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BOOSTING BIOLOGY STUDENTS' ACHIEVEMENT AND SELF CONCEPT THROUGH CONSTRUCTIVIST-BASED INSTRUCTIONAL MODEL (CBIM)

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ABSTRACT

This study ascertained the effects of engaging learners with Constructivist-Based Instructional Model (CBIM) for achievement and self concept in Biology in a learner-centered Science classroom. The quasi-experimental design which involved pre-test and post-test activities with intact groups. The sample consists of 100 SS 2 students selected through a purposive sampling procedure. The Biology Achievement Test (BAT) was used to determine the students' achievement in both pre-tests and post-tests while self-concept inventory which includes 15 items of general self-concept, 20 items of academic self-concept, and 20 items of non-academic self-concept. The reliability of the instrument (BAT) was ascertained by the use of Kuder Richardson formula 20 (K – R) 20. The co-efficient of internal consistency was established at 0.78 while the reliability of self-concept inventory established using Cronbach Alpha had a coefficient of 0.69. Findings from the study showed that Learners taught with Constructivist-Based Instructional Model (CBIM) had higher achievement in the researcher-made Biology Test than those taught using Lecture method. Equally, the self-concept of students taught with Constructivist-Based Instructional Model (CBIM) was higher than their counterpart taught with Lecture method .The reason for this result could be that the learner's in the CBIM group had good interaction with the materials which offered the learners hands-on, minds-on as well hearts-on experiences. The constructivist model is not gender selective as the outcome of its use did not discriminate against the gender of the students. This is because in this model the key factors that influence the learning process – the learners, teachers, tasks and context do not exist in isolation. Students taught with constructivist method show evidences of knowledge retention than those taught with lecture method. The study therefore recommended that Science Teachers (Biology) should use Constructivist-Based Instructional Model (CBIM) in teaching so as to create a learning environment that is invigorating, interactive and informative.

INTRODUCTION

Teachers must invite learners to experience the world's richness, encourage them to ask questions and seek their own answers, and challenge them to explore the world's complexities, not solely focus on academic achievement scores (Akinyemi & Folashade, 2010, Ibe, 2016). The typical Nigerian classroom situation is as follows: teachers often disseminate knowledge and expect students to identify the facts of the knowledge presented; most teachers rely heavily on textbooks; the information the teacher disseminates to students is directly aligned with the view of the textbook; most classrooms encourage competition among students, structurally discourage cooperation and require students to work in relative isolation on tasks that require low level thinking, rather than high-order thinking; students' independent thought is devalued in most classrooms. When asking students' questions, most teachers seek not to enable students to think through intricate issues, but to discover whether student knows

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the "right" answer and schooling is premised on the notion that there exists a fixed world that students should understand. The construction of new knowledge is not as highly valued as the ability to demonstrate mastery of conventionally accepted knowledge (Ekon, Ekwueme & Meremikwu, 2014).

Traditionally, learning has been thought to be nothing but a repetitive activity, a process that involves students imitating newly provided information in tests. Traditional instruction leads students to believe they are not interested in particular subject areas.

The constructivist teaching practice, on the other hands, helps learners to internalize and transform new information. Transformation of information occurs through the creation of new understanding that results from the emergence of new cognitive structures. Teachers may invite transformations but may neither mandate nor prevent them. Deep understanding is, unlike the repetition of prescribed behaviour, the act of transforming ideas into broader, more comprehensive images which escape concise description (Akanwa & Ovute, 2014). The principles of constructivist teaching are: posing problems of emerging relevance to students; structuring learning around primary concepts; seeking and valuing student's points of view; adapting the curriculum to address students' suppositions; and assessing student learning in the context of teaching (Brook & Brooks, 1993)

The constructivist paradigm holds disinterest less as a function of a particular subject area than as a function of the ways in which students have been taught. A look at the table below made a comparison of the traditional lecture classroom with the constructivist classroom

S/N	TRADITIONAL CLASSROOM	CONSTRUCTIVIST CLASSROOM
1	Begins with parts of the whole–Emphasizes basic skills	Begin with the whole – expanding to parts
2	Strict adherence to fixed curriculum	Pursuit of student questions / interests
3	Textbooks and workbooks	Primary Sources / manipulative materials
4	Instructor gives/students receive	Learning is interaction – building on what students already know
5	Instructor assumes directive, authoritative role	Instructor interacts / negotiates with students
6	Assessment via testing / correct answers	Assessment via student works, observations, points of view, tests. Process is as important as product
7	Knowledge is inert	Knowledge is dynamic / change with experiences
8	Students work individually	Students work in groups

Source: Brook and Brook (1993)

In a constructivist classroom in which the teacher is using constructivist teaching, students are encouraged to discover for themselves how things work. They do this first by making simple observations, from which they later build ideas and hypotheses which they then go on to test. Pre-testing allows a teacher to determine what knowledge students bring to a new topic and thus will be helpful in directing the course of study. In CLEs, learning is driven by the problem to be solved; students learn content and theory in order to solve the problem. This is different from traditional objectivist teaching where the theory would be presented first and problems would be used afterwards to practice theory. Depending on students' prior experiences, related cases and scaffolding may be necessary for support. Instructors also need to provide an authentic context for tasks, plus information resources, cognitive tools, and collaborative tools. In the constructivist classroom, the teacher's role is to prompt and facilitate discussion. Thus, the teacher's main focus should be on guiding students by asking questions that will lead them to develop their own conclusions on the subject (Udogu & Njelita, 2010).

The constructivist classroom is characterized as follows: the learners are actively involved; the environment is democratic; the activities are interactive and student-centered

and the teacher facilitates a process of learning in which students are encouraged to be responsible and autonomous.

This is contrary to the traditional classroom in which students work primarily alone, learning is achieved through repetition, and the subjects are strictly adhered to and are guided by a textbook (Abida & Muhammad,2012).

The following activities are encouraged in constructivist classrooms: Experimentation; Research projects; Field trips; Films and Class discussions. Class discussions are used in all of the methods described above. It is one of the most important distinctions of constructivist teaching methods and this study adopted class discussion activity for this study.

Constructivist teaching is based on constructivist learning theory (Piaget, 1976, Vygotsky, 1978). This theoretical framework holds that learning always builds upon knowledge that a student already knows; this prior knowledge is called a schema. Because all learning is filtered through pre-existing schemata, constructivists suggest that learning is more effective when a student is actively engaged in the learning process rather than attempting to receive knowledge passively. The Constructivist teaching rely on some form of guided discovery where the teacher avoids most direct instruction and attempts to lead the student through questions and activities to discover, discuss, appreciate and verbalize the new knowledge.

Constructivist learning theory says that all knowledge is constructed from a base of prior knowledge. Learners are not a blank slate and knowledge cannot be imparted without the learner making sense of it according to his or her current conceptions. Therefore learners learn best when they are allowed to construct a personal understanding based on experiencing things and reflecting on those experiences

Today, it is essential to organize the learning environments in a student centered and democratic way facilitating the student development in various respects. The traditional learning environment in which students memorize information as it is without questioning and researching result in negative consequences. Some of the problems that arise from traditional learning environments are that the learned information cannot be permanent, just memorized for the examinations and are forgotten later on, most information is understood either imperfectly or wrongly and that the male and female students cannot apply learned material into real life (Agogo and Naakaa, 2014). To eliminate that kind of problems, student-centered approaches should be taken into consideration.

Recently, one of the approaches that closely influence the organization of the learning environments is the Constructivist approach. Constructivist teaching is a teaching strategy which holds the view that knowledge are personally constructed and reconstructed by the learner based on his prior knowledge or experiences. It is a strategy of learning based on the belief that knowledge is not a thing that can be simply given or transferred by the teacher in front of the classroom, to learners seated at their desks. Rather, knowledge should be constructed by the learners through an active mental developmental process. It also allows the students to interact with themselves, explore and work in groups, making meaning of tasks and setting out to solving problems that are perplexing to them (Ekon, Ekwueme and Meremikwu, 2014).

The Constructivist instructional model gives importance to the students' constructing knowledge themselves and developing higher order thinking skills. For the male and female science students to construct knowledge, different principles are applied in constructivist learning environments compared to traditional learning environments. Traditional learning environments are teacher-centered (Akinyemi and Folashade, 2010). While teacher has the role of transferring information and directing the students, students are passive receivers. Moreover, students are active in constructivist learning environments. Their roles are to organize knowledge and the learning environment, carry out the learning activities and to monitor their own learning (Ekon, Ekwueme and Meremikwu, 2014). In such an environment, teacher's role is to guide the students in the learning process and to do various evaluations based on various techniques such as diaries, research reports, etc. In constructivist instructional model, teachers design classroom activities that will develop students' higher-order thinking skill, enable them to learn new concepts and unify the previously learned information with the new one.

Organizing learning environments based on the Constructivist approach is important for realizing the higher-order aims (Akanwa and Ovute, 2014, Ibe, 2016). When the students participate in the learning process actively, their

learning becomes meaningful and they can develop themselves in various respects. Learning, in this approach, is reinterpreting the previous knowledge in the tight of new experiences.

There are several Constructivist Instructional Models as cited in Ekon (2013) that are useful in helping learners reconstruct knowledge based on their experiences which include the five phases of constructivist models. This instructional model is activity-based, students-centered, interactive oriented. The five phases of Constructivist Instructional Models are:- Engagement stage which is problem identification stage; Exploration stage which is the experimenting and problem solving stage; Explanation stage which is the classification stage; Elaboration stage which is the generalization stage; Evaluation stage which is the signal feedback stage.

Objectives that guided the study are as follows:

1) ascertain the achievement scores in a researcher-made Biology test (RMBT) of biology students taught using the Lecture method or the Constructivist method respectively at post test
2) establish the self-concept scores in a researcher-made Biology test (RMBT) of students taught using the Lecture method or the Constructivist method respectively at post test

Research Questions

The following questions guided the study.

1) What are the mean achievement scores in a researcher-made Biology test (RMBT) of students taught using the Lecture method or the Constructivist method respectively at post test?
2) What are the student's mean self-concept scores in a researcher-made Biology test (RMBT) of students taught using the Lecture method or the Constructivist method?

Three hypotheses were formulated and tested at 0.05 level of significance

HO 1: The mean achievement scores in a researcher-made Biology test (RMBT) of students taught using the Lecture method or the Constructivist method do not differ significantly at post test.

HO 11: The student's mean self-concept scores and mean achievement scores in a researcher -made Biology test (RMBT) of students taught using the Lecture method or the Constructivist method do not differ significantly at post test

Method

The study adopted the quasi-experimental design. The research design involved pre-test and post-test with intact groups. This type of research design was used because the researcher did not have full control over some of the intervening variables, that is, those things capable of impinging on the results such as the classroom arrangements, health, studying together, comparing notes, resources available to learners beyond treatment session after school (Ibe, 2008). The sample consists of 100 SS 2 students (49 females and 51 males) selected through a purposive sampling procedure. The Biology Achievement Test (BAT) was used for the determination of students' achievement in both the pre-tests and post-tests while self-concept inventory which includes 15 items of general self-concept, 20 items of academic self-concept, and 20 items of non-academic self-concept was used to determine students' self concept.. The BAT has 20 questions. The reliability of the instruments (BAT) was ascertained by the use of Kuder Richardson formula 20 (K – R) 20. The co-efficient of internal consistency were established at 0.78 while the reliability of self-concept inventory established using Cronbach Alpha had a coefficient of 0.69.

In this study, the BAT was used for both the pre-test and post-test, but at the post-tests level, it was re-arranged. The purpose of the rearrangement was to test the ability and control their test- wiseness.

The Biology Achievement Test (BAT) was presented to one specialist in Educational Measurement and Evaluation and two specialists of Science Education for validation. Equally the Self concept inventory was validated by two specialists of Educational Psychology and one specialist of Educational Measurement and Evaluation.

Experimental Procedure

- **Pre-Treatment Phase**

The researcher first of all made her intentions known to the principal of the sampled school. This was to bring about cordial relationship between the researcher and the

officials of the schools and to discuss the best way of conducting the research to obtain the desired results. Thereafter, the researcher was introduced to the students by the Biology Teacher. Then, the researcher administered the instruments (BAT) on the sampled school as well the self-concept inventory.. Before administering the instrument, the Biology teachers and the assistants helped the researcher to organize the students into two classes of 50 (26 females and 24 males) and 50 (23 females and 27 males) students each and then the test was given to them to respond to. Equally, the learners responded to the self-concept inventory.

The pre-treatment phase included the administration of the Biology Achievement Test (BAT) and the Self –Concept Inventory (SCI) to the students as a pre-test. The purpose of the pre-test was to identify the students' level of achievement before the actual lesson was delivered to them (the experimental treatment) as well as their self concept level. The result of the pre-test when compared with the post-test enabled the researcher to determine whether there was improvement after the treatment.

Treatment Phase

The students were assigned to two experimental groups respectively based on the teaching methods (Lecture Method and Constructivist Method). Each of the two experimental group comprised 50 students each.

Post-Treatment Phase

After the various experiments for each group, the BAT was administered to the students as a post-test as well as the SCI at the same time and under the same conditions. The research questions were answered using mean and standard deviation while hypotheses 1 and 2 were tested using Analysis of Co-Variance (ANCOVA).

Results

Table 1: Means and Standard Deviations of the students' achievement scores in post-test (RMBT)

GROUPS	GENDER	Mean (X)	S.D	N
	M	55.7500	7.04180	24
CG	F	58.5769	7.55869	26
	Total	57.2200	7.37976	50
	M	42.3704	10.88806	27
LM	F	46.9130	13.93789	23
	Total	44.4600	12.46417	50
	M	48.6667	11.39942	51
Total	F	53.1020	12.38488	49
	Total	50.8400	12.04010	100

Where N = No. of subjects; X= mean ; SD= Standard Deviation; CG=Constructivist group LM=Lecture method

Data presented on Table 1 show that the mean achievement score of students taught using the constructivist group is (57.22 with S.D 7.04) while the lecture method is (44.46 with S.D 12.46). Still on table 1, data presented show the mean score for male students using the constructivist method is (55.75 with S.D 7.04) and females (58.58with S.D 7.56). For lecture method, males have (42.37 as mean and S.D 10.89) while females have (46.91as mean and S.D 13.94).

Table 2: Mean and Standard deviation of self-concept scores of biology students taught with Lecture method or the Constructivist method

Variables	N	Mean	S. D
SEC (CBIM)	50	57.22	7.38
SEC (LM)	50	44.46	12.464

- **Self-concept - SEC**

Data presented on table 2 show a mean score of 57.22 and an S.D of 7.38 as the mean score and standard deviation scores of the students self efficacy taught with Lecture method or the Constructivist method. The value shows that the students taught using Constructivist method have higher self concept (57.22) when compared with Lecture method (44.46).

Ho1: The mean achievement scores in a RMBT of students taught using the constructivist method or the Lecture method do not differ significantly ($p<0.05$).

Table 3: Analysis of Covariance (ANCOVA) of Biology Students' Overall Achievement Scores by Teaching Methods at Post-test

Sources of Variation	Sum of Squares	Df	Mean squares	Fcal	Sig	Decision at P<0.05
Pre-test (Covariates)	2186.252	1	2186.252	26.838		
Teaching Methods	4577.535	1	4577.535	56.194	.000	S
Gender	181.939	1	181.939	2.233	.138	NS
Error	7738.716	96	81.460			
Corrected Total	14351.440	99				

- S-Significant
- NS- Not Significant

Data presented on table 3 show that teaching method as a main effect on students' achievement in Biology is significant. This is because the probability value of 0.000 at which this main effect is shown to be significant is lower than the level of 0.05 at which it is being tested. This implies that teaching methods have statistically significant effect on students' mean achievement score in Biology. In other words, the null hypothesis of no statistically significant effect is rejected at 0.05 level of confidence. Thus, the earlier observed difference between the overall mean achievement scores of the method groups as in table 1 is a real difference which could not be attributed to chance associated with the study.

HO_2: The student's mean self-concept scores and mean achievement scores in a researcher - made Biology test (RMBT) of students taught using the Lecture method or the Constructivist method do not differ significantly at post test

Table 4: Analysis of Covariance (ANCOVA) of Biology Students' self-concept Scores by Teaching Methods

Sources of Variation	Sum of Squares	Df	Mean squares	Fcal	Sig	Decision at P<0.05
Pre-test (Covariates)	2584.816	1	2584.816	33.260		S
Teaching Methods	4583.839	1	4583.839	58.982	.000	
Self concept	4577.535	1	4577.535	56.194	.000	S
Error	7383.011	96	77.716			
Corrected Total	14300.750	99				

Data presented on table 4 show that teaching method as a main effect on students' self-concept in Biology at post test is significant. This is because the probability value of 0.000 at which this main effect is shown to be significant is lower than the level of 0.05 at which it is being tested. This implies that teaching methods have statistically significant effect on students' mean self concept score in Biology.

DISCUSSION

- **Effect of Teaching Methods on Students' Achievement in Biology at Posttest**

Findings from the study show that the constructivist group performed glaringly better than the Lecture group. This implies that the constructivist model is superior to Lecture method of teaching Biology at secondary school level. This difference may be attributed to the fact that constructivist model provides an opportunity for students to play active role in building their own knowledge. This agrees with (Agogo and Naaka,. 2014) who is of the view that constructivist model is a veritable tool for shifting science teaching from the traditional talk and chalk method to the hands-on method which is learner centred. Akinyemi and Folashade (2010) supported this by saying that constructivists of different persuasion hold a commitment to the idea that the development of understanding requires active engagement on the part of the learner.

- **Effect of Teaching Methods on Students' self concept in Biology**

Data presented on table 4 clearly show that teaching method is significant on students' self concept in the researcher made biology. The mean self concept scores of students at post-test were compared with their achievement scores in the two experimental groups. It was found that self concept of the students taught with constructivist method was much higher than the students taught with lecture. This could be as a result of students solving problems themselves and by doing so students develop understanding of subject matter. The students apply and represent their ideas in a manner similar to the way in which experienced individuals in the field generate and use knowledge (Igwebuike and Oriaifo, 2014). These researchers observed that the adoption of learner-centred strategy based on constructionist model can improve learners' academic achievement and self concept and do not allow knowledge to fade away easily from the memory. This result in also in line with the findings of Udogu and Ngelita (2010) who remarked that in accordance with the constructionist model, students now need opportunities to apply their knowledge in a new situation and this has helped them in the retention of knowledge gained. The construction of knowledge is a lifelong process and at anytime. The body of knowledge the individuals have constructed makes sense and helps them interpret or predict events in their experiential worlds.

CONCLUSION

The findings from this study show that Constructivist Based Instructional teaching strategy led to improved achievement of students in the researcher-made Biology topic as well as enhance the self-concept of the students. Over the years, students have shown that the use of good instructional model facilitates to a large extent the learning process. Students taught with constructivist method show evidences of higher self-concept than those taught with lecture method. The teachers' duty is to provide the enabling environment that will facilitate learning and knowledge construction. This is because constructivists do not see education as what the teacher gives but a natural process spontaneously carried out by individual and is acquired not by listening to words but by experiences upon the environment.

RECOMMENDATIONS

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

- For constructivist strategy, the Science (Biology) teacher should create a learning environment that is invigorating, interactive and informative. The Biology teacher Provides learners with choices, tools and constructs, help them learn and not merely instruct them.
- The classroom needs to be a human community that prepares learners to live in the real world and students tend to retain ideas generated by themselves than those memorized from textbooks or from the teacher.
- When teachers use Constructivist Based Instructional Model to teach, students will be held accountable for learning since the students are fully involved in the whole learning process that enhance their self-concept.
- When teachers use Constructivist Based Instructional Model to teach, learning reaches all students since all students are fully involved in the interaction and production of their own individual foldable.

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