower are the senses. It is only through seeing, hearing, touching, smelling and tasting that an individual interacts with the environment. Constructivist classes afford the teacher the opportunity to expose the children to anomalous data that will induce cognitive conflict thus challenging the alternative conceptions and misconceptions. Dialogue among children is therefore an important strategy of encouraging them to construct new conceptual framework. This study is based on Piaget's point of view of seeing the learner as an active thinker who constructs his own knowledge by thriving with objects and ideas. The child tries to make sense of his world as he asks questions …, wants to know ..., and have purposes and intentions. However, the child's sense making is limited by his experience. Teachers should therefore possess some competencies that would enable them employ classroom practices and teaching strategies that actively involve the learner. From Piaget's theory we can interpret the classroom and its activities as creating and offering opportunities for learners to learn and attain reasonable levels of scientific literacy. Since the attainment of good levels of scientific literacy by all (males and females) is an important purpose of STEM education; it becomes necessary to explore the efficacy of an innovative inquiry based strategy, Constructivist Instructional strategy (5ES model) on the attainment of scientific literacy by boys and girls exposed to science curricula that emphasize scientific literacy as one of the primary objectives.

STATEMENT OF PROBLEM

Attainment of scientific literacy at an adequate level is of paramount importance in STEM education. Literature in STEM education indicates a trend tilting towards low level of scientific literacy attainment of females in science related tasks compared to boys at all levels of science education including the junior secondary school level (grades 7-9). This is the situation in Nigeria, where science curricula have been reviewed and re-structured in line with demands of the dynamic global challenges and requirement. This includes developing in males and females the relevant and functional knowledge, skills and attitudes that will empower them to appreciate and participate appropriately and adequately in civic matters that affect their lives, make rational decisions on matters such as personal health, natural resources and hazards, climate changes, environmental sustainability etc. These required abilities for all males and females, to live autonomous and fulfilled lives in a scientific and technological world are the indicators of scientific literacy that reflects an effective STEM education. In Nigeria where gender stereotyping against girls does strongly exist, there is need to ensure the attainment of reasonable levels of scientific literacy by both boys and girls. This calls for a shift in pedagogical practices from the usual conventional practices to the use of innovative strategies that will cater for all students.

Constructivist models of instruction which is inquiry and activity based (agreeing with the nature of science), and interactive seems to be gender unbiased since it has the capacity to give equal learning opportunities to all students. Therefore it becomes imperative to explore the efficacy of 5ES in the attainment of scientific literacy by male and female science students in Nigeria.

Purpose of the Study: The study focused on levels of attainment of scientific literacy by junior secondary school male and female students exposed to constructivist instructional practices and those exposed to conventional (lecture) method. Specifically the study sought to determine:

Scientific literacy attainment of students at the four levels under constructivist instructional model of instruction.

Influence of gender on scientific literacy attainment at the four levels.
The interaction effect of gender and method on students' attainment of scientific literacy at the four levels

Research Questions

The research questions that guided the study were:
What are the mean scientific literacy attainment scores of students exposed to constructivist instructional model and the conventional (lecture) method as measured by TOSL?
(2)What is the influence of gender on the mean scientific literacy attainment scores of students?

Hypotheses:

Three null hypotheses that guided the study were:
HO1: There is no significant difference between the mean scientific literacy attainment scores of students taught using constructivist model and those taught using lecture.
HO2: There is no significant difference between the mean attainment scores of male and female students taught using constructivist model and lecture on levels of scientific literacy as measured by TOSL
HO3: The interaction effect of gender and method on students' attainment of scientific literacy is not significant

RESEARCH DESIGN AND PROCEDURE

The research design was quasi-experimental. Specifically the non-equivalent control group design was used. This design was considered appropriate due to the use of intact classes instead of randomization of samples. This was done to avoid disruption of normal classes which would not be accepted by school authorities. The study was carried out in Ohafia Local Government area of Abia State in South Eastern Nigeria where students' levels of attainment of scientific literacy has not been investigated as observed from literature. 162 JS2 students (made up of 88 males and 77 females) formed the sample. Purposive sampling was used in selecting four coeducational schools out of 23. An intact class of JS2 was randomly drawn from each of the 4 schools. The four intact classes were randomly assigned, two to a constructivist group and two to a control (lecture) method group. The regular teachers for the selected classes taught the students. In order to control errors that may arise from teacher differences, the researcher trained and supervised the regular class teachers of the experimental groups using a mock teaching exercise and the lesson notes that were prepared by the researchers. The training lasted for one week. The teachers were advised to adhere strictly to the lesson notes prepared by the researchers. The researchers kept monitoring the teachers to ensure that they do not deviate from the procedures of instructions given to them. The instructional packages for both the treatment and control groups were the same in contents, specific objectives and evaluation method. The difference was only on the instructional method. Students were pretested before commencement of treatment. The treatment lasted for six weeks. At the end of the treatment, the same instrument (Test of Scientific Literacy –TOSL) was administered to students as post-test. Lessons were taught in all the classes of JS2 in the schools selected using the method of instruction assigned to each school by the researchers in order to avoid experimental bias/ Hawthorne effect. Before use, the instrument tagged TOSL was face validated by experts in the Department of Science Education, University of Nigeria, Nsukka. The content validity was established using a table of specification. TOSL was made up of practical test items (part A) and multiple choice objective items (Part B). Trial testing of the instrument was carried out using a school outside the study area but of the same characteristics. The reliability coefficients of 0.69 was found for section A using Spearman Rank Order Correlation while a coefficient of 0.72 was established for Part B using Kuder-Richardson formula 20(K-R).

METHOD OF DATA ANALYSIS

Data collected using the TOSL were analysed based on the research questions and the corresponding hypotheses. Mean and standard deviation were used in answering the research questions while Analysis of Covariance was used in testing the hypotheses at 0.05 level of significance. The tests of scientific literacy were scored on 100% as follows – Nominal Scientific Literacy (23%), Functional (24%), Structural (26%) and Multidimensional (27%). An individual's ability to score half the total mark of any of the levels was considered as being scientifically literate at the level. Criteria means for the scientific literacy levels were therefore as follows: Nominal =11.50, Functional =12.00, Structural=13.00, and 13.50 for Multidimensional.

Results

The results are presented in tables according to the research questions and their corresponding hypotheses that guided the study.

Research questions 1: What are the mean scientific literacy attainment scores of students exposed to constructivist instructional model and the conventional (lecture) method as measured by TOSL?

ISSN: 2277-9655
Impact Factor: 4.116

Research question 2: What is the influence of gender on the mean scientific literacy attainment scores of students?

Table 1: Mean and Standard Deviation scores of students exposed to constructivist model and the traditional (lecture) method by Gender and by scientific literacy levels as measured by TOSL

Teaching Methods	Student's Gender	Levels of Scientific Literacy				
			Nominal	Functional	Structural	Multi-dimensional
Constructivist group	Males	Mean	16.77	12.61	11.47	13.02
		N	44	44	44	44
		SD	4.502	3.005	3.114	4.06
	Females	Mean	16.90	12.82	11.78	13.70
		N	41	41	41	41
		SD	4.482	2.914	3.207	4.094
Constructivist group. (ALL STUDENTS)	**ALL** (Treatment)	Mean	16.83	12.71	11.62	13.35
		N	85	85	85	85
		SD	4.446	2.946	3.207	4.069
Lecture group	Males	Mean	10.52	10.54	9.22	9.00
		N	44	44	44	44
		SD	3.344	3.121	3.607	3.07
	Females	Mean	11.66	10.96	9.96	9.57
		N	33	33	33	33
		SD	4.806	3.924	4.390	4.02
Lecture group(ALL STUDENTS)	**ALL** (Control)	Mean	11.01	10.72	9.54	9.24
		N	77	77	77	77
		SD	4.047	3.470	3.952	3.49

Data in table 1 show that in the constructivist group, the post-test mean scores of students (**ALL**) in the Nominal, Functional, Structural and Multidimensional levels were 16.83, 12.71, 11.62 and 13.35 respectively. These were above the post-test mean scores of 11.01, 10.72, 9.54 and 9.24 obtained by students (**ALL**) in the control group in the four levels of scientific literacy respectively.

For research question 2 on influence of gender, data in table 1 above also reveal that in the constructivist group, females had post-test mean scores of 16.90, 12.82, 11.78, and 13.70 respectively for the four levels. These mean scores also appear to be slightly above the mean scores of 16.77, 12.61, 11.47, 13.02 recorded for males at the four levels in the same constructivist group. However, the differences between the mean scores of males and females seem not to be substantial. The low standard deviations (for both sexes) are indications of the compact nature of scores around the mean. To find out if the difference in attainment of scientific literacy at the various levels is significant for both treatment and gender, the corresponding hypotheses 1 and 2were tested and results presented in tables 2, 3, 4 and 5 according to the four scientific literacy levels investigated

ISSN: 2277-9655
Impact Factor: 4.116

Hypotheses:

HO1: There is no significant difference between the mean scientific literacy attainment scores of students taught using constructivist model and those taught using lecture.

HO2: There is no significant difference between the mean attainment scores of male and female students taught using constructivist model and lecture on levels of scientific literacy as measured by TOSL

Table 2: Analysis of Covariance (ANCOVA) of Students' Acquisition of Scientific Literacy at Nominal Level by Treatment and by Gender

	Source	Type III Sum of Squares	Df	Mean Squares	F	Sig
	Corrected model	1444.609	4	361.152	19.926	.000
Dependent	Intercept	2265.971	1	2265.971	125.018	.000
Variable:	Pre Nominal	50.004	1	50.004	2.759	.009
Nominal	Treatment	1318.799	1	1318.799	72.761	.000
scientific	Gender	23.223	1	23.223	1.281	.259
Literacy (SL)	Treatment by Gender	12.768	1	12.768	.704	.403
	Error	2845.644	157			

For hypothesis 1, data on table 2 indicate that for the treatment, at the Nominal level, the exact probability level of .000 is less than the already set alpha level of .05 at 1 degree of freedom. This means that at the Nominal level, there is significant difference between the mean attainment scores of students exposed to constructivist instructional model and the lecture method as measured by TOSL. Analysis of Covariance (ANCOVA) for test of hypothesis 1 at the 3 scientific literacy levels of functional, structural and multidimensional are presented on tables 3, 4 and 5 below.

Table 3: Analysis of Covariance (ANCOVA) of Students' Acquisition of Scientific Literacy at Functional Level by Treatment and by Gender

	Source	Type III Sum of Squares	Df	Mean Squares	F	Sig
	Corrected Model	205.903	4	51.476	5.005	.001
Dependent	Intercept	562.310	1	562.310	55.223	.000
Variable:	Pre Functional	41.470	1	41.470	4.073	.045
Functional	Treatment	189.645	1	189.645	18.625	.000
Scientific	Gender	16.897	1	16.897	1.695	.200
Literacy	Treatment by Gender	1.710	1	1.710	.168	.683
	Error	1898.646	157	10.182		
	Total	24 253.000	162			
	Corrected Total	1804..549	161			

Data on table 3 indicate that for the treatment, at the Functional level, the exact probability level of .000 is less than the already set alpha level of .05 at 1 degree of freedom. This means that at the functional level, there is significant difference between the mean attainment scores of students exposed to constructivist instructional model and those exposed to lecture method as measured by TOSL.

Table 4: Analysis of Covariance (ANCOVA) of Students' Acquisition of Scientific Literacy at Structural Level by Treatment and by Gender

ISSN: 2277-9655
Impact Factor: 4.116

	Source	Type III Sum of Squares	Df	Mean Squares	F	Sig
Dependent Variable: Structural Scientific Literacy	Corrected Model	195.672	4	48.918	3.784	.006
	Intercept	801.089	1	801.089	61.961	.000
	Pre structural	8..858	1	8.858	.685	.409
	Treatment	171.795	1	171.795	13.228	.000
	Gender	16.627	1	16.627	1.286	.259
	Treatment by Gender	1.331	1	1.331	.103	.749
	Error	2029.841	157	12.925		
	Total	20551.0000	162			
	Corrected Total	2225.512	161			

Data on table 4 indicate that for the treatment, at the Structural level, the exact probability level of .000 is less than the already set alpha level of .05 at 1 degree of freedom. This means that at the functional level, there is significant difference between the mean attainment scores of students exposed to constructivist instructional model and those exposed to lecture method as measured by TOSL.

Table 5: Analysis of Covariance (ANCOVA) of Students' Acquisition of Scientific Literacy at Multi-dimensional Level by Treatment and by Gender

	Source	Type III Sum of Squares	Df	Mean Squares	F	Sig
Multidimensional	Corrected Model	789.674	4	197.418	14.004	.000
	Intercept	1064.866	1	1064.866	75.538	.000
	Pre multidimensional	92.280	1	92.280	6.546	.011
	Treatment	434.366	1	434.366	30.812	.000
	Gender	40.023	1	40.023	2.339	.094
	Treatment by Gender	.360	1	.360	.026	.873
	Error	2213.246	157	14.097		
	Total	24061.000	162			
	Corrected Total	3002.920	161			

Data on table 5 indicate that for the treatment, at the Multidimensional level, the exact probability level of .000 is less than the already set alpha level of .05 at 1 degree of freedom. This means that at the Multidimensional level, there is significant difference between the mean attainment scores of students exposed to constructivist instructional model and those exposed to lecture method as measured by TOSL.
Data on the tables 2 to 5 reveal that experimental group students scored significantly higher than the control group students in the test of scientific literacy at Nominal, Functional, Structural and Multidimensional levels. Therefore, the null hypothesis one (HO1) of no significant difference is rejected.

As regards hypothesis 2 that sought information on gender and performance, data on tables 2, 3, 4, and 5 show that the exact probability levels of .259 (nominal), .200 (functional), .259 (structural) and .094 (multidimensional) are greater than .05 at 1 degree of freedom. This means that at the four levels of scientific literacy, the difference between male and female students' attainment in the experimental group is not statistically significant.The hypothesis of no

significant difference in mean scientific literacy attainment scores of male and female students in the experimental group is therefore accepted for nominal, functional, structural and multidimensional levels of scientific literacy.

As regards hypothesis 3 on interaction effects of gender and method, data on tables 2, 3, 4 and 5 show that the exact probability levels of .259 and .403 (nominal), .200 and .683 (functional), .259 and .749 (structural), .094 and .873 (multidimensional) are greater than .05 at 1 degree of freedom. Gender therefore does not interact with teaching method in influencing students' attainment in all the scientific literacy levels studied. Constructivist instructional model as main effect had constant effect on levels of scientific literacy, independent of the sexes of the group.

DISCUSSIONS, EDUCATIONAL IMPLICATIONS OF FINDINGS AND RECOMMENDATIONS

Students' acquisition of scientific literacy was higher for the constructivist group than the control group in all the scientific literacy levels. The low Standard Deviations recorded showed how compact students' scores were distributed close to the mean, meaning that predictions were small.

With respect to hypothesis one, data in tables 2 to 5 indicate that for the treatment and for the scientific literacy levels studied, the exact probability level of .000 is less than the already set alpha level of .05 at 1 degree of freedom. This means that at the four levels, the ANCOVA test show that there is significant difference between the mean attainment scores of students exposed to constructivist instructional model and those exposed to lecture method as measured by TOSL.

Constructivist group was persistently superior to lecture group in scientific literacy attainment at the four levels The finding authenticates the tenets of constructivist theory that emphasize activity/ inquiry based teaching and interactive learning and the learning theory of Jean Piaget on active involvement of the learner in the process of teaching and learning. Thus the students learnt more effectively and performed better in the treatment group.

In addition, scientific literacy mean scores were higher for the lower levels of nominal and functional when compared to their mean attainment scores in the higher levels of structural and multidimensional. Mean scores of students (ALL) at structural and multidimensional levels were low if the criteria means (13.00 and 13.50) set ab initio for the two levels by the researchers were taken into consideration. The findings of low scientific literacy of students at the reasonable/ higher (structural and multidimensional) levels of scientific literacy agree with the researches of (Njoku, 2004; Okoro, 2000 and Holbrook, 2011) who found low levels of scientific literacy among students and teachers. These findings were attributed to poor educational policy and curriculum implementations as they relate to classroom practices and teaching methods among others.

Also, the findings of low attainment of scientific literacy in this study (All students), at the higher levels of structural and multidimensional levels means that students' ability to acquire relevant and required knowledge, skills and attitudes that will enable them develop their full capacities, solve everyday life problems, improve their lives and their environment, participate fully in decision making relating to their community development, and be able to compete favorably in the global market is lacking. This situation may be attributed to poor student background in science and technology related tasks, ineffective science Education due to teachers' lack of adequate attainment of scientific literacy, poor content knowledge as well as use of poor pedagogical strategies.

The effectiveness of constructivist instructional model in the enhancement of scientific literacy among students implies that teachers should practice and use this instructional model for effective science education. Students should be given opportunities to explore their environment, manipulate materials, ask probing and thought provoking questions as well as provide the answers in an interactive learning setting.

For research question two, data in table 1 also indicate that although the posttest mean scores of females appeared to be slightly higher than those of the males in the constructivist group, the difference was not statistically significant as revealed by the test of hypotheses in tables 2, 3, 4 and 5. Analysis of Covariance as presented in these tables show that there is no significant difference between the mean attainment scores of males and females exposed to constructivist instructional model as measured by TOSL.

This is in support of Abonyi (2004) observations that the high achievement of boys over the girls in science related tasks as found in some literature may not be due to the superior intellectual ability of males over females but as a result of use of gender biased teaching methods (in favour of boys) and lack of exposure of girls to science related activities as often as the boys. The findings of no significant differences in the mean Scientific Literacy attainment scores of both male and female students in the individual scientific literacy levels also agree with the findings of Nworgu (2004), Afuwape and Oludipe (2008) whose findings revealed that gender gap in science is declining.

RECOMMENDATIONS

Based on the findings of the study, it is recommended that (i) teachers practice and use inquiry based teaching method that are students' centred and interactive. (ii) Gender biases in favour of males should be removed from conventional science and technology curriculum as well as science classrooms. This will ensure effective science education for all students. (iii) Collaborative research among science teachers from developed and developing nations in relation to science content and pedagogical competencies needed for enhanced scientific literacy at the four levels. (iv)Organisation of conferences, workshops and seminars for both inservice and pre-service teachers on the use of constructivist model and other learner centered activity oriented methods. (v) Nigerian government and Non-governmental organisations should collaborate in providing enabling environment for activity oriented teaching and learning

CONCLUSION

Constructivist instruction enhanced students SL in the four levels.
Students SL scores were high at nominal and functional levels
Low attainment was found at structural and multidimensional levels for all students
Males and females SL attainment did not differ significantly
There was no significant interaction effect between teaching method and gender
However, the following limitations were observed in the study: The teaching of the groups was done by different research assistants in their different schools. Although training was done for all of them to enhance standard, individual differences could occur that might affect the external validity of results.
A replication study may be carried out with larger sample than the one used in the study in other education zones or other states of the Federation so that the result can be generalized.

ACKNOWLEDGEMENTS

As this manuscript is an extract of my completed Ph.D dissertation, I sincerely and earnestly express my gratitude to my Supervisor, Prof. A.A. Nwosu. Our profound gratitude goes to Profs. Uchenna Eze, F. A. Okwor, U.N.V. Agwagah, Drs. C.R. Nwagbo, L.N. Nworgu and F.O. Ezeudu for reading and contributing useful ideas that guided the development and improvement of the study. Finally we are indebted to the University of Nigeria, Nsukka, our employer for providing enabling environment for untying the seemingly knotty academic packages that normally accompany research venture. The research was self-funded. To God be the glory.

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