THE EFFECTS OF SCAFFOLDING ON THE ACHIEVEMENT OF SENIOR SECONDARY SCHOOL STUDENTS IN PHYSICS IN MINNA METROPOLIS

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Abstract

This study determined the effects of scaffolding on the achievement of senior secondary school students in physics in Minna metropolis. Quasi-experimental design, specifically the pre-test, post-test control group design was used.There were four teachers two teachers from each group and 30 students from each school, which summed up to the total number of the students to 120 students from the four schools therefore serve as the sample while the nine (9) schools in Minna servesas the total population for this research.The instrument used is a researcher designed physics achievement test (PAT).The content validity of this research instrument was verified by an educational technologist, three physics education lecturers in Science Education department of Federal University of technology to check for the appropriateness of the instrument in terms of content coverage, and objectives of the research. Data were collected and subjected to statistical analysis using mean, standard deviationsto answer the research questions while ANCOVA was used to test for the hypothesis at 0.05 level of significance.The result shows that students taught using scaffolding performed better compared to students taught using the lecture method. The use of scaffolding to teach physics students in senior secondary school had no significant effect on gender as related to students' performance. Recommendations were made such as, physics teachers should use scaffolding to enhance students' achievement. Seminar and workshops should be organized by federal and state ministries of education where teachers and student-teachers, and curriculum planners will be taught various scaffolding methods of teaching and learning in physics. Textbook authors should work with the curriculum planners to include constructive activities in physics textbooks. The state and federal ministries of education should also provide suitable environment by providing necessary facilities to carry out constructive teaching and learning processes.

Introduction

In view of previous studies the use of teaching strategy or methodology to enhance teaching and learning process has great significance or importance to students

learning outcome, it has been discovered that the use of instructional strategy vary from subject to subject as well as the content, the use of mono-teaching strategy may not yield the required result in terms of students performance. Multiple instructional strategies are often needed to sustain the student's interest, make learning interesting and enhance maximum understanding.The factors that influence change of strategy or instructional methodology ranges from nature of the course content, students responses and interest of the students. The conceptscaffolding houses multiple teaching methods such as lecture method, experimentation method, simulation and games method, demonstration method and group discussion method. It was discovered that physics teacher are not competent enough to make use of scaffolding in teaching and learning physics since, it involves interchangeably using various instructional strategies where and when necessary which give rise to low performance of students in physics in secondary school. In order to overcome the problem of low performance of secondary school students in physics, physics teachers should be expose to scaffolding methods and organize training, seminar and workshop to physics teachers to know the significance of scaffolding approaches as well as other science teachers. Science has been regarded as the bedrock of modern day technological breakthrough. Nowadays, countries all over the world, especially the developing ones like Nigeria, are striving hard to develop technologically and scientifically, since the world is turning Scientific and all proper functioning of lives depend greatly on science. The current method used in teaching physics is mostly the lecture method and demonstration methods which are not that effective to make students understand in concepts physics and therefore,the need for scaffolding approach to be used in teaching and learning of physics and other science subjects.

Learning is driven in the scaffolding approach (CLEs) by the problem to be solved that is, students solve problem and in the process learn contents and theory . This is different from traditional objectivist teaching where the contents and theory would be presented first and problem would be used afterwards to practice theory. Depending on students' prior experiences, related cases of such problems and scaffolding may be necessary for support in understanding physics concepts. Instructors also need to provide an authentic context for tasks, plus information resources, cognitive tools, and collaborative tools in teaching physics.In order to suppress the low performance of secondary school students in physics, physics teachers should be expose to scaffolding approach of teaching skills and organize training, seminar and workshop to physics teachers to know the significance of scaffolding teaching approach as well as other science teachers. The National Policy on Education stated that Physics can be taken as one of the 'cores' among science subjects that is, one of biology, chemistry, physics or health science (FRN 2009). Physics is regarded as the backbone of all technologies therefore it is the basis of all machine design and also all technological inventions. For example, advance study of electromagnetism or nuclear physics has led us to the development of new innovations such as television, computers, domestic appliances, and nuclear weapons, which have dramatically transformed modern-day society. Therefore the study of physics should be taken so serious and since this level is the foundation of the study of this subject therefore it is required that the foundation should

be laid so firmly so as to have a meaningful technological advancement in a nation. One major target for Physics education is the gaining of problem solving skills. Besides, Physics as one of the Science subjects, it remains one of the perceived most difficult subjects in the school curriculum according to the Nigeria Educational Research and Development Council (NERDC Isola, 2010). Poor academic achievement in Physics could be attributed to many factors among which teacher's strategy itself was considered as an important factor. This implies that the mastery of Physics concepts might not be fully achieved without the use of instructional strategy. The teaching of Physics without an effective strategy may certainly result in poor academic achievement. In Nigeria, Akinbobola (2008) affirmed that the changes in the aims and objectives of physics curriculum have not been accompanied by corresponding changes in the teachers' educational practices. Most physics education teachers are not versed on how to make their classroom a constructivist one to enhance learning.

Teachers need to have a sound understanding of what constructivism means so as to evaluate the learners and to use the strategy knowledgeably and effectively. Teachers' personal theories of learning have long been viewed as having considerable influence on virtually all aspects of teachers' decisions about instruction. Not only one's expectations for what learning outcomes are to be valued and sought, but also how one plans (i.e., organizes, structures and sequences) instruction is directly impacted by one's beliefs about learning. In addition, teachers' views of learning guide them as they make decisions about desirable means of implementing and assessing instruction. It is popular today to speak of paradigm shifts, and certainly major conceptual changes do occur in virtually all fields of study. Paradigm shifts bring new perspectives, new conceptualizations and new ways of thinking about a topic, large or small.

The objectives of secondary school Physics curriculum developed by the Federal Ministry of Education, in conjunction with Comparative Education Study and Adaptation Centre (FME & CESAC, 1985) are:

(a) To provide basic literacy in Physics and provide detailed explanations for the happenings around us
(b) To stimulate and enhance creativity.
(c) To acquire essential scientific skills and attitudes as a preparation for the technological application of Physics.
(d) To acquire basic concepts and principles of Physics as a preparation for further studies

In many African countries, however, the challenging fact is the lack of qualified teachers. This problem is further exacerbated by growing poverty and lack of funding for their salaries, and the exponential rise in student population in the last two decades (National Universities Commission, 2005). Traditionally, the question of whether students really learn the fundamental concepts of physics has been a thing of great worry which in most cases the answer to this question is a great call for attention and alarming.The importance given to 'mechanics' was revealed by WAEC chief examiner's report 2010, 2011, 2012, 2013 and 2014 respectively. More than fifty percent of the West African Examination Council (WAEC) questions are usually from mechanics (Adetona&Rafiu, 2009). Poor performance in physics were mainly on the concept of

Elasticity, conservation of Momentum, Kinetic theory, Simple Harmonic Motion, Projectile Motion, Surface Tension, Mechanical Energy and problem of simple mathematical computations were recorded from this aspect of physics.

Despite the important role of physics in any nation technological advancement the persistent poor performance record of students in physics is no longer a news as it kept on coming year in year out. An attempt to address this issue leaves traces of the teacher lacking that scaffolding approach to teaching which was supposed to form the basis of understanding for the learners.

Boyo and Akomolafe (2012) reported that physics is seen by students in the senior secondary school in Nigeria as a very difficult subject. It is perceived as a vast, abstract, mathematical and experimentally embedding almost most aspect of life science, living or non-living, ranging from chemistry, biology, mathematics and even to engineering. The external examination bodies in Nigeria such as West African Examination Council (WAEC) and National Examination Council (NECO) have reported consistently poor performances of students in physics. Boyo (2012) also claimed that reports have established some of the causes of great dismay in the performance of students in physics. Despite the great importance of physics to nation building, frequent failure is being recorded in students' performance in the subject in the various standard examination bodies all over the nation year-in year-out. Subsequently, this has led to loss of interest in the subject or better still created hatred in students on the subject. Research works have been carried out on the causes of failure in physics(Akinbobola,2008) and they came up with different opinions on factors which might be contributing to this problem. In spite of all the advantages derived and the recognition given to physics as one of the core science courses and as a pivot to technological and economic development, there are wider gaps between curriculum planner, the implementers, that is, physics classroom teachers and what goes on in the classroom. This has led to the perception of students that physics is a difficult subject and this perception of students has affected learners' interest and led to declining rate of students' achievement in physics in West African Senior Secondary School Certificate Examination (WASSSCE) and National Examinations Council (NECO) in Nigeria (Akinbobola, 2008). Hence, constructivism learning environment can be used to create and sustain students' interest and enhance their achievement in Physics? The physics teacher needs to be encouraged for frequent use of constructivism environment to enhance learning of physics in secondary schools. Based on the fore going the question remainsgermane, what will be the effect of scaffolding on the performance of senior secondary school students in physics in Minna metropolis?

Purpose of the Study

The aim of this research was to find out the effects of scaffolding on the achievement of senior secondary school students in physics in Minna metropolis, Nigeria. Specifically, the study determined to find out the:

1. Effects of scaffolding and conventional teaching method on students' learning outcome in physics.
2. Effect of scaffolding on male and female learning outcome in physics.

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Research Questions

The study established answers to the following research questions:

1 What are the mean achievement scores of senior secondary school students taught physics with scaffolding and conventional teaching methods?

2 What are the mean achievement scores of male and female senior secondary school students taught physics using scaffolding method?

Research Hypotheses

The following null hypothesis were formulated and tested at 0.05 level of significance.

1. There is no significant difference between the achievement mean score of senior secondary school students taught physics with scaffolding and those students taught with the conventional method?

2 There is no significant difference in the achievementmean score of male and female senior secondary school students taught physics with scaffolding method?

Methodology

The research is an experimental research design which focuses on teachers' use of scaffolding method to enhance learning outcome of students when taught using scaffolding and the usual conventional teaching method. The population of the study is the fifteen (15) senior secondary schools in Minna metropolis. The number of both private and public senior secondary schools in Minna is 15 out of which nine schools are government senior secondary and , six schools are private owned schools (a statistics obtained from the Niger State Ministry of Education). From the above statistics, the nine (9) government schools are the only relevant schools for theresearch. Simple random sampling techniques was used to sampled out four schools, two schools out of the four schools served as experimental group and the other two schools serves as control group for the research. There are one hundred and twenty five students from the four schools which serve as the sample sizefor the study. Two topics (vector representation and waves) have been selected and used in this research work. The choice of the selected topics was based on fundamental and reality reference of these two topics which form the basics of understanding physics concepts and the examiners reports of 2005 to 2015 shows that students in these schools performed below average.The instrument used is a researcher designed physics achievement test (PAT) .The validity of the research instrument was verified by an educational technologist, three physics education lecturers in Science Education department of Federal University of Technology Minna to check for the appropriateness of the instrument in terms of content coverage and objective of the research. Data were collected and subjected to statistical analysis using mean, standard deviationsto answer the research questions while ANCOVAwas used to test for the hypothesis at 0.05 level of significant. Kuder-Richerson KR_{21} was used and the reliability coefficient of the research instrument was obtained to be 0.87 which was considered high enough to justify the reliability of the instrument. Both the pretest and posttest data were collected and subjected to statistical

analysis using mean, standard deviations, and ANCOVA. This constituted necessary test for the twohypothesis and two questions raised in the study

RESULT

Research Question 1: What are the mean achievement scores of senior secondary school students taught physics using scaffolding and conventional teaching methods?

Table 1: Achievement Mean Scores and Standard deviation of Students taught with Scaffolding and those Students taught with Conventional Method.

		Pre-test		Post-test		
Groups	N	Mean	SD	Mean	SD	Mean Gain
Experimental	63	34.29	12.07	71.98	12.71	
Control	62	34.68	10.74	42.66	9.08	29.32

Table 1 shows the achievement mean scores of students who were taught with scaffolding (Experimental Group) and those students taught with conventional teaching methods (Control Group). Those who were taught with scaffolding had mean achievement score of 34.29 in the pre-test and 71.98 in the post-test on the other hand, those students who were taught with the conventional teaching method had mean achievement score of 34.68 in the pre-test and 42.66 in the post-test therefore, the mean gain from the post test scores of the two groups is 29.32 in favour of the experimental group. This result indicated that teaching physics with scaffolding might increase academic achievement of the students.

Research Question 2: What are the mean achievement scores of male and female senior secondary school students taught physics with scaffolding method?

Table 2: Mean Achievement Scores and Standard deviation of Male and Female Students taught with Scaffolding Method (Experimental

		Pretest			Posttest		
Group	**Sex**	**N**	**Mean**	**SD**	**Mean**	**SD**	Mean Gain
Experimental	Male	40	34.41	11.11	62.35	17.83	
	Female	23	34.42	12.53	56.57	18.97	5.78

Table **2** shows the mean achievement score of male and female students taught with scaffolding(experimental group) .The male students had mean achievement score of 34.41 in the pre-test and 62.35 in the post-test while the female students had mean achievement score of 34.42 in the pre-test and 56.57 in the post-test therefore the mean achievement gain of the female and male students is 5.78 in favour of the male

students. This shows that the achievement of the male students taught with scaffolding might be better enhanced as compared with the achievement of the female students.

Hypothesis One

1. There is no significant difference in the achievement mean score of senior secondary school students taught physics with scaffolding and those students taught with conventional methods?

Table 3: Summary of ANCOVA Table of Students Scores in the Physics Achievement Test (PAT) usingScaffolding and Conventional Strategies.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Remark
Corrected Model	27215.578[a]	4	6803.894	55.485	.000	S
Intercept	32529.726	1	32529.726	265.27	.000	S
Pretest	341.638	1	341.638	4	.098	NS
Treatment	21864.466	1	21864.466	2.786	.000	S
Gender	5.022	1	5.022	178.30	840	NS
Treatment *	1.430	1	1.430	1	.914	NS
Gender	14715.222	121	122.627	.841		
Error	454350.000	125		.012		
Total	41930.800	124				
Corrected Total						

S= Significant at 0.05 Probability level NS= Not Significant at 0.05 Probability level

Table 3 shows the value of the significance of F (178.301) on achievement is 0.000 compare to P≤0.05 alpha level already set at 1 degree of freedom. The null hypothesis of no significant difference is rejected. This means that there is a significant difference in the mean achievement scores of students taught with scaffolding and those students taught with conventional methods. Comparing table 1 and table 3 one can inferred that the use of scaffolding in teaching physics is a significant factor in the academic achievement of the students whencompared to conventional teaching method.

Hypothesis Two

2. There is no significant difference in the achievement mean score of male and female senior secondary school students taught physics with scaffolding method?

Table 4: Summary of ANCOVA Table ofMale and Female Students Scores in the Physics Achievement Test (PAT)) using Scaffolding.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Remark
Corrected Model	27215.578	4	6803.894	55.485	.000	S
Intercept	32529.726	1	32529.726	265.27	000	S
Pretest	341.638	1	321.638	4	.058	NS
Gender	4.022	1	4.022	2.606	.740	NS
Treatment * Gender	1.330	1	1.330	.741	.814	NS
Error	14715.222	59	122.627	.013		
Total	454350.000	63				
Corrected Total	41930.800	62				

S= Significant at 0.05 Probability level NS= Not Significant at 0.05 Probability level

Table 4 reveals that the value of significant of F (0.741) on the mean achievement score of students in the experimental group for gender is 0.740 against the level of $P \leq 0.05$ level for one degree of freedom. Since the value of F is higher than that of alpha set at $P \leq 0.05$, the null hypothesis of no significant difference in the mean achievement scores of male and female students taught with scaffolding is therefore accepted. This indicated that gender is not a significant factor in the achievement scores of students who were taught with scaffolding.

The major findings of this research are summarized based on the results of the analysis of data presented in this chapter.

1. The teacher's competency to inter-change teaching strategy (scaffolding) and effective teaching skills to enhance the student's achievement are sustained by using scaffolding teaching platform.
2. The students taught using scaffolding teaching method performed better in their academic achievement as compared to students taught using conventional teaching method.
3. The use of scaffolding to teach physics in senior secondary school has no significant difference on the gender as related to their academic achievement therefore this simply means that scaffolding method is gender friendly.

Discussions of Findings

In table 1 the experimental group in the post-test had a mean score of 71.98 this is higher than the means score of 42.66 for the control group (students taught with scaffolding and conventional methods). This shows that the scaffolding method used by the teacher in the experimental groupmight enhanced the achievement of students as compared to the conventional teaching method used (Control group).

In table 2 the mean achievement score of male and female in the experimental group in the post-test was 62.35 for male students and 56.57 for female students. The male mean post-test score is higher than the female post-test score. This shows that the

teaching of physics using scaffolding might improve the student's academic achievement. Also table 2 reveals that the gain achievement score is in the fovour of the experimental group. Table 3 revealed that there was significant difference in the achievement of students taught using the two methods which it could be inferred from table 1 and 3 that the significant is as a result of the scaffolding method t used. Table four shows that there was no significant difference in the achievement of male and female students when taught with scaffolding Thus students who were taught (Representation of Vector and Waves) using scaffolding achieved better than those taught using conventional teaching method.This implies that the instructional strategies used in teaching physics can affect the students learning outcome in terms of their academic achievement

Table 4 further confirm that gender is not a significant factor in students achievement in learning physics concept in a constructivism teaching platform. This shows that the right combination of instructional strategies can help both male and female students to benefit equally. Constructivism teaching method is gender friendly as such it bridge the gap between male and female students performance in physics.

Conclusion

The following conclusions are made based on the findings of this study. The result of this research provided empirical evidence that the use of scaffolding enhance students academics achievement in physics more than the use of conventional teaching classroom. The use of scaffolding in teaching physics is better than teaching physics using conventional method of teaching.

Male and female students who were taught using scaffolding performed higher than their counterpart that were taught using the conventional teaching method. In general, the use of scaffolding proved to be viable in enhancing meaningful teaching and learning of physics.

The result of this study has some obvious implications to the teachers in the sense that teachers will now know that using scaffolding is better than using conventional teaching method. Teachers should therefore apply this knowledge from the findings of this work in their teachings especially now that the world is technologically advancing teachers should keep themselves abreast to the modern trend of teaching.

Since the efficacy of the use of scaffolding has been indicated by this study, states and federal ministries of education should organize seminars and workshops for teachers and student-teachers where teachers and student-teachers text-book authors and curriculum planners will be taught various skills of operating scaffolding method of teaching in their various aspect of learning process for effective teaching and learning of physics. These textbook authors should design the activities and exercises in the text book in that will clearly spelled out the different strategies that can be applied in a scaffolding method of teaching such that the student- teacher and the teachers in science education implementing the teaching exercise will be able to construct new knowledge at the end.

The result of this study also calls for a critical review of the secondary school physics curriculum with emphasis in the use of scaffolding. Time allocated for teaching

physics should be increased and provide enabling environment. It could also provide an optimum instructional strategy that could be employed by teachers to enhance gender equality in physics performance. Furthermore the findings of this study can serve as reference point for other researchers.

The following recommendations were made based on the findings of this study.

1 Since the use of constructivism teaching environment enhances the performance in physics lesson, the physics teachers should use it as one of the optimum teaching strategies to be employed in Physics classroom.

2. Seminar and workshops should be organized by state and federal ministries of education where teachers and student-teachers, textbook authors and curriculum planners will be taught various competence skills to operate a constructivism teaching and learning method in physics. These textbook authors should work with the curriculum planners to include scaffolding activities in the physics textbooks. The state and federal ministries of education should also provide suitable environment by providing necessary facilities to carry out scaffolding teaching and learning processes.

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