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MASTERY LEARNING APPROACH VERSUS CONSTRUCTIVIST-BASED LEARNING APPROACH ON SENIOR SECONDARY SCHOOL STUDENTS' ACADEMIC ACHIEVEMENT IN BIOLOGY

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ABSTRACT: *This study as a comparative study, investigated the impact of two learning approaches, mastery learning approach and constructivist-based learning approach on senior secondary school students' academic achievement in biology. The population of the study comprised of the 2016/2017 academic session of the senior secondary school biology students of Hallmark Academy Secondary School, Omoku, Rivers State. An intact class of 58 students in two streams (A/B) made up the sample size. Stream A had twenty eight (28) students who were taught using Mastery learning Approach, while stream B had thirty (30) students who were taught using Constructivist-Based Learning Approach. The instrument was a post 20-item test with a reliability coefficient of 0.66 gotten using test re-test, which was administered to the two groups. T-test statistics was the analytical tool used in testing the two hypotheses of this study. The study revealed that students taught using Mastery learning approach had higher academic achievements than those taught using constructivist-based learning approach. Consequently, it is recommended that Mastery Learning Approach should be encouraged in schools for mastery of subject contents and improved students' achievement in science subjects especially in biology.*

KEYWORDS: Mastery, Constructivist-Based, Learning Approach, Academic Achievement.

INTRODUCTION

One fundamental element of instructional process is teaching method. Productive and rewarding outcomes of instructional process depend upon effective teaching methods and this is why researchers are trying to find out constructive, productive and worthwhile teaching methods at every level. Methods and techniques for teaching and learning in a formal classroom setting have been flowing overtime; old ones being replaced by newer and effective ones. Educationists now believe that all can learn well under a set of certain condition. This reformed thought has brought a great change in concept and processes of teaching in classrooms. It provides a platform where teachers and students get involved in a more constructive teaching and learning process; a phenomenon that allows students to feel and put into practice what they are being taught thereby reducing the abstraction associated with using the conventional teaching methods.

Bloom's theory of school learning asserts that almost all students can learn well what they are taught if given the appropriate and prior conditions. Bloom (1968) hypothesize that a classroom with a mastery learning focus as opposed to the conventional method of instruction (lecture method) would reduce the achievement gaps between learners of varying degrees of academic abilities (Filgona, Filgona & Sababa, 2017). Mastery Learning Approach (MLA) is one of such techniques that could provide solution to students' difficulties in some biology concepts.

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Mastery Learning Approach (MLA) is an instructional approach where students are allowed unlimited opportunities to demonstrate mastery of content they are taught (Oladejo, Olosunde, Ojebisi, Isola, & Olawale, 2011, cited in Wambugu & Changeiywo 2008). It is an instructional approach in which learners are provided with the opportunity to master a particular unit of lesson before proceeding to the next (Filgona, 2016). Mastery Learning Approach (MLA) involves breaking down the subject matter to be learned into units of learning, each, with its own objectives and followed up with formative evaluation. In Mastery Learning Approach classes, learners' are expected to master the learning objectives to specified criteria in a unit before proceeding to the next unit. All learners who could not obtain the expected cut-off marks are subjected to further remedial lessons and parallel tests until 75% of them master at least 75% of the objectives of a unit before proceeding to the next unit (Abakpa & Iji 2011). Using this teaching approach, it is believed that individual difference between learners will be minimized at the end of instruction. Mastery Learning Approach in this study involves providing: quality instruction, immediate feedback to learners, corrective lessons for remediation, and re-testing until the set criteria for mastery is achieved. Yildrin Adyin (2005), Aderemi (2006), Akinsola (2007) and Kazu, Kazu and Ozedemi (2005) in their study found that mastery learning approach improved students' achievement in sciences subjects. Mastery learning approach stresses more on mastery of content. Mastery learning approach uses differentiated and individualized instruction, progress monitoring, formative assessment, feedback, corrective procedures, and instructional alignment to minimize achievement gaps and focuses on how to improve the process of mastering content rather than changing it. The developers of mastery learning assert that it is most useful with basic skills and slow learners at both elementary and secondary levels. Group instruction is often given to the entire class by the instructor with individual time for learning provided until mastery is met. The goal of mastery learning is success for the student. It is asserted that success in achievement, attitude, and motivation in the education or learning environment makes learning more effective.

In the recent times, revolution in instructional method has provided new approaches of teaching of which constructivist based learning method is one. Constructivist based learning method encourages hands on activities as well as the extension of learning to what happens in the environment. Constructivism is an approach in education that claims humans have a better understanding of information they constructed themselves. According to constructivist theories, learning is a social advancement that involves interaction and collaboration. One of the primary goals of using constructivist based learning method is that students learn how to learn by giving them the training to take initiative for their own learning experiences.

According to Audrey Gray, the characteristics of a constructivist classroom are as follows:

- the learners are actively involved
- the environment is democratic
- the activities are interactive and student-centered
- the teacher facilitates a process of learning in which students are encouraged to be responsible and autonomous.

The model for constructivist based learning approach used in this study was hinged on Bybee's (1997) 5E learning model: Engage, Explore, Explain, Elaborate and Evaluate.

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The 5E model presents a framework for constructivist learning theories and can be effectively used in teaching science subjects. The 5 E's, which is an instructional model, is based on the constructivist approach to learning, which says that learners build or construct new knowledge adding to the previous knowledge. Each of the 5 E's describes a phase of learning, and each phase begins with the letter "E": Engage, Explore, Explain, Elaborate, and Evaluate.

Engage

In this phase, connections to past learning experience with actual learning experience can be invoked by introducing the task. A demonstration of an event, the presentation of a phenomenon or problem or asking pointed questions can be used to focus the learners' attention on the topic, create interest and generate curiosity on the tasks that will follow. The goal is to spark their motivation, interest and involvement.

Explore

Learners should work together, take part in activities that allow them to work with materials that give them a 'hands on' experience of the phenomena being observed. This could be done without the teacher's direct instruction. The teacher, as a guide, coach and facilitator, can provide simulations or models, whose parameter can be manipulated by learners, so that they can build relevant experiences of the phenomena. Questioning, sharing of observations and ideas and communication among learners should be encouraged at this stage.

Explain

At this stage, the teacher comes in to explain to the learners what they don't understand, correct their mistakes and add up to whatever they missed. The focus at this stage is on analysis. The learners' are encouraged to put observations, questions, hypotheses and experiences from the previous stages into language. Communication between learners and learner groups can spur the process. The teacher may choose to introduce explanations, definitions, mediate discussions or simply facilitate by helping learners find the words needed using any appropriate teaching method.

Elaborate

Using the understanding gained in the previous stages, now learners can expand on what they have learnt and apply new knowledge to different situations. Inferences, deductions, and hypotheses can be applied to similar or real-world situations. At this stage also, examples and applications of concepts learnt, strengthen mental models, provide further insight and understanding, decision making and problem solving skills.

Evaluate

Evaluation should be ongoing and should occur at all stages whereby the teacher will observe the students learning progress at every phase/stage, in order to determine that learning objectives have been met and misconceptions avoided. Any number of rubrics, checklists, interviews, observation or other evaluation tools can be used. If interest in a particular aspect or concept is shown, further inquiry should be encouraged and a new cycle can begin that builds upon the previous one. This phase reveals how constructed scientific knowledge and relate it to other situations.

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This model is concerned with increasing learners' motivation towards learning. It is a model that stresses on the importance of practice and increases achievement and, also helps learners' to learn actively in order to acquire science process skills. The 5E learning cycle model assures that students are active in classes, they have the opportunity to research and analyze, and that they reach knowledge by creating discussion environments and by continuous inquiring (Gunduz-Bahadir, 2012).

In the teaching and learning process, the goal of a dedicated teacher is to find out ways and means of lowering the bars of abstraction in presenting difficult concepts and processes so as to achieve anti-entropic ends in instruction. While the other limitless capabilities of a constructive instructional method holds promise for this, when, how, and where to apply its specific potentials in instruction will continue to put pressure on the frontiers of our imagination and innovation. Emeka (2015) opined that learning should be student-driven process of exploration, creativity and discovery of new ideas. For students to learn processes especially, the science processes, the basic tools or learning method they need should be something they can construct themselves; like an instructional material for better understanding (Okebukola, 2004). This brings to limelight the need for more effective teaching strategies/methods like the constructivist based teaching method versus mastery learning approach which can promote internalization and retention of abstract concepts and enable the realization of goals of teaching science subjects like biology.

Abakpa and Iji (2011), Akinsola (2011) in their studies, state that mastery learning approach enhances students' academic achievement and retention in integrated science and mathematics than the conventional teaching method. Also, Wachanga and Gamba (2004) in their study on effects of using Mastery Learning Package on secondary school students' achievement in Chemistry found that Mastery Learning Package improves students learning Chemistry better than the conventional teaching method. This, in turn, agrees with Ngesa (2002) who reported that students' taught with Mastery Learning Package got higher achievement in Agriculture than the students' taught with the conventional teaching method. He argued that the results were significant with regard to classroom Instruction and Teacher Education in Agriculture. Filgona , Filgona and Sababa (2017) in their recent study on effects of Mastery Learning Strategy and Learning Retention on Senior Secondary School Students' Achievement in Physical Geography found that Mastery Learning Strategy has the potentials to improve students' learning outcomes, achievement and retention in all spheres of cognitive domain in Physical Geography than the Conventional teaching Method.

A study by Adeyemo, and Babajide (2014) which investigated the effect of Mastery Learning Approach (MLA) on students' achievement in Physics, using a total of 160 Senior Secondary school II Physics students from four selected Senior Secondary Schools in Bariga and Somolu Local Government Areas of Lagos State, shows that students exposed to Mastery Learning Approach performed better than those taught using Conventional Teaching Method. Recent works by Hussain and Suleman (2016), Lamidi, Oyelekan and Olorundare (2015), Udo and Udofia (2014) all affirm the positive outcome effect of constructive teaching and learning using mastery learning strategy over the conventional teaching method.

A study by Jack (2017) on the effect of learning cycle constructivist-based approach on secondary schools students' academic achievement and their attitude towards chemistry, concluded that, constructivist-based learning cycle method seems an appropriate instructional model that could be used to solve the problems of science teaching and learning since it enhances students' achievement, facilitates learning and its effectiveness is not limited by

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attitude. Also, a study by Bimbola and Daniel (2010), on the effect of constructivist-based teaching strategy on academic performance of students in integrated science at the junior secondary school level, revealed that, if integrated science teachers could incorporate constructivist-based teaching strategy into their teaching methods, there would be an improvement in academic achievement of Junior Secondary School Students in integrated science. Another findings by Akanwa and Ovute (2014) revealed that constructivist based approach had a significant effect on both the achievement and interest of SSS physics students. The findings from these works revealed that the students taught using mastery learning package performed better than their counterparts taught through the conventional teaching method. This implies that the mastery of science subject concepts like in biology may not be fully achieved without the use of a more constructive and engaging method of teaching like the constructivist based learning approach versus mastery learning approach.

Therefore, the call for a more constructive and engaging method of teaching for better student performance and retention in biology concepts becomes important hence, the study was carried out to compare and find out the impact of two learning approaches; mastery learning approach versus constructivist-based learning approach on senior secondary school students' academic achievement in biology.

Purpose of the study

The purpose of this study is to compare the impact of two learning approaches; Mastery Learning Approach (MLA) versus Constructivist-Based Learning Approach (CBLA) on senior secondary school students' academic achievement in biology. The specific objectives of the study are to:

1 determine the extent to which students taught biology using Mastery Learning Approach and Constructivist Based Learning Approach differ in terms of academic achievement.

2 determine the extent to which sex of students affect their performance when taught biology using Mastery Learning Approach and Constructivist Based Learning Approach.

Null hypotheses

The following hypotheses formulated will be tested for the study.

Ho_1: Mastery Learning Approach and Constructivist Based Learning Approach are not significant factors in students' academic achievement in biology.

$H_{O2:}$ There is no significant difference between the mean performance of students taught biology using Mastery Learning Approach and Constructivist Based Learning Approach with respect to gender.

METHODOLOGY

Design: The study was a comparative study, and so, the comparative design was applied. That means the scores of students exposed to Mastery Learning were compared with that of those exposed to the constructivist based learning approach. The essence was to ascertain if one approach had an obvious advantage over the other.

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Population: A population of senior secondary school biology students of Hallmark Academy Secondary School, Omoku, Rivers State was used for the study. These were students of the 2016/2017 session in their third term.

Sample: A sample size was an intact class of fifty eight (58) students in two streams (A/B). stream A had twenty eight (28) students, while there were thirty (30) of them in stream B. The composition of the sample size is represented below

Table 1: Demographic data of the sample size

Category	N	Gender
Stream A/Mastery Learning Package	28	28 ♀
Stream B/Constructivist Based Learning Package	30	30 ♂
TOTAL	58	58

Instrumentation: Two lesson packages were designed and developed based on Mastery and constructivist based Learning Approaches, by the researchers. The packages were labelled Mastery Learning Package (MLP) and Constructivist-Based Learning Package (CBLP), for the two groups of students. Also, a 20 test-item was constructed based on the lesson on the circulatory system. The test item was validated by trusted colleagues in test construction. In the same vein, through the test re-test measure, a reliability co-efficient of 0.66 was obtained via a pilot application different from the target sample size.

DATA ANALYSIS: t-test was used to test the two null hypotheses

Result

Ho_1: Mastery Learning Approach and Constructivist Based Learning Approach are not significant factors in students' academic achievement in biology.

Table 2: Mean and standard deviation of both categories

Category	sum of X	sum of $\overline{(x- x)}2$	$\overline{N}$	X	SD	df	t-cal	t-tab	α-level
Mastery Learning Package	448	42	28	16	1.34	56	10.1	2.021	0.05
Constructivist-Based Learning Package	450	32	30	15	1.03				

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Since t-cal (10.1) is greater than t-tab (2.021) at df of 56, the null hypothesis is rejected and the alternative accepted.

H_{O2} : There is no significant difference between the mean performance of students taught biology using Mastery Learning Approach and Constructivist Based Learning Approach with respect to gender.

Table 3: Mean and standard deviation based on Gender

Category	sum of X	sum of $(\bar{x}- x)^2$	N	$\bar{X}$	SD	df	t-cal	t-tab	α-level
Male	480	59	30	16	1.92	56	6.3	2.021	0.05
Female	420	28	28	15	1.00				

Since t-cal (6.3) is greater than t-tab (2.021) at df of 56, the null hypothesis is rejected and the alternative accepted.

DISCUSSION OF FINDINGS

This study investigated the impact of two learning approaches, mastery learning approach and constructivist-based learning approach on senior secondary school students' academic achievement in biology.

Table 2 results indicated that there is a significant difference in the mean values of students taught biology using mastery learning approach from those taught biology using constructivist-based learning approach. Comparing students' academic achievement in biology using mastery learning approach and constructivist-based learning approach indicated that students exposed to biology through mastery learning approach achieved remarkable results than their counterparts taught through the constructivist-based learning approach. This finding coincides with the works of Adeyemo and Babajide (2014), Hussain and Suleman (2016), Lamidi, Oyelekan and Olorundare (2015), Udo and Udofia (2014), who found that Mastery Learning approach improved students' achievement better by breaking down subjects to be mastered in unit through re-teaching and re-testing until that concept is mastered. On the other hand, this finding is not in line with that of Jack (2017) and Akanwa and Ovute (2014) who established that, constructivist-based learning approach seems an appropriate instructional model that could be used to solve the problems of science teaching and learning since it has significant effect on students, enhances students' achievement, facilitates learning and its effectiveness is not limited by attitude. This finding tallies with that of Filgona, Filgona and Sababa (2017) and Aderemi (2006) who observed students' performance was better with mastery learning approach than with conventional (lecture) method.

Table 3 finding indicated that there is significant difference in the mean values of male students from their female counterparts exposed to either or both packages. The male students outperformed the female students when taught using mastery learning approach or constructivist-based learning approach. Hence, students' gender is a significant factor that determines how they learn through mastery learning approach and constructivist-based learning approach. This opposes Abakpa and Iji (2011) finding who stated that there is no gender difference when good teaching method is used.

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CONCLUSION

This study has shown that Mastery Learning Approach is outstanding, effective and efficient in promoting the desired learning outcome of students and enhancing their academic achievement in biology. It gave students the opportunity to break down the subject matter into units, and master each unit before proceeding to the next. Through differentiated and individualized instruction, progress monitoring, formative assessment, feedback, corrective procedures, and instructional alignment, students exposed to learning of concepts in biology using mastery learning approach achieved higher academically and retained the concepts better. Teaching biology using the Mastery Learning Approach at secondary school level can address students' poor academic achievement and the low enrolment in the subject.

Implication to Research and Practice

1) Mastery learning approach accommodates the natural diversity in learning abilities among different groups of students which provides a flexibility platform that accommodates all students according to their respective levels of learning, understanding and interest. This learning approach does not only enhance students' achievement but also stimulate students to be more actively involved in the teaching learning process.

2) Most of the students learn by doing so the students are allowed unlimited opportunities to demonstrate mastery of content they are taught.

3) Opportunities are given to those students who do not learn fast to catch up because subject contents are broken down into units and repeatedly taught until every student has mastered that unit before moving to another unit.

4) Teaching these students using mastery learning approach goes a long way in promoting knowledge acquisition and improving their academic performances.

RECOMMENDATIONS

Based on the findings of the study and conclusion reached, the following recommendations were made:

(1) Biology teachers should adopt Mastery Learning Approach as an effective teaching method in order to enhance students' academic achievement in internal senior secondary school biology examination as well as in external Senior Secondary School Certificate Examination level.

(2) Teachers should undergo training on how to use the mastery learning approach as an instructional strategy/method in the classroom.

(3) Workshops, seminars and conferences should be organized for biology teachers to update them on the principles and the use of Mastery Learning Approach as an instructional strategy.

(4) More teachers should be recruited to reduce class size as the current large class size may alter effective implementation of the Mastery Learning Approach as an efficient instructional strategy.

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