Effects of Scaffolding teaching strategy on Students' academic achievement in Secondary School Chemistry in Ekiti State, Nigeria

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***Abstract*: The study examined the effects of scaffolding teaching strategy on students' academic achievement in Senior Secondary School Chemistry in Ado Local Government Area, Ekiti State, Nigeria. The research design adopted in the study was Pre-test Post-test Quasi-experimental. The sample for the study was 130 Senior Secondary One (SSI) Chemistry students, selected through the multistage sampling technique in public Senior Secondary Schools in Ado Local Government Area, Ekiti State. The instrument used to collect relevant data from the subjects was tagged: Chemistry Achievement Test (CAT) and the treatment package used for the study was tagged: Chemistry Scaffolding Instructional Package (CSIP). The reliability of the instrument was determined through the split-half method with the reliability coefficient of 0.86. 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 analysis revealed that there was significant difference in the academic performance of students in Chemistry 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 Chemistry in secondary schools than the conventional method in practice in the nation schools 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 achievement**

Introduction

Science is a universal subject that spans the branch of knowledge that examines the structure and behavior of the physical and natural world through observation and experiment. Science education is most commonly broken down into the following three fields: Biology, Chemistry, and Physics (online: science subjects in secondary schools, 2020). Chemistry Education plays important role in enhancing the quality of teaching and research as well as ensuring that students are equipped with good knowledge to produce intensive goods and services to meet human needs for food, health care products and other materials aimed at improving the quality of life (online: importance of Chemistry in Education, 2014).

Chemistry is the study of matter, its properties, how and why substances combine or separate to form other substances, and how substances interact with energy. Understanding basic chemistry concepts is important for almost every profession. Chemistry is very helpful in improving the health of human beings by providing Antibiotics, Pain killers, penicillin, tetracycline etc. it has provided us with vitamins, enzymes, minerals and Anesthesia (chloform, formalin etc.) (online: reason for study chemistry, 2018). 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). According to Omoniyi & Torru (2018) several teaching methods can be used to teach chemistry in which scaffolding represents one of them.

Instructional scaffolding is the support given to a student by an instructor throughout the learning process. This support is specifically tailored to each student; this instructional approach allows students to experience student-centered learning, which tends to facilitate more efficient learning than teacher-centered learning (Sawyer, 2006). This learning process promotes a deeper level of learning than many other common teaching strategies.

Instructional scaffolding provides sufficient support to promote learning when concepts and skills are being first introduced to students. These supports may include resource, compelling task, templates and guides, and/or guidance on the development of cognitive and social skills. Instructional scaffolding could be employed through modeling a task, giving advice, and/or providing coaching (Online: instructional scaffolding, 2020).

According to Palincsar (1986), the support and guidance provided to the learner is compared to the scaffolds in building construction where the scaffolds provide both "adjustable and temporal" support to the building under construction. The support and guidance provided to learners facilitate internationalization of the knowledge needed to complete the task. This support is weaned gradually until the learner is independent (Palincsar, 1986). These supports are gradually removed as students develop autonomous learning strategies, thus promoting their own cognitive, affective and psychomotor learning skills and knowledge. Teachers help the students master a task or a concept by providing support. The support can take many forms such as outlines, recommended documents, storyboards, or key questions.

Andrianes (2013) in Omoniyi & Torru (2018) defines educational scaffolding as a teaching method that enables students to solve a problem, carryout a task or achieve a goal through a gradual shedding of outside assistance. In education, scaffolding refers to variety of instructional techniques used to move a student progressively toward stronger understanding and, ultimately, greater independence in the learning process (Omoniyi & Torru, 2018).

According to Raymond (2000) cited in Awodun (2019) 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. This 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 (Awodun, 2019).

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).

Awodun (2019) cited Robinson & Daniel 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.

Moreover, Mohammed (2013) cited in Awodun (2019) 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.

Robinso & Danie cited in Awodun (2019) 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 (Awodun, 2019).

The general desire to improve teaching performance and student's academic performance in sciences (particularly, chemistry) should be a concern of all stakeholders in education in Nigeria. Therefore, this study is intends to examine the effects of Scaffolding Teaching Strategy on Students' academic achievement in Secondary School Chemistry in Ado Local Government Area, Ekiti State, Nigeria.

Research hypotheses

Three hypotheses were formulated and tested at 0.05 level of significance.

H_{01}: There is no significant difference in the achievement mean scores of students in experimental and control groups before treatment.

H_{02}: There is no significant difference in the achievement mean scores of students in experimental and control groups after treatment.

H_{03}: 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 Pre-test Post-test 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 population of the study was made up of all senior secondary student class One (SS1) in Ado Local Government Area of Ekiti State. Purposive and stratified random sampling techniques was used to select a total sample of 130 public senior secondary class one (SS I) Chemistry students (this sample was divided into the experimental and control groups in ratio 1:1 meaning that, 65 students from each group) from two Senior Secondary Schools in Ado Local Government Area, Ekiti State. The instrument used for the study was Twenty six (26) standardized objective questions tagged: Chemistry Achievement Test (CAT) drawn from the topic (Atomic structure and stoichiometry) 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 (Pre-test and Post-test) 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 and analysis of Covariance (ANCOVA).

Results and Discussion

Hypothesis H_{01}

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	Mean	SD	df	t_{cal}	t_{tab}	Result
Control	65	12.15	7.26	128	0.384	1.658	**
Experimental	65	11.68	6.69				

P > 0.05 (Result Not significant at 0.05 level), ** = 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} = 0.384) 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 upheld.

Hypothesis H_{02}

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	Mean	SD	df	t_{cal}	t_{tab}	Result
Control	65	13.16	6.94	128	5.316	1.658	*
Experimental	65	20.81	9.28				

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} = 5.316) 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 H_{03}

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: ANCOVA showing analysis on the achievement mean scores students in each of the experimental and control groups by gender

Source	SS	df	MS	F_{cal}	F_{tab}
Corrected Model	735.980	4	183.995	37.249	2.45
pretest Achievement	1.051	1	1.051	.213	3.92
Gender	.153	1	.153	.031	3.92
Group	620.256	1	620.256	125.569	3.92
Gender * Group	1.916	1	1.916	.388	3.92
Error	533.471	108	4.940		
Corrected Total	1269.451	112			
Total	69564.000	113			

P > 0.05 (Result Not significant at 0.05 level)

Table 3 showed that the computed F-value ($\mathbf{F_{cal}} = 0.031 < \mathbf{F_{tab}} = 3.92$) 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 ($\mathbf{F_{cal}} = 0.388 < \mathbf{F_{tab}} = 3.92$) 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 were homogenious. 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 Chemistry.

Furthermore, the result of the study also revealed a relative increase in the post-test mean score of the students in the experimental group over those taught with the control group. Thus confirmed that scaffolding teaching strategies are learner-centered and capable of making remarkable impart on instructional practices. This result agrees with the findings of Awodun (2019) that students exposed to scaffolding method of teaching performs better than their counterparts who were exposed to conventional teaching method. Similarly, Mohammed (2013) cited in Awodun (2019) 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 mean 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 chemistry 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 chemistry. The finding agrees with the findings of Robinson and Daniel (2017) cited in Awodun (2019) that there is no significant difference between the mean academic performance of male and female students exposed to scaffolding teaching strategy.

Conclusion

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

The study however found no significant difference between academic performance of male and female students in chemistry when scaffolding teaching strategy was used. 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 chemistry teaching. They should be trained and encourage to use scaffolding teaching strategy.
2. Authors of chemistry textbooks should present the content and concepts alongside the worked examples using scaffolding strategy.
3. Government should encourage their chemistry 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 chemistry teachers and expose them to a wide range of methods which can enhance their teaching in classroom situation.

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