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Effects of Scaffolding Teaching Strategy on Students' Performance in Chemistry in Secondary Schools in Ondo State, Nigeria

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ABSTRACT

The study identified Addition Reaction of Unsaturated Organic Compounds in ordinary Level West African Secondary School Certificate (WASSC) Chemistry syllabus, and examined the effects of scaffolding teaching strategy on students' performance in chemistry. The study adopted pre-test post-test experimental design with lecture method as the control group. The sample consisted of 77 participants selected from two Senior Secondary School II Students in Akoko North East Local Government Area of Ondo State. Two intact classes were classified into experimental group Scaffolding (SF=42) and control group, lecture method (LM=35). A 20 item instrument tagged Addition Reaction of Unsaturated Hydrocarbon Achievement Test (ARUHAT) was developed by the researcher and ascertained for reliability (r=0.78, p<0.05). The study was guided by two hypotheses. Data collected were analysed using t-test. The result showed that there was a significant difference in the effectiveness of SF and students' performance in chemistry (t=0.043), p<0.05. Furthermore, SF was found to be more effective (X=13.01) than lecture method (X =10.43). The study concluded that scaffolding is an effective method of teaching chemistry concepts in general and concepts involving building of models in particular.

Keywords: Scaffolding, students' performance, effects, teaching strategy.

INTRODUCTION

Students' poor performance in chemistry at various levels of education has been an issue of concern over the years to stakeholders. For instance, some of the reasons attributed to poor performance in chemistry as a subject by scholars include lack of frequent practice, poor mathematical background, inadequate and poor method of teaching (Omoniyi, 2016). Hence, scholars are making a paradigm shift from what is generally believed to be a conventional method of teaching to an entirely different approach that is activity – based and interactive.

Novak and Cavas (2008) observed that knowledge is actively constructed by the learner on the grounds of constructs already available to him/her in the mind. A key factor in the teaching and learning process derived from teacher related factors is the strategies used in imparting knowledge to the learner. According to Onwuka (1990), knowledge of available techniques is a valuable asset towards effective teaching. Generally, success in teaching depends to a large extent on the appropriate selection and application of a teaching strategy from each subject matter.

Also, Achumugu (2013), Ali (2008), Njoku (2009) stated that a major factor for effective learning to take place is the use of interesting instructional approach that enables participation

of students in the teaching / learning process. Ajeyalehin and Owoyemi (2014), and Omoniyi (2017), have subjected a shift from the conventional method of teaching chemistry to some innovative and activity-based instructional strategies to ensure improvements in students' interest and achievement in the subject.

Several teaching methods can be used to teach chemistry in which scaffolding represents one of them. The metaphor of scaffolding is derived from construction work where it represents a temporary structure that is used to erect a building. In education, scaffolding refers to support that is tailored towards students' needs. The metaphor is alluring to practice as it appeals to teachers' imagination Saban (2007). Scaffolding is derived from mother-child observations and has been applied to many other contexts, such as computer education (Azevedo & Hadwin, 2005). The term is used to describe certain kinds of support which learners receive in their interaction with parents, teachers, and other 'mentors' as they move new skills, concepts or levels of understanding. It is a term which helps to portray the temporary, but essential nature of the mentors' assistance as the learner advances in knowledge and understanding. Andrianes (2013) defines educational scaffolding as a teaching method that enables student to solve a problem, carry out a task or achieve a goal through a gradual shedding of outside assistance. In education, scaffolding refers to a variety of instructional techniques used to move a student progressively toward stronger understanding and, ultimately, greater independence in the learning process.

THEORETICAL FRAMEWORK OF SCAFFOLDING

Jerome Brunner- a cognitive psychologist, created a theory of development. On this premise, Bruner and Jean Piaget agreed on several components of learning. Brunner as a constructivist, his major theme is that learning is an active process in which learners construct new ideas or concepts based upon their past or current knowledge.

Bruner's constructivist theory suggests that it is effective when faced with new materials to follow a progression from enactive to iconic to symbolic representation, this holds true even for adult learners. Hence, the concept of Addition Reaction of Unsaturated Hydrocarbons could be effectively taught based on this theory.

STATEMENT OF THE PROBLEM

Chemistry as a subject, virtually affects all aspects of human life and it is a basic requirement for admission for nearly all the courses of study in tertiary institutions. National Policy on Education has also placed it on a prestigious position as a servicing subject to engineering, Medicine and Computer Science courses in the universities. Nevertheless, the subject has not attained students' performance at its best especially in external examination such as West African School Certificate Examination (WASCE) and National Examination Council (NECO). It appears that the teaching method may be one of the factors responsible for this. The conventional lecture method being used to teach chemistry students is not learner- centered; hence, students become passive and have less interaction with one another. Therefore, to teach chemistry effectively, there is the need for classrooms' shift from teacher centered teaching strategy to student- centered teaching strategy such as Scaffolding in order to improve students' performance in chemistry concept- for example Addition reaction of unsaturated hydrocarbon which involves building of models. In scaffolding instructional package, the more the students practice the building of the models, the easier it is to master the basic facts.

To guide the study, two hypotheses were formulated namely;

1. There is no significant difference in the pre-test scores of students on the selected chemistry concept-Addition Reaction of Unsaturated Hydrocarbons.

2. There is no significant difference between the academic performance of students exposed to scaffolding and lecture method after treatment.

METHOD

The study adopted a pre-test, post-test control group design. The population for the study consisted of students offering chemistry in Senior Secondary II in the 22 secondary schools located in Akoko North East Local Government Area of Ondo State. From these, two schools were randomly selected and from which two SSII science classes were selected. A total of 77 students participated in the study. The period of administration of the treatment was five weeks. The concept chosen is Addition Reaction of Unsaturated Hydrocarbons which is taught under Organic Chemistry in the SSS chemistry curriculum.

Instrument and Administration

The instrument used for the study was Addition Reaction of Unsaturated Hydrocarbons Achievement Test (ARUHAT) which consisted of 20 questions (10 objectives, 5 short-structured question and 5 questions involving skills). The questions were given to university and secondary school chemistry teachers to vet. This was to ensure content validity and suitability of the instrument for the study. The instrument had a test-retest reliability coefficient of 0.78.

Procedure for the Study

From the researchers' experience as a chemistry teacher in secondary school in Ondo State for many years, and her interaction with students in form of informal interview; Addition Reaction of Unsaturated Hydrocarbons was chosen as the topic to be taught using scaffolding instructional package because of the structures of the organic compounds that would require building of models.

Next, the ARUHAT was administered on the experimental and control groups in their respective schools separately in the second weeks of the study to obtain the pre-test scores. Thereafter, the experimental group was exposed to treatment in scaffolding teaching strategy while the control group was exposed to the traditional lecture method. The two groups were taught separately by the researcher for a period of three weeks after which the post-test was administered.

Method of Instruction

Instruction was activity and discussion oriented where students were allowed to construct models for themselves. It is important for teachers to provide opportunities for students to constantly learn new things. Some of those may be complex and will require support of a very focused teacher. Teachers need to be aware of the developmental state of each of the students they teach, and should provide scaffolding that is appropriate. Although, this may not be possible to do on their own, teachers can improvise and provide scaffolding through other support, including the use of teaching assistants who are more knowledgeable.

As students gain in confidence and competence in a particular area, teachers could place them in groups so that the good ones can extend their competence / knowledge to other students. It is also important that teachers recognize when a child is at the point where they begin to learn independently, and decisions can be made on how to construct more scaffolding. (Wood, D. J, Brunner, J. S & Ros, G. 1976).

STEP I

Examples of unsaturated hydrocarbons were given to students e.g ethene with the structure $CH_2= CH_2$

Structure of alkene is written as C = C

Step II

Students were asked to construct the scaffolding for this structure as an unsaturated compound

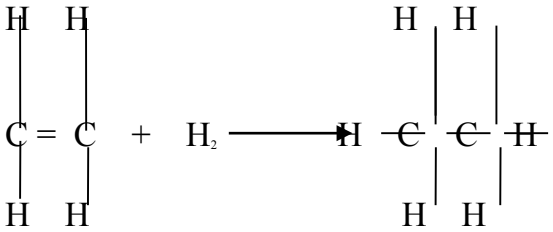
Step III

Models of Hydrogen as a molecular compound (H_2) H-H was given to the students

STEP IV

Students were required to construct scaffolding by addition reaction of H_2 with ethene ($CH_2=CH_2$)

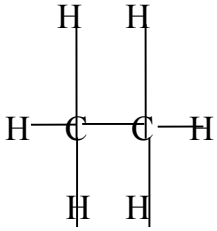
Equation



Ethene **Ethane**

Step V

Students constructs a new model of a saturated hydrocarbon from unsaturated compound. A new saturated compound ethane (C_2H_6) with structural formular



is formed

RESULTS

Tables 1 and 2 present the results

Table 1: Difference between pre-treatment scores of experimental and control groups

Group (s)	N	X	Std Dev	df	T
Scaffolding	42	5.83	4.15	76	2.782
Lecture method	35	5.09	3.43		

P>0.05

Table 2: Difference between post-treatment scores of experimental and control groups

Group	N	X	Std Dev	df	t
Scaffolding	42	13.01	3.33	76	0.043
Lecture method	35	10.43	2.82		

P<0.05

From Table 1, the t-value of 2.784 was not significant at 0.05 level. This showed that there was no significant difference between the mean scores of students exposed to scaffolding (X =5.83) and lecture method (X = 5.09) before treatment. Also, Table 2 shows that the mean score for the students in the scaffolding group (X = 13.01) was higher than that of the traditional lecture method. When the mean scores were subjected to t-test, it yielded a value of 0.043 which was significant at 0.05 level.

DISCUSSION

The results shows that scaffolding teaching strategy was an effective method in teaching some chemistry concepts in secondary schools. This was evident in the result of the post-test in scaffolding (X=13.01) and lecture method (X=10.43). The low mean scores of both experimental and control groups indicated that students had little knowledge about the concept before treatment.

The reason for the better performance of students in scaffolding could be due to the active participation process in which learners construct new ideas which enhances students' understanding progressively and ultimately led to greater independence in the students' learning process. Reasonably, this can be linked to the factor of social interaction that existed among the students. Existing studies found that social interaction is a key factor for better performance in computer supported collaborative learning (Kreijns, Kirschner, Jochens, 2003)- because of the fact that "the social process of developing shows understanding through interaction is the "natural" way for people to learn" (HiHZ, 1994).

CONCLUSION

In conclusion, scaffolding teaching strategy tend to be effective both in enhancing students performance in chemistry and in increasing social interaction among the students. There is the need therefore, for chemistry teachers to recognize the connection between the students cognitive and their social interaction.

RECOMMENDATIONS

1. Teachers should carefully design and teach their students appropriate scaffolds considering their functions and the use of relevant methods to pply in teaching chemistry concepts.
2. As there is a paradigm shift from teacher –centered approach to learner- centered approach in the evolution of the educational instruction (Gibb's 1981), instructors should acknowledge students' voice and what they perceive of scalfolding provided. From students' feedback, the teacher can have less lessons learnt about delivering appropriate scaffolds to meet the students' needs. On the other hand, teachers can ask students for feedback at the end of the course to see the effectiveness of the whole scaffolding works.

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