The Effect of Cueing Questions as Instrumental Scaffolding on Student Achievement in Biology in Ogidi Education Zone of Anambra State

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Abstract. *This study sought out to investigate the effects of cueing question as instructional scaffolding on the achievement of students' of different cognitive categories in biology in Secondary Schools in Ogidi Education Zone of Anambra State, Nigeria. A pretest, posttest control group and quasi experimental design was used in the study. Two (2) secondary schools were used for the study using simple random sampling technique. Seventy seven (77) students constituted the sample for the study. Three research questions and three hypotheses guided the study. The treatment group was taught 3 biology concepts using cueing question as instructional scaffolding while the control group was taught without the cueing question. The study lasted for 6 weeks. The instrument for data collection was a 24 items BAT constructed by the researcher. Data was analyzed using mean and standard deviation while the Analysis of Covariance (ANCOVA) was used to test the hypotheses at 0.05 level of significance. The summary of result revealed that in all categories ofstudents' cueing question used as scaffold led to improved achievement in Biology. Recommendations were made base on the finding and suggestions were made for further studies.*

Keywords*: Effect, Cueing, Instructional, scaffolding, Achievement, Biology*

1 INTRODUCTION

Science is seen as a dynamic and objective process of seeking knowledge, and an enterprise that involves people searching, investigating and seeking verification of natural phenomena. Since, science is both an organized body of knowledge and a process of finding out knowledge, it therefore demands that it should be taught through hands on method approach. Biology as branch of science and the prerequisite subject for many fields of learning contributes immensely to the technological growth of the nation. Learning is a process requiring efforts in which the learner actively constructs his own meaning based on their experiences. This is because learners bring to the class ideas which affect any new information they receive and what they learn, therefore, results from interaction between their previous knowledge and what is experienced during learning. Thus in the constructivist model of instruction, students redefined, elaborate, and change their initial concepts through interaction among themselves and their environment. The learners interpret objects and phenomena and internalize the interpretation in terms of previous knowledge (Nwosu, 2003).

Edmond and Novak (1993) noted that there is a relationship between students epistemologies and their approach to learning which in turn determines whether they would learn meaningful or not. Constructivists believe that learning is an active process with the learner being active in knowledge construction. Jegede (1997) had earlier joined the crusade for meaningful learning as a panaceas for enhanced performance. He proposed that meaningful instructional strategy, that is, a teaching strategy that is child centered and

actively oriented will lead to improved performance. One of such strategies could be the use of instructional scaffolding.

Instructional scaffolding is a teaching strategy that emphasizes the teaching of new skills by engaging students collaboratively in tasks that would be too difficult for them to complete on their own (Okafor, 2014, Raymond, 2000). Also, Nzewi and Ibeneme (2011) described instructional scaffolding as a supportthat is designed to provide assistance necessary to enable learners accomplish and develop understanding that would not quite be able to manage on their own. The teaching strategy emphasizes on the role of teachers and others in supporting the learning development and providing support structures to get to the next stage or level (Raymond, 2000).

(Raymond, 2000). This teaching strategy originated from Levi Vygotsky socio-cultural theory and his concept of the Zone of Proximal Development (ZPD) (Raymond, 2000). Raymond's 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 view, 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 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 ZPD.

Instructional scaffolding as a teaching strategy depends heavily on the idea that children come to any educational setting with a great deal of pre-existing knowledge, some of which may be correct or incorrect. It is the process of building on what a student already knows that makes scaffolding an effective instructional technique. Olson and Prath (2000) observed that in instructional scaffolding, a more knowledgeable others provides scaffolds to facilitate the learner development. The scaffold facilitates a student ability to build on prior knowledge and internalize new information. The activities provided in scaffolding instructions are just beyond the level of what the learner can do alone. An important aspect of scaffolding is that scaffoldings are temporary. As the learner abilities increases the scaffolding provided by the more knowledgeable person is progressively withdrawn. Finally, the learner is able to complete the task or master the concepts independently (Chang and Uhem, 2002). As a learner gains control of these new ideas of learning, the teacher withdraws the support gradually while the learner becomes increasingly able to complete the task alone. The teacher then plans and provides further support on new learning. Such support structures could be helping the learner to complete a task by using cueing questions, discussions, concepts maps or explanations.

In using cueing question for example, a teacher can ask the students to differentiate between living things and non-living things. The teacher starts by asking the students to mention someattributes of a living thing. The expected response may include that living things have life, they can move about, they can reproduce, they can breathe, they can excrete waste product and they can feed themselves. The teacher acknowledges the answers when the students answer the question, the teacher then asks the students to state what made it possible for living things to perform all these activities while non-living things cannot. An expected answer will be that living things have senses and organs in their system while non-living things do not have. An essential factor in scaffolding is active participation of the learner. This can be encouraged by the teacher as early as the planning stage of a new unit of work. A case study by Flick (2000)revealed that teachers scaffolding highlight critical association and opportunity for reflection that help students make meaningful use of investigation, process and results.

Biggs and More (1993) identified three approaches to learning used bysecondary school students. These are surface, deep and achieving approaches. Students who use the surface approach try to avoid working too hard and failing assessment. They tend to limit their target to base essentials, reproduce essentials for assessment purpose through memorizing or rote learning. They are passive in their learning, have negative emotions about learning and prefer to learn in isolation. Students who adopt to deep approach on the other hand, aim to satisfy their interest in what is being learned, develop high level of competence in examining various points of views and become involved in creating knowledge and understanding through discussion (Biggs, 1989). Students who adopt the achieving approach come from the "ego trip that comes from achieving high marks" (Biggs and More, 1993). Achievers choose strategies which will give them the best rewards from the teacher and the highest marks, so they strategize depending on the task and situation. Appleton and Beasley (1994) stated that there is an element of efficiency in their choices, which can involve either deep or surface approach.

Studies have shown that the teaching of science in Nigeria secondary schools falls short of standard expected of it; it has been observed that the present methods used in teaching science in schools do not augur well for the acquisition of science process skills by students (Nnorom, 2006, Chikelu&Nwagbo, 2014; Nnorom& Obi, 2013;Nzewi&Ibeneme, 2011).Ali (1997) asserted that there is no best method, but, that effective science teaching should be actively oriented, laboratorycentered rather than text book or lecture centered which characterized the Nigeria schools.

1.1 The Problem

The overall poor academic achievement in the science among secondary school students raises doubts on the efficacy of the teaching methods utilized by teachers in schools. Biggs (1989) and Gibbs (1992) had listed the factors affecting students approach to learning to include:teachers' style of teaching; students' awareness to task demand, intellectual development, the level of students' newness and size of subject degree of threat felt by student and nature of assessment. One then begins to wonder how helping students to make meaning out of a learning situation can affect the engagement on task of surface and deep learners. In other words, when surface and deep learners are exposed to scaffolds that will help them along in their learning, will the surface learners be able to achieve more, and what effect will these scaffolds have on deep learners? The problem of this study posed as a question is: will cueing questions used as instructional scaffolding improve the achievement of different categories of students in biology?.

Therefore, the major purpose of this study is to ascertain the effect of cueing questions as instructional scaffolding on students' achievement in biology. The study will specifically:

1. examinecritically the effect of cueing questions as instructional scaffold on the mean achievement score of SS II students in three (3) biology topics.
2. examine the effect of cueing questions as an instructional scaffold on the mean achievement scores of SS II students who are surface learners in three (3) biology topics.
3. examinethe effect of cueing questions as an instructional scaffold on the mean achievement score of SS II students who are deep learners in (3) biology topics.

1.2 Research Questions

The following research questions were formulated to guide the study:

1. What is the effect of cueing question as an instructional scaffold on the mean achievement scoresof SS 11 students in three (3) biology topics?

2. What is the effect of cueing questions as on instructional scaffold on the mean achievement score of SS11 students who are surface learners in three (3) biology topics?
3. What is the effect of cueing questions as on instructional scaffold on the mean achievement score of SS 11 students who are deep learners in three (3) biology topics?

1.3 Hypotheses

The following hypotheses were formulated to guide the study at 0.05 statistical level of significance:

Ho_1: There is no significant difference between the mean achievement score in selected biology topics of SS11 biology students taught with cueing questions and those taught with the conventional method.

Ho_2: There is no significant difference between the mean achievement score in selected Biology topics of surface learners SS11 biology students taught with cueing questions and those taught with the conventional method.

Ho_3: There is no significant difference between the mean achievement score in selected biology topics of deep learners SS11 biology students taught with cueing question those taught with the conventional method.

2 METHODS

A quasi experimental design, specifically the pre-test , post-test,non equivalent control group design was used for the study. Seventy-seven (77) SSI students randomly selected from two secondary schools in Ogidi Education Zone of Anambra State. Simple random sampling was used for the study. Only two schools were randomly sampled due to experimental nature of the study.

Treatment was assigned to the group. At the onset of the experiment, the researcher established the categories of the learners using a learning Approach Questionnaire (LAQ). The LAQ was used to categorize students into surface or deep learners depending on their mean score in the LAQ. Any student with a mean score of 3.00 in the LAQ was identified as a deep learner while any student with a mean score of less than 3.0 was categorized as a surface learner. This was done without their knowledge. At the end 55 students (23 in experimental and 32 in control group) emerged as surface learners while 22 (18 in experimental group and 14 in control group) emerged as deep learners.

The instrument used for the study was Biology Achievement Test (BAT). The instrument had a reliability index of 0.83. Students in one school were taught some biology topics using cueing questions as instructional scaffolds, while the other school was taught without the cueing questions. In the conventional class for instance, the teacher asks the students to explain the factors that affect growth. If they fail to get the correct explanation, the teacher will go ahead to explain it. In the experimental class, the teacher will not supply the answer but will go ahead to ask other questions e.g.How does the environment affect growth? What happens to a newly germinating maize plant when there is normal temperature, rainfall, availability of nutrient and light intensity? Or in the basis of growths, in the conventional class, asks students general questions about it and supply answers when they fail to do so. In the experimental class, the teacher will ask questions like: mention two physiological processes in plant in relation to growth; what is growth?What is the importance of climatic factors to the growth of plants? In the absence of some of the growth factors you have listed, what will happen to plants and animals? The students' response will be written out on the board by one of them or the teacher, and these will form the basis for summarizing the lesson.

At the end of 6 weeks, the teacher administer the posttest to the subjects in the two groups using BAT. The data generated were analyzed using mean, standard deviation for answering the research questions while Analysis of Covariance (ANCOVA) was used to test the hypotheses at 0.05 level of significance.

3RESULTS

3.1 Research Question 1:

What is the effect of cueing questions as an instructional scaffold on the mean achievement score of SSII students in the selected Biology topics?

Table 1: Mean achievement scores of SS II students in three biology topics using scaffolding

Teaching Method	N	Pre Test	Post Test	Gain Score	SD
Scaffolding (Cueing Question)	40	10.0000	18.60000	8.8250	3.35802
Conventional	37	9.8919	14.0270	4.1351	3.72799
Total	77	9.9481	16.4026		

From the result on table 1 above, the Pre Test score of the scaffolding is 10.00 and the post score is 18.60 with a Gain score of 0.83. Also, the Pre Test score of the control (conventional method) is 9.89 and the post score is 14.03 with a Gain score of 4.14. The result showed that the gain score for the cueing question method is higher than the conventional method.
Ho_1: There is no significant difference in the mean achievement score in selected Biology topics of SSII biology students taught with cueing questions and those taught with the conventional method.

Table 2: The Analysis of Covariance (ANCOVA) of the mean achievement score in three Biology topics of SSII biology students taught with cueing questions and those taught with the conventional method.

Source	Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	56.667[a]	12	4.722	2.324	.017
Intercept	2085.470	1	2085.470	143.277	.000
Gain C	56.667	12	4.722	.324	.017
Error	349.333	24	14.556		
Total	3403.000	37			
Corrected Total	406.000	36			

From the result on Table 2 above, the F-ratio is 2.324 with significance value of .017. Since the probability is below (p.<0.05), 5% level of significance, we reject the null hypothesis. Thus we conclude that there is a significant difference in the mean achievement score in selected Biology topics of SSII biology students taught with cueing questions and those taught with the convention method.

3.2 Research Question 2:

What is the effect of cueing questions as an instructional scaffold on the mean achievement score of SSII students who are surface learners in three Biology topics?

Table 3: Mean achievement scores of surface learners taught using conventional and those taught with scaffold.

Teaching Method	N	Pre Test	Post Test	Gain Score	SD
Scaffolding (Cueing Question)	22	8.6818	17.1364	8.0870	2.92191
Conventional	23	9.0870	13.1304	4.0435	3.63666
Total	55	8.8889	15.0889		

Table 3 result indicate that the pre test achievement score for those taught using scaffold is 8.68 and post test score is 17.14 with gain score of 8.09. Those taught without scaffolding has pre test score of 9.88 and post test of 13.13 with gain score of 4.04. The result showed that the gain score is higher for surface learners taught with scaffold. This implies that scaffold is a better teaching method than the conventional method.

Ho_2: There is no significant difference in the mean achievement score in selected Biology topics of surface learners SSII biology students taught with cueing questions and those taught with the conventional method.

Table 4: The Analysis of Covariance (ANCOVA) of the mean achievement score in selected Biology topics of surface learners SSII biology students taught with cueing questions and those taught with the conventional method.

Source	Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	132.454[a]	12	11.038	1.981	.051
Intercept	72.666	1	72.666	13.044	.006
Con Pre	.656	1	.656	.118	.739
Sca Pre	13.214	1	13.216	2.372	.158
Control	55.597	10	13.214	12.998	.006
Error	50.137	9	5.560		
Total	6643.000	22	5.571		
Corrected Total	182.591	21			

The ANCOVA result show that,the F-value is 12.998 with significance value of 0.05. The significance value ($p.<0.05$) is less than 5%, thus, we reject the null hypothesis. Therefore the study conclude that there is significant difference in the mean achievement score in selected Biology topics of surface learners SSII biology students taught with cueing questions and those taught with the convention method.

3.3 Research Question 3:

What is the effect of cueing questions as an instructional scaffold on the mean achievement score of SSII students who are deep learners in three Biology topics?

Table 5: Mean scores of the deep learners taught using scaffold and those taught with conventional method.

Teaching Method	N	Pre Test	Post Test	Gain Score	SD
Scaffolding (Cueing Question)	18	11.6111	20.3889	8.7059	3.15762
Conventional	14	11.2143	15.5000	4.2857	4.00823
Total	32	11.4375	18.2500		

The results showed that deep learners taught with scaffold has 11.61 pre test score, 20.38 post test score and 8.71 gain score. Those taught without scaffold has 11.21 pre test score, 15.50 post test score and 4.28 gain score. The result indicates that the gain score for deep learners taught using scaffold are higher. This implies that scaffold is more effective for teaching deep learners on biology topics.

Ho_3: There is significant difference in the mean achievement score in selected Biology topics of deep learners SSII biology students taught with cueing questions and those taught with the convention method.

Table 6: The Analysis of Covariance (ANCOVA) of the mean achievement score in selected Biology topics of deep learners SSII biology students taught with cueing questions and those taught with the convention method.

Source	Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	59.890[a]	10	5.989	8.720	.008
Intercept	16.401	1	16.401	1.971	.005
Con Pre	2.485	1	2.485	.299	.623
Sca Pre	1.998	1	1.998	.240	.658
Control	57.784	8	7.223	21.868	.014
Error	24.967	3	8.322		
Total	5846.000	14			
Corrected Total	84.857	13			

Result in table 6 reveals that the F-value is 21.868 with a significance value of 0.014. The result has significance value less than 5% ($p<0.05$). Since the significance value is less than 5% level, we reject the null hypotheses and thus conclude that there is a significant difference in the mean achievement score in selected Biology topics of deep learners SSII biology taught with cueing questions and those taught with the convention method.

4 DISCUSSION OF FINDINGS

The study from the research question 1 revealed that students taught selected biology topics using scaffolding performed better than those taught using conventional method (lecture method). This implies that using cueing questions as instructional scaffolding has more positive effect in enhancing and facilitating student's achievement in biology than the conventional method. This result is in line with Nzewi and Ibeneme (2011) who also found out that students taught using scaffolding performed better than those taught using conventional method.This is because cueing questions involve student's participation in the class. The students were always active answering or asking questions.The students became more motivated and interested in the task and this lead to high achievement.

The study also revealed in research question 2, surface learners tend to limit their target to bare essentials and reproduce these essentials for assessment purpose through memorizing or rote learning thereby satisfying examination requirements only (Biggs, 1989 and Gibbs, 1992). When these surface learners were taught Growth using scaffolding, their understanding was enhanced. Hammond (2001) had indicated that the essential factor in scaffold is active participation of the learner. By participating in the question and answer sessions involved in using cueing questions, the surface learners were pushed beyond their current abilities and levels of understanding. They were thus able to achieve well as indicated by result.

The study also revealed in question 3 that deep learners benefitted more than when taught with scaffolding. Deep learner posses high level of competence in examine various points of view, and are usually involved in creating knowledge and understanding through discussions (Biggs, 1989; Gibbs, 2001&Nzewi&Ibeneme, 2011. Teaching with cueing questions as instructional scaffolding therefore enabled them to be at their best leading to better achievement.

5 CONCLUSION

The finding of this study led to the conclusion that cueing questions as instructional scaffolding affected students' achievement more positively than the conventional method when used in teaching Growth, Skeleton, Excretion. In addition cueing questions as instructional scaffolding was more effective in improving achievement of surface and deep learners in the topics taught than the conventional method.

6 RECOMMENDATIONS

Based on the findings, the following recommendations were made:

1. Relevant authorities (Ministry of Education Science, Teachers' Association of Nigeria and other professional bodies) should organize seminars, workshops, conference and in service training to train teachers on the use of cueing questions as instructional scaffolding.

2. Biology teachers should incorporate cueing questions as a technique in teaching biology.

3. Teachers training institutions (Universities and colleges of Educations) should include cueing questions as instructional scaffolding as technique in biology teaching method course content, this will ensure that biology teachers are adequately train on how to use this technique.

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