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ATTAINING MEANINGFUL LEARNING OF ECOLOGICAL CONCEPT: A TEST OF THE EFFICACY OF 7E LEARNING CYCLE MODEL

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ABSTRACT

This study explored the efficacy of the 7E learning cycle model on students' achievement and retention ability in ecology. The study employed a quasi-experimental research design. A total of seventy-five (75) SSII biology students drawn from two purposively sampled schools in Education District V of Lagos state formed the sample of the study. Ecology Achievement Test (EAT) was used for data collection. An expert in test and measurement and a biology teacher validated the achievement test. The reliability coefficient of the EAT was determined to be 0.80 using the split-half reliability coefficient. One research question was raised and three hypotheses were tested at a 0.05 level of significance and data were analyzed using analysis of covariance (ANCOVA). The results revealed a significant main effect of the 7E learning cycle on students' achievement in ecology [F (1,72) = 0.00; p< .05), the study also revealed that there was a significant difference in students' retention ability [F (1,72) = 0.03; p< .05) in favour of the group taught using 7E learning cycle and there was no gender influence on the achievement of students taught using the 7E learning cycle. Based on the findings it was concluded that the 7E learning cycle model is a potent strategy that offers a glimmer of hope that the problem of underperformance in ecological concepts can be changed for the better. Therefore, it was recommended amongst others that the use of the 7E learning cycle as an instructional strategy should be explored by teachers to enhance meaningful learning of difficult concepts in biology.

KEYWORDS

7E Learning cycle model; Achievement; Retention; Gender; Ecological concepts.

Introduction

In the quest to improve teaching and learning of science subjects in Nigerian classrooms, several methods have been postulated by findings from research to teach some difficult concepts in science subjects. Biology, as posited by (Ahmed, Shittu, Yahaya, &Dada, 2021), is the backbone of the three major science subjects (biology, chemistry, and physics) taught in the Nigerian senior secondary schools. Ecology is the branch of biology that is concerned with the study of living organisms in relation to their environment. The knowledge of students in ecology is required for the perfect understanding of; factors that affects the environment, how living and non-living organisms depend on one another and the environment for survival, prevention of health hazards and diseases, prevention of natural disasters.

Furthermore, the understanding of concepts of ecology is needed for better achievement in biology. Unfortunately, the West African Examinations Council (WAEC, 2017, 2018, 2019, 2020) Chief Examiners' report stressed that candidates avoid questions on ecology as they find ecological concepts concrete and difficult to understand, and the few students who answered questions on ecology performed poorly (Akintola, &Odewumi, 2021). These dismal performances have been attributed to many factors but (Ndayambaje, 2021) attributed students' poor achievement to the faulty teaching methods adopted by Nigerian secondary school biology teachers, while (Jolif, 2018) attributed the poor performance to inadequate and inappropriate instructional materials, unavailability of facilities, time constraints and poor teaching methodology.

Consequently, Adebanjo, (2021) attributed the poor performance of students in biologyto the use of lecture method to teach in secondary schools (Adebanjo,2021). Teachers, with the aim of covering a wide range of topics, deliver their lessons via the traditional approaches like lecture method which is known for being teacher centered and does not encourage learners' creativity, and only beams its light on a cognitive domain of learning at the detriment of other domains (Aroyoku&Obunwo, 2014).Ahmed, Shittu, Yahaya, &Dada, (2021) argued that the conventional lecture method used in many schools to teach biology is a major barrier to achieving success in biology education. Nwogbor (2001, as cited in Kangu, 2015) reported that teacher avoids more efficient activity-oriented pedagogical approaches such as inquiry, learning cycle, cooperative learning, concept mapping, Vee-mapping, and think-pair-share in favor of lecture method, which they believe is simple but according to (Cherono, 2021) it is sometimes inadequate and inappropriate.

Concerns about the impact of teaching methods on student achievement and retention ability have sparked a great deal of interest in educational research. This in turn lead to the development and implementation of constructivist instructional approach to enhance meaningful learning. Constructivist instructional approaches are student-centered approaches that emphasize learners' active participation in the process of constructing knowledge (Cherono, Samikwo& Stella, 2021). Constructivism classroom instruction prompts students' previous knowledge and their active participation, therefore enhancing meaningful learning and understanding of concepts being taught (Chenoro, 2021). The 7E Learning Cycle Model belongs to the constructivist approach of pedagogy, and it has seven potent stages that were expanded from the 5E learning Cycle Model by Einsenkraft. The 7E Learning Cycle Model combines both cognitive and social constructivist approach with its activities and stages being tailored in such a way that they enhance learners' mastery of the subject matter while actively being involved in the learning process. The benefits of 7E learning cycle model to the students as identified by (Fatimah &Anggrisia, 2019), ranges from offering experimental activities guidance to giving them opportunities to explore, explain and apply what they have learnt

to solve real-life problems. Consequently, Chenoro, (2021) opined that the primary aim of the 7E Learning Cycle Model is to highlight the increasing importance of prompting previous knowledge and transferring the knowledge acquired to a new context. The 7E Learning Cycle Model has seven crucial stages; elicit, engage, explore, explain, elaborate, evaluate and extend (Suardana, 2018).

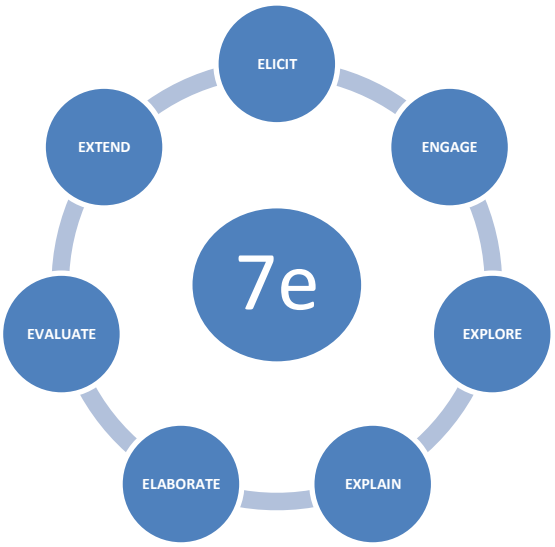

Fig 1: Diagrammatical representation of 7E Learning Cycle

The 7E learning cycle model was birthed when Eisencraft (2003) included 'elicit' and 'expand' at the beginning and the end of the existing 5E learning model. The rationale for this is not to confuse or burden the teachers, but to ensure that they do not skip or miss important learning elements. The elements of the 7E learning cycle model are intricately interwoven in a manner that permits the learners to make new discoveries through exploration of the instructional materials in the learning process, then apply what they have learnt to new situations. Each element of the 7E learning cycle model consists of various teaching and learning activities.

Elicit Stage is where the learners' knowledge about the topic to be discussed will be assessed. At this stage, the attention of the student is drawn to previous knowledge to help invigorate prior understanding (Shaheen&Kayani, 2015).

The **Engage Stage** is about focusing the learners' attention to the task at hand. Focusing the learners' attention requires the introduction of brief but interesting activities which in turn stimulate their thinking and increase their interest and curiosity to be exposed to new concepts and ideas (Naade, Alamina&Okwelle ,2018).

During the **Explore Stage**, students are expected to make observations, record data, design experiments, test hypotheses, interpret results, isolate variables and explain their discoveries.

During the **Explain Stage**, a more central role is assumed by the teacher as new concepts, ideas, theories, laws, themes are introduced and thoroughly explained by the teacher (Juliana ,2019).

Enlarging the learners' conceptual understanding is the thrust of the **Elaborate Phase.** This stage is believed to be proportionately bonded with the psychological construct called transfer of learning Einsenkraft (2003, as sited in Chenoro,2021). At this stage, students are opportune to transfer what

has been learned from one context to another. The knowledge that has been previously garnered is now administered to new words/ideas/theories at this stage (Chenoro,2021).

At the **evaluation stage**, the teacher assesses learners' conceptual understanding both formatively and summatively (Chenoro, 2021). At this stage, the objectives set by the teacher are analyzed and the extent to which these objectives have been attained is estimated. This can be achieved by the teacher assigning task to the students, conducting quizzes, and asking questions (Sharma, 2018).

Finally **extend phase** was added to elaboration phase with the sole purpose of ensuring students are able to successfully apply a learned idea or principle in a new situation (Kajuru&Kauru, 2011). 7E learning cycle model provides more specific steps to ensure that students' prior knowledge, learning transfer and application are not overlooked.

A brief review of literature on the 7E Learning Cycle model led us to findings from the study conducted by (Marfilinda, 2021), while investigating the efficacy of 7E Learning Cycle model on students' achievement in basic science. The study revealed that the 7E Learning Cycle model is more effective than conventional lecture method of teaching as the students in the 7E learning cycle group outperformed their counterpart in the conventional lecture method group. In the same vein (Abdullahi, Jibrin, Dauda, &Danjuma, 2021), conducted experimental research to determine whether conventional methods of teaching are better than the 7E Learning Cycle model. The study revealed that the students taught using 7E Learning Cycle model performed better than those taught using the conventional methods. Additionally, the students taught with the 7E Learning Cycle model retained 80% of the concepts taught while those who were taught using the conventional methods retained 10% of the concepts taught. In a study conducted by (Chenoro, 2021) on the impact of the 7E Learning Cycle model on students' achievement and attitude in Biology. The study revealed that the 7E Learning Cycle model when used as a learning model improves students' academic performance and allows active involvement in learning, discussion and sharing of ideas amongst the students.
However, little explanation has been provided in literature on the effect of 7E learning cycle model on achievement and learning retention of students in Nigeria. Gleaning from the foregoing, this study considered investigating students' achievement and retention in biology with particular interest in ecological concepts.

Research question

1. Will there be any significant difference in the mean score of students taught using the 7e learning cycle model and those taught using the conventional lecture method?

Hypotheses

The following research hypotheses were formulated and tested to guide the study

1. There will be no significant difference in the academic performance of students taught using the 7E learning cycle model and those taught using the Conventional lecture method
2. There will be no significant difference in the retention ability of students in ecological concepts taught using the 7E learning cycle model and those taught using the Conventional lecture method

There will be no significant difference in the academic performance of male and female taught ecological concepts using the 7E learning cycle model.

Materials and Methods

The study employed a quasi-experimental research design. This is due to the inability to assign participants to the experimental and control groups at random during data collection. A total number of *seventy-five senior secondary school II biology students comprising of 42 males and 33 females selected from two purposively sampled schools in Education District V of Lagos state formed the sample of the study*. Intact classes were used for the study because the school authority wouldn't allow the disorganization of the classes. Forty students in one school were used as experimental group, while thirty-five students in another school stood for the control group. Both groups were exposed to 45 minutes of instruction on Ecology. The experimental group was taught Ecology using the 7e learning cycle model, while the control group was taught using lecture method.

Ecology Achievement Test (EAT), a 30-item multiple-choice test was used to collect quantitative data. The instrument was adapted from the West African Examination Council (WAEC) biology past question from 2017 to 2020 with little moderation hence there was a need for reliability and validity. The reliability of the EAT using split-half reliability coefficient was 0.80. Face and content validity of the instruments was ensured by test experts, biology teachers and science educators. The instrument consists of two sections; section A which required demographic data of the students and section B which consisted of 30 objective questions on ecology.

Data Collection Procedure

Permission was sought from the authorities of the participating schools and students consent to voluntarily participate in the study with an understanding that they are free to withdraw their interest at any point during the study. A pre-test was conducted for both groups using Ecology Achievement Test (EAT) to determine the prior knowledge of the students. In each item, there were three distractors and one key. The achievement pre-test was marked and each correct answer was awarded 1mark and the maximum obtainable mark is 30 marks. The experimental group received treatment using the 7e learning cycle model while the control group were exposed to the conventional method. The treatment lasted for four weeks and each group were exposed to 45 minutes of instruction on Ecology.

The teacher for the experimental class was trained on how to use the 7e instructional approach to deliver instruction. Two microteaching sessions were conducted to ensure the mastery of the approach by the teacher. The treatment lasted for four weeks. At the end of the treatment, a post test was conducted to determine the difference in achievement of the students. The test administration was carefully done with no observable difference in the process for the two groups particularly concerning time allotted, supervisors and willingness to take the test by the students.

Four weeks after the posttest, a retention test was applied to both the experimental and control group to ascertain the difference in their retention ability.

Data Analysis

The pretest and posttest data generated from the study were analysed using ANCOVA on IBM SPSS version 23 software. Having confirmed that the two groups are not significantly different using the Levene test of homogeneity of variance ($F = .98$; $P > .05$) and the Shapiro-Wilks' test of normality

showed that the two groups are normal; Experimental group (N= 40) = .49, p > .05 and control group (N= 35) = .49, p > .05, an ANCOVA Statistic was applied on the pre-test and post-test scores using the pre-test as a covariate

Results

Research question one: Will there be any significant difference in the mean score of students taught using the 7e learning cycle model and those taught using the conventional lecture method?

To answer this question the bar chart of the mean and standard deviation of students taught using the 7e Learning Cycle Model and those taught using the conventional lecture method were used. The result is presented in Figure1;

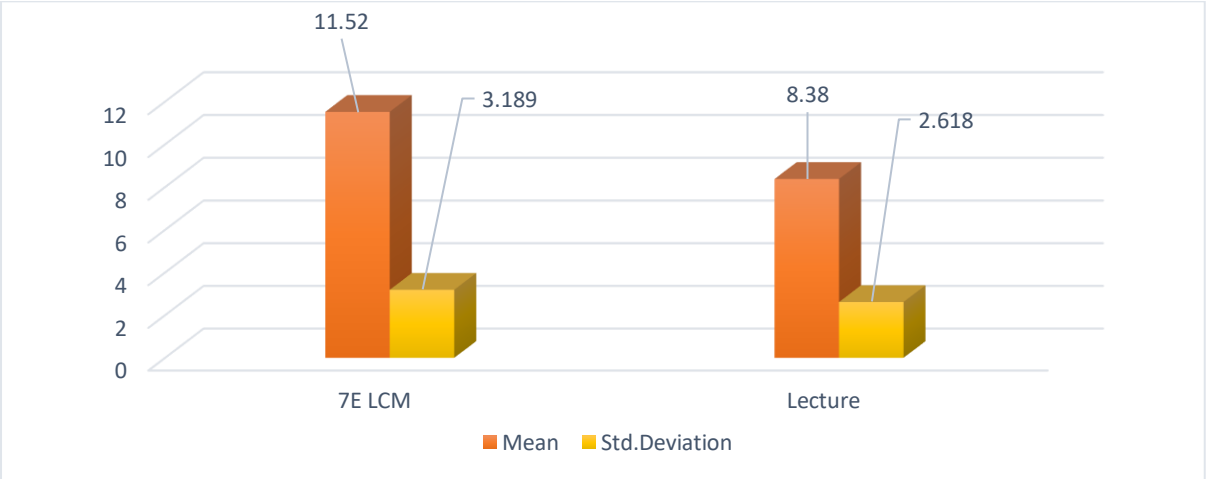

Fig 2; Graphical representation of the mean score of students in the 7e Learning Cycle Model (7E LCM) group and those in the conventional lecture method group

From the bar chart above, it was observed that the students in the 7E learning cycle group had a higher mean score 11.520 and a standard deviation of 3.189 compared to the students taught with the conventional lecture method which recorded a mean score of 8.380 and a standard deviation of 2.618. The mean difference between the 7e Learning Cycle Model group and the conventional lecture method group can be calculated to be 3.14 with the 7e Learning Cycle Model group having a higher mean gain.

Hypothesis one

There will be no significant difference in the achievement of students taught using the 7E learning cycle model and those taught using the conventional method

To test this hypothesis, the analysis of variance statistical tool was used and the result is presented in Table 2.

Table 1. Analysis of covariance on the posttest achievement of the 7e learning cycle model and the lecture group

Dependent Variable: Posttest

Source	Type III Sum of squares	Df	Mean Square	F	Sig
Corrected Model	196.879[a]	2	98.440	11.275	0.00
Intercept	567.653	1	567.653	65.015	0.00
Pretest	2.734	1	2.734	.313	.577
Method	196.044	1	196.044	22.454	.000
Error	628.641	72	8.731		
Total	8206.000	75			
Corrected Total	825.520	74			

a. R Squared = .238(Adjusted R Squared= .217)

The ancova results showed a significant difference in the achievement of students taught using the 7E learning cycle model and those taught using the Conventional lecture method [F (1,72) = 0.00; p< .05). Based on this result, the hypothesis that there will be no significant difference in the achievement of students taught using the 7E learning cycle model and those taught using the conventional method is therefore rejected.

Hypothesis two

There will be no significant difference in the retention ability of students taught using the 7e learning cycle model and those taught using the Conventional lecture method.

Table 2. Analysis of covariance on the retention ability of the 7e learning cycle model and the lecture group

Dependent Variable: Posttest

Dependent Variable: Posttest

Source	Type III Sum of squares	Df	Mean Square	F	Sig
Corrected Model	63.174[a]	2	31.587	2.534	.086
Intercept	572.131	1	572.131	45.902	.000
Pretest	16.448	1	16.448	1.320	.254
Method	55.656	1	55.656	4.465	.038
Error	897.413	72	12.464		
Total	9687.000	75			
Corrected Total	960.587	74			

a. R Squared = .066 (Adjusted R Squared= .040)

The ancova results showed a significant difference in the learning retention of students taught using the 7E learning cycle model and those taught using the Conventional lecture method [F (1,72) = 0.03; p< .05). Based on this result, the hypothesis that there will be no significant difference in the learning retention of students taught using the 7E learning cycle model and those taught using the conventional method is therefore rejected.

Hypothesis three

There will be no significant difference in the academic performance of male and female taught using the 7e learning cycle model.

Table 3. ANCOVA summary table of difference in the achievement of male and female students in the 7e learning cycle model group
Dependent Variable: Posttest

Source	Type III Sum of squares	Df	Mean Square	F	Sig
Corrected Model	8.281[a]	2	4.140	.446	.644
Intercept	526.242	1	526.242	56.685	.000
Pretest	4.208	1	4.208	.453	.505
Gender	3.265	1	3.265	.352	.557
Error	343.494	37	9..284		
Total	5573.000	40			
Corrected Total	351.775	39			

b. R Squared = .024(Adjusted R Squared= .029)

The result of the ANCOVA showed that there was no significant difference in the achievement of male and female students taught using the 7e learning cycle model [F (1,37) = 0.557; p>.05. Based on this result, the hypothesis that there will be no significant difference in the achievement of male and female students taught using the 7E learning cycle model and those taught using the conventional method is therefore not rejected.

Discussion of Findings

This study explored the effect of 7e Learning Cycle Model on students' achievement and retention ability**.** The first hypothesis investigated if there is any difference in the achievement of students taught using the 7E Learning Cycle Model and those taught using the conventional method. The study revealed that students taught using 7e learning cycle model achieved significantly better than their counterparts exposed to the lecture method. This finding is in agreement with that of Cherono et al, (2021); Fatima and Anggrisia, (2019); Cherono, (2021); Adesoji&Idika, (2015). The aforementioned researchers, in separate studies, found that the 7E learning cycle model had a positive impact on students' critical thinking ability, learning retention and achievement as they performed better than students taught using the conventional method.

The statistically significant difference in favour of the 7e learning cycle model group was because, unlike the lecture method where students are passive participants, students in the 7e learning cycle model group were actively involved in knowledge construction through a series of short activities executed individually and in groups. Consequently, the students in the LCM group were involved in two vital learning phases; elicit and extend, which are unique to this model. Elicit step, as Eisenkraft (2009, as cited in Chenoro, 2021) opined, is crucial for understanding learners' prior knowledge to determine what they know. If there were any misconceptions, they could be assessed and corrected so that the learners do not misconstrue the teacher's presentation of concepts. The extend phase, which supports the transfer of learning, an essential component in science education, ensures that the learners apply learnt concepts to new contexts and real-life situations. The application of the 7E Cycle learning model positively impacts both the teacher and the learners as it helps the teacher construct a

pleasant and not boring learning atmosphere and helps the students sharpen their critical thinking skills. This explains why (Marfilinda et al, 2019) advocated for the 7E learning cycle model because it fosters inquiry-based learning and allows students to work together, explore, ask questions and seek scientific explanations and answers. Students in the 7e learning cycle model group are not taught to memorize the content but to understand and comprehend what has been taught and apply this knowledge in their daily lives. These features are uncommon in the conventional method group as students rely solely on the information given by the teacher and, as such, remain passive during the learning process. On the other hand, the result of the current study contradicts the submission of Chawla, 2015. The disparity in results could be attributed to the different sample size, class and location used in the study.

The second research hypothesis sought if there was a statistically significant difference in the achievement of male and female students taught using the 7E learning cycle model. The findings revealed a no statistically significant difference in the achievement of male and female students taught using the 7E learning cycle model. This finding is in agreement with that of Okoronka, 2018; Ogonnaya *et al*., 2018; Chawla, 2015; Cherono, (2021), who found no significant difference in the achievement of male and female students and observed that male and female students achieved almost equally when exposed to innovative teaching strategy. This implies that the 7E learning cycle model is equally beneficial for both sexes. Hence it could be applied in a mixed-gender classroom to increase the achievement of all students.

However, the findings of this study contradicted that of Sor *et al*, (2018); Udeani& Okafor, (2012), whose findings revealed that there was a statistically significant difference observed between gender which was in favour of the female students and that of Oladejo *et al*, (2020) in favour of the male.

The third hypothesis sought if there is a statistically significant difference in the retention ability of students taught using the 7E learning cycle model and those taught using the conventional lecture method. This study also revealed a significant difference in the learning retention of students taught with the 7E learning cycle model and those taught with the conventional lecture method. This finding implies that 7e learning cycle model can be employed in teaching ecological concepts as it aids conceptual understanding by the students, allowing students to retain concepts that have been taught earlier. This finding agrees with that of Abdullahi et al, (2021). The significant difference in the retention ability could be because the students in the experimental group were actively involved in knowledge construction through a series of short activities and the extend phase, which made them relate what they learnt in the classroom to their day-to-day life activities. Hence this might promote better learning retention.

Conclusion

The study investigated the efficacy of the 7E learning cycle model on students' achievement and learning retention in ecological concepts in biology. From the findings of the study, the 7E learning cycle model had a significant impact on students' achievement and learning retention in ecological concepts. It also revealed that both the male and female students benefitted equally from the approach. It was deduced that the use of the 7E learning cycle model would significantly improve educational outcomes, particularly in difficult concepts in biology. The 7E learning cycle model offers a glimmer of hope that the problem of underperformance in ecological concepts needs to and can be changed for the better.

Recommendations

Based on the findings, the study recommends that ministries of education at all levels and stakeholders like NERDC and STAN should commission research studies on the use of 7e learning cycle model in schools to create a pathway for its integration considering its potential to improve students' achievement and learning retention in ecological concepts, which can consequently have a positive effect on science and technological advancement in the nation. Furthermore, the 7E learning cycle model should be integrated into various topics, not just biology but also other science subjects, to improve students' performance. Lastly, Further work should include investigations of the potency of the 7E learning cycle model on a larger number of participants with more diverse cultural backgrounds and school locations.

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