

## Effects of scaffolding teaching strategy on students' academic performance in secondary school physics in ekiti state for creativity and economic development

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### Abstract

The study investigated the effects of scaffolding teaching strategy on students' academic performance in Senior Secondary School Physics in Ekiti State, Nigeria for creativity and Economic Development. The research design adopted in the study was Pretest-Posttest Quasi-experimental. The sample for the study was 120 Senior Secondary One (SSI) Physics students, selected through the multistage sampling technique from a total population of 5,723 SS I students offering Physics in all the 184 public Senior Secondary Schools in Ekiti State. The instrument used to collect relevant data from the subjects was tagged: Physics Achievement Test (PAT) and the treatment package used for the study was tagged: Scaffolding Instructional Package (SIP). The reliability of the instrument was determined through the split-half method with the reliability coefficient of 0.83. Three null hypotheses were tested at 0.05 level of significance. The data collected were analysed using t-test and Analysis of Covariance (ANCOVA) statistical analysis. The results of the analyses showed that there was significant difference in the academic performance of students in Physics in the experimental and control groups in favour of experimental group. Based on the findings of the study, it was concluded that scaffolding teaching strategy is more potent in boosting students' performance in Physics in secondary schools than the conventional method in vogue in the nation and it was recommended that the conventional method presently in use by Physics teachers should either be improved upon, modified or replaced with an activity- based teaching approach (as appropriate).

**Keywords:** scaffolding, teaching strategy, scaffolding teaching strategy, academic performance

## Introduction

Science is regarded as a foundation upon which the bulk of the present technological breakthrough is built. Science education plays a vital role in the lives of individuals and development of a nation scientifically and technologically (Alebiosu & Ifamuyiwa, 2008) cited by Oludipe (2011).

Creativity is the use of imagination or original ideas to create something. Creativity is the act of turning new and imaginative ideas into reality. Creativity is characterized by the ability to perceive the world in new ways, to find hidden patterns, to make connections between seemingly unrelated phenomena, and to generate solutions.

Studies in science education points to the fact that “creativity in school, science is at a much lower level than is required even to begin approaching an answer” (Kind & Kind, 2007). Moreover, research based on the life stories of scientists (e.g., Einstein, Maxwell, Faraday, Watts, Feynman) questions the development of students’ imaginative skills by formal schooling. For as Shepard (1988) has pointed out, “ their development occurs before, outside of or perhaps in spite of such schooling-apparently through active but largely solitary interaction with physical objects of one’s world”. All these make the development of students’ creativity a real challenge. This challenge becomes even greater if we consider the fact that creativity is grounded in knowledge, and therefore science teachers should help students build content knowledge, but “without killing the creativity” (Boden, 2001).

The teaching- learning process is as old as human being on the earth. It has been carried out by human beings and even by animals, to teach their young ones for successful adjustment to existing conditions in their environments (Owoeye, 2015). Teaching as conventionally understood by the traditional teacher, is just the act of disseminating information to learners in the classroom. An observation of the traditional classroom teaching reveals that either the teacher is delivering information, or one of the students is reading from the text book and other students are silently following him in their own text books. Conventional teaching is simply chalk-talk approach in which students remain passive as learners. Instruction is not properly organized and rote learning is

heavily emphasized. Mostly, the results of the students are not satisfactory due to the use of this approach.

Instruction in science is aimed at achieving two goals: the first is the acquisition of the body of organized knowledge in a particular domain, and the second important goal in science instruction is the ability to solve problems in that domain (Nwagbo, 2007).

Instructional scaffolding is the provision of sufficient support to promote learning when concepts and skills are being first introduced to students. These supports may include the following: resources, a compelling task, templates and guides and guidance on the development of cognitive and social skills (online Wikipedia, 2018). These supports are gradually removed as students developed autonomous learning strategies, thus promoting their own cognitive, affective and psychomotor learning skills and knowledge. Teachers help the student master a task or a concept by providing support. The support can take many forms such as outlines, recommended documents, storyboards, or key questions.

Moreover, Keith (2006) also defines Instructional scaffolding as a learning process designed to promote a deeper level of learning. Scaffolding is the support given during the learning process which is tailored to the needs of the student with the intention of helping the student achieves his/her learning goals. Similarly, Vanderbilt University (2016) defines Instructional Scaffolding as a process through which a teacher adds supports for students in order to enhance learning and aid in mastery of tasks. The teacher does this by systematically building on students' experiences and knowledge as they are learning new skills.

According to Van de Pol, Volman, Monique & Bershuizen (2010), instructional scaffolding can be thought of as strategies that a teacher uses to help learners bridge a cognitive gap or progress in their learning to a level they were previously unable to accomplish. Scaffolding refers to a variety of instructional techniques used to move students progressively toward stronger understanding and, ultimately, greater independence in the learning process (online scaffolding, 2018). Lipscomb & West (2004) opined that scaffolding is a natural approach to ensure the learning of the

student. The teacher therefore offers assistance with only those skills that are beyond the students' capacity.

Instructional scaffolding strategy emphasizes on the role of teachers and others in supporting the learner development and providing support structures to get to that next stage or level (Raymond, 2000). According to Raymond (2000) Instructional scaffolding teaching strategy originated from Lev Vygotsky socio-cultural and his concept of the zone of proximal development (ZPD). This socio-cultural theory spelt out that social interaction plays an important role in the development of cognition. He believes that learning occurs through participation in social or culturally embedded experiences. In his views, the learner does not learn in isolation, rather learning is strongly influenced by social interactions, which takes place in meaningful contexts. Children social interaction with more knowledgeable or capable people and their environment significantly affect their ways of thinking and interpreting situations. The second foundation for instructional scaffolding is Vygotsky concept of the zone of proximal development (ZPD). The ZPD is that area between what a learner can do independently (Mastery level) and what can be accomplished with the assistance of a competent adult or peer (instructional level). He believes that any child could be taught any subject effectively using instructional scaffolding techniques by applying the scaffolds at the ZPD.

In general, scaffolding is construed as support given by a teacher to a student when performing a task that the student might otherwise not able to accomplish. First common characteristic in the various definitions of scaffolding is contingency; often referred to as responsiveness, tailored, adjusted, differentiated, titrated or calibrated support. The teachers' support must be to the current level of the students' performance and should either be at the same or a slightly higher level. A teacher acts contingently when he/she adapts the support in the way or another to a (group of) student(s). A tool for contingency is diagnostic strategies, to provide contingent support, that is one must first determine the students' current level of competence. Only with such knowledge can the support to be provided be adapted to the students' level of learning (i.e. made contingent). Many authors have acknowledged the importance of diagnosis in relation to scaffolding and were referred to as: dynamic assessment (Lajoie, 2005).

Alake and Ogunseemi (2013) cited Verhagen & Collins (1996) that scaffolding is described as a temporary support made available for students' learning until the students can perform independently of that support. Scaffolding can be seen as a temporary framework that supports a building under construction. When the structure is strong enough to stand on its own, the scaffolds are removed.

Robinson & Daniel (2017) in their study on the effect of instructional scaffolding on academic performance of students in financial Accounting in secondary schools in Delta State found out that there is no significant difference between the mean academic performance of male and female students exposed to scaffolding method of teaching. Secondly, they also found out that there is significant difference between the mean performance of students taught financial accounting using scaffolding method of teaching and those taught with traditional methods of teaching.

Similarly, According to Alake & Ogunseemi (2013) there is significance difference between the groups from the mean scores. Students exposed to scaffolding method of teaching perform better than their counterparts who were exposed to conventional teaching method.

Moreover, Mohammed (2016) also affirmed that significant difference exist between the mean performance score on peace education between students' taught using scaffolding strategy and those taught using conventional teaching approach in College of Education.

Robinson & Daniel (2017) affirmed that instructional scaffolding can be thought of as the strategies that a teacher uses to help learners bridge a cognitive gap or process in their learning to a level they were previously unable to accomplish. These strategies evolve as the teachers evaluate the learners initial level of ability and then through continued feedback throughout the progression of the task. In the early studies, scaffolding was primarily done in oral, face-to-face learning environments. In classrooms, scaffolding may include modeling behavior's, coaching and prompting, thinking out loud, dialogue with questions and answers, planned and spontaneous discussions, as well as other interactive planning or structural assistance to help the learner bridge a cognitive gap. This can also include peer mentoring from more experienced students. The

contemporary scaffolding provided by the teacher is removed as soon as the students internalize the content and or process and are competent to assume a full responsibility for controlling the process of a given task.

Physics is among the three major pillars of science (i.e. Physics, Chemistry and Biology). The importance of Physics for the development of a nation is, therefore, glaring. Physics is the most basic of the sciences and its concepts and techniques underpin the understanding of other disciplines: A thorough understanding of mechanics is necessary to the chemists and the material scientists since the structure of every atom in the universe is determined by mechanics.

Physics is also a cross-cutting discipline that has applications in many sectors of economic development, including health, agriculture, water energy and information technology (Macmillan, 2012). There is no doubt that a good part of the scientific knowledge is derived from the principles of Physics. Indeed, the knowledge of Physics has led to so many inventions such as the production, application and utilization of integrated circuits, production and use of machines and other contrivances. It also accounts for the discovery and production of hydroelectric power, gas turbine and thermonuclear power plant, telephones, refrigerators, heaters and gas/electric cookers. Physics is an important science subject that makes immense academic demands on students in its learning (Sunday, 2010).

A number of factors have been identified a militating against students' attainment of the objectives of science instruction, and the most pronounced factor identified by researchers is the inappropriate and uninspiring teaching methods adopted by science teachers (Ali,2015). According to Ogunleye & Babajide (2011), Nigeria has witnessed persistent poor students' performance in Physics at the senior school certificate level. This has been linked to the adoption of instructional strategies which did not give enough consideration to learners' previous knowledge and how they reasoned in order for learners to construct their knowledge based on these. Similarly, Achufusi (2015) the ignorance of teachers and neglect of activity oriented methods by teachers grossly contributed to students' low performance in Physics.

Therefore, this study is intends to examine the Science Education for Creativity and Economic Development: Effects of Scaffolding Teaching Strategy on Students' academic Performance in Secondary School Physics in Ekiti State, Nigeria.

### Research hypotheses

The following null hypotheses were formulated to guide the study:

1. There is no significant difference in the achievement mean scores of students in experimental and control groups before treatment.
2. There is no significant difference in the achievement mean scores of students in experimental and control groups after treatment.
3. There is no significant difference in the achievement mean scores of male and female students in each of the experimental and control groups.

### Methodology

The design for this study was Pretest-Posttest Quasi-Experimental. The design afforded the researcher the opportunity to collect relevant data which helped to facilitate better understanding and evaluation of the problem under study. The pre-test was used to establish the knowledge baseline of the students as well as the academic homogeneity of the two groups before the commencement of the experiment. The post-test was used to determine the levels of academic performance of students within the two groups after the application of treatment.

The population of the study was made up of all senior secondary student class One (SS1) in Ekiti West Local Government Area of Ekiti State. Purposive and stratified random sampling techniques was used to select a total sample of 100 public senior secondary class one (SS I) Physics students (this sample was divided into the experimental and control groups in ratio 1:1 meaning that, 50 students from each group) from four senior secondary schools in Ekiti West Local Government Area, Ekiti State. The instrument used for the study was thirty (30) standardized objective questions tagged: 'Physics Achievement Test (PAT)' drawn from the topic (causes of motion, concepts associated with motion in straight line, parameters and equation of motion) with four options (A-D) considered for the study.

The teaching covered three weeks with the control group taught using conventional method while the experimental group was taught using Scaffolding teaching strategy. The tests (Pretest and Posttest) questions were administered to students; each of the tests was marked and scored accordingly.

The three formulated null hypotheses were tested at 0.05 level of significance. The data collected were analysed using inferential statistics of t-test analysis.

## Results and Discussion

### Hypothesis 1

There is no significant difference in the achievement mean scores of students in experimental and control groups before treatment.

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

GROUP	N	$\bar{X}$	SD	df	$t_{cal}$	$t_{tab}$	Result
Experimental	50	13.45	7.56	98	0.408	1.671	NS
Control	50	12.78	8.78				

**$P > 0.05$  (Result Not significant at 0.05 level), NS = Not Significant.**

As shown in table 1, when the mean score of students in the experimental and control groups before the treatments (pre-test) were statistically compared, a *t-value* ( $t_{cal} = 0.408$ ) with  $p > 0.05$  alpha level was obtained, which was not significant at 0.05 level. This implies that there is no significant difference between experimental and control groups in pretest achievement mean score. Consequently, the null hypothesis which states that there is no significant difference in the achievement mean scores of students in experimental and control groups before treatment was accepted.

### Hypothesis 2

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

**Table 2 : t-test analysis of achievement mean scores of students in experimental and control groups after treatment**

GROUP	N	$\bar{X}$	SD	df	$t_{cal}$	$t_{tab}$	Result
Experimental	50	23.63	8.65	98	4.93	1.65	*
Control	50	16.159	6.38				

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

As shown in table 2, when the mean score of students in the control and experimental groups after the treatments (posttest) were statistically compared, a *t-value* ( $t_{cal} = 4.93$ ) with  $P < 0.05$  alpha level was obtained, which was significant at 0.05 level. This implies that there exists significant difference between the control and experimental groups achievement mean scores after the treatment in favour of experimental group. Consequently, the null hypothesis which states that there is no significant difference in the achievement mean scores of students in experimental and control groups after treatment was rejected. As such, the conventional method of instruction (control group) can be said to be less effective compared with scaffolding teaching strategy (experimental group).

### Hypothesis 3

There is no significant difference in the achievement mean scores of male and female students in each of the experimental and control groups.

**Table 3: Summary of ANCOVA analysis on the achievement mean scores of male and female students in each of the experimental and control groups**

Source of variation	SS	df	Ms	F <sub>cal</sub>	F <sub>tab</sub>	P	Result
Corrected model	1562.188 <sup>a</sup>	4	420.549	49.68	2.42	0.000	
Covariate (pretest)	22.446	1	22.446	2.65	3.89	0.106	
Gender	.860	1	.860	0.10	3.89	0.750	NS
Group	1523.497	1	1523.497	191.77	3.89	0.000	*
Gender *Group	12.823	1	12.823	1.40	3.75	0.239	NS
Error	1326.441	94	8.466				
Corrected Total	2875.450	99					
Total	52705.000	100					

P > 0.05 (Result Not significant at 0.05 level), NS = Not Significant, and \* = Significant

Table 3 showed that the computed *F-value* ( $F_{cal} = 0.10 < F_{tab} = 3.89$ ) with a *P-value* ( $P > 0.05$  alpha level) obtained from the analysis of the students' gender was not significant. Hence, the mean achievement scores of male and female students were not significantly different. The table also revealed that the compared *F-value* ( $F_{cal} = 1.40 < F_{tab} = 3.75$ ) with a *P-value* ( $P > 0.05$  alpha level) obtained for the interaction of gender and group was not significant as well. The null hypothesis was thus not rejected. It, therefore, implies that there is no significant interaction between gender of students and scaffolding teaching strategy applied. In other words, gender of students has no significant influence on either the effectiveness (or otherwise) of the approach of instruction applied.

## Discussion

The result of this study revealed that the pre-test mean scores of the students in the scaffolding teaching strategy was not significantly different from that of those exposed to conventional method. The implication of this is that the two groups involved in the study exhibited comparable characteristics. Thus, they both entered the instructional experiment on equal strength and ability which showed that the two groups were

suitable for the study when comparing scaffolding teaching strategy with conventional method on achievement in Physics.

Furthermore, the result of the study also revealed a relative increase in the post-test mean score of the students in the scaffolding teaching strategy group over those taught with the conventional method. Thus confirmed that scaffolding teaching strategies are learner-centered and capable of making remarkable impact on instructional practices. This result agrees with the findings of Alake & Ogunseemi (2013) that students exposed to scaffolding method of teaching performs better than their counterparts who were exposed to conventional teaching method. Similarly, Mohammed (2013) also affirmed that significant difference exist between the mean performance score on peace education between students' taught using scaffolding strategy and those taught using conventional teaching approach in College of Education.

Moreover the findings of this study also revealed that: There was no significant difference in the achievement means scores of male and female students in each of the experimental and control groups before and after the treatment. In other words, the achievement of male and female students exposed to scaffolding teaching strategy did not differ significantly as female students were found to have similar achievement in Physics as their male counterparts in the two groups involved in the study. The implication of this result is that gender was not a significant predictor of students' achievement in Physics. The finding agrees with the findings of Robinson & Daniel (2017) that there is no significant difference between the mean academic performance of male and female students exposed to scaffolding method of teaching.

## Conclusion

Based on the findings of this study, it can be concluded that scaffolding teaching strategy is more potent in improving students' academic performance in Physics in secondary schools than conventional method in vogue in the nation in term of performance and retention.

The study however found no significant difference between academic performance of male and female students in Physics when scaffolding teaching was used as strategy of instruction. This simply implies that performance of students taught using different teaching strategies is not in any manner affected by either their gender.

## Recommendations

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

1. Scaffolding teaching strategy assessment should be practically applied to classroom situations. Teachers should use scaffolding strategy to arouse the interest of their students in Physics teaching. They should be trained and encourage to use scaffolding teaching strategy.
2. Principals of secondary schools should encourage their Physics teachers through sponsorship to attend refresher courses and other forms of in-service training to enable them acquire the needed skill that can help them use or apply different strategies in the classroom teaching and learning. Thus help eradicate mediocrity among Physics teachers and expose them to a wide range of methods which can enhance their teaching in classroom situation.
3. Authors of Physics textbooks should present the content and concepts alongside the worked examples using scaffolding strategy.

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