Applying 7E Learning Cycle Model to Unlock Gender Differences in Biology Academic Achievement in Chesumei Sub-County, Kenya

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Abstract

This study explored the application of the 7E learning cycle model as an alternative to bridge the gender gaps that exist in the achievement of Biology among secondary school students. The study objective was to investigate the effect of 7E learning cycle Model on gender performance in Biology in secondary schools in Chesumei Sub-County. Quasi experimental design was used. A sample size of 346 form three students was selected using stratified sampling and simple random sampling techniques. Data collection instrument was Biology Achievement Test. Validity of the instrument was determined by two experts in the field of Biology Education. Test- retest technique was used to determine the reliability of the instrument. A reliability coefficient of 0.83 was obtained by use of statistical tools. Mean, standard deviation and t-test were used to analyze data. The results were presented using inferential statistics. Results of the study revealed that the mean score of the girls in the experimental group performed better than the boys in the same group. In addition, the study also found that there was a statistically significant difference between the mean scores of those taught using 7E Learning Cycle Model and those taught using Convectional Instructional Method. The study concluded that 7E Learning Cycle Model has the potential of improving academic achievement of the learners in both group, but more significantly the girls outperformed the boys. It was therefore recommended that Biology teachers should employ such constructivist approach as 7E learning cycle model in teaching so as to bridge the gender gaps that we experienced in class. In addition, Kenya Institute of Curriculum Development should organize and conduct capacity building on teachers on the adoption of 7E Learning Cycle Model for instruction at various levels of curriculum implementation.

Keywords: 7E Learning Cycle Model, Gender, Biology, Academic achievement

INTRODUCTION

Constructivist learning theory has had an enormous influence on contemporary science education in the recent years. In his book, Mathews (1998) argues that constructivists link their ideas to empowerment and emancipation, ideas that clearly outruns mere epistemology and culminates at each stage of growth with questions arising that deserves the attention of every educator in the learning process. Constructivism learning theory in science is a theory of how learner constructs knowledge from experience, which is unique to every individual. According to this theory, an individual construct their understanding and knowledge of the environment, through experiencing with objects and reflecting on experiences they have received (Van Manen, 2015). Learners prefer positive constructive work environments as this involves the learner as an active participant in their environment for meaningful learning to take place. Learning is an active process and therefore the active role the learner takes in the

constructivist learning theory does not give room for passive transmission of knowledge from the educator to the learner. Due to its importance in the educational set up, several teaching methods and strategies have been developed to bring about effective delivering of content by teachers and easy and meaningful understanding of concepts by students (Sam, Owusu and Anthony-Krueger, 2018). Scholars in this area of teaching and learning have developed several models in the teaching learning environments where learners take the center role in knowledge generation. 3E learning cycle model (Exploration, Explanation and Expansion) have been developed and used for lower order thinking skills. Then came the 4E learning cycle model with Explore, Explain, Expand and Evaluate. A further extension of the 5E Learning cycle model was also used to teach science concepts i.e Engage, Explore, Explain Expand/Elaborate and Evaluate (Trowbridge and Bybee, 1990). Chasin and Moore (2004) added another 'E' to make the 6E learning model Engage, Explore, Explain Expand/Elaborate, Evaluate and e-search which ties the five stages and incorporates the use of technology into the model. To begin with, Aubusson, Watson and Brown (1998) carried out 5E model trial study in enhancing lower primary science to solve the problem where teachers found it difficult and impracticable to use theoretical approaches in their classes. A unit work was developed using the Five E's (Engage, Explore, Explain, Elaborate and Evaluate) to teach sample of 10 students. The students in the study found it interesting, motivating, fun and promoted higher order thinking skills.

In Africa, several studies have shown that teachers have utilized variety of instructional strategies to improve students' academic achievements. For instance, in order to address persistent low students' performance in secondary schools, South Africa put in place initiatives to improve school quality. Some of the measures put in place included; reviewing of education policy, prioritizing teacher development, involving stake holders in education planning. 7E is a model based on Learning Cycle. It emphasizes seven phases that should be adopted by science teachers in teaching science: Elicit, Engage, Explore, Explain, Elaborate, Evaluate and Extend. Each phase covers hands-on and minds-on activities that respectively aim to elicit prior knowledge and transfer of learning.

THE 7E LEARNING MODEL CYCLE

Eisenkraft (2003) stated seven critical elements: elicit, engage, explore, explain, elaborate, evaluate, and extend as the component of the model. The 7E Learning Cycle Model is a useful recommended instructional approach in science curriculum and teachers should be encouraged to incorporate this model in their teaching (Balta & Sarac, 2016). Existing learning model should sometimes be amended to maintain its value after new knowledge has been gathered (Eisenkraft, 2003). The changing science curriculum demands that highly successful 5 E instructional model should be expanded to a 7E instructional model. Eisenkraft (2003) extended the 5E learning model into 7E learning model, with Elicit and Extend at the beginning and at the end, respectively. This is not to add complexity but to ensure the instructors do not omit crucial components for learning. 7E instructional model is important because it emphasizes eliciting previous knowledge or understanding of the learner. It also emphasizes transfer of knowledge which the most important part in science education. 7E instructional model steps are shown in figure 1 below:

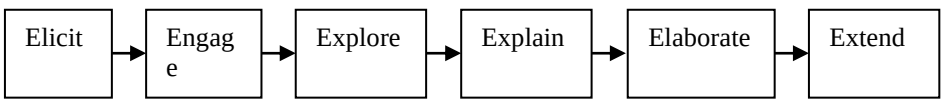

Figure 1: Showing the 7E instructional model steps
Source: Eisenkraft, 2003

7E learning cycle model is a series of seven planned and interconnected phases in which the learner goes through various scientific investigations by exploring teaching material, build the concept after arriving at a certain conclusion and finally apply the concept or a principle in a novice situation. The description of each phase of the 7E model is according to Eisenkraft (2003), is as follows;

Elicit stage has to do with arousing students' prior knowledge to ascertain what the students know about the topic being taught (Eisenkraft, 2003). The teacher plays an active role during the eliciting phase. It lets the teacher assess any misconceptions the students have. New knowledge is built on existing knowledge which assists in transferring of knowledge (Adesoji & Idika, 2015). The means by which teachers may elicit prior knowledge is by framing a "what do you think" question at the beginning of the lesson. From the students' responses the teacher could elicit their prior knowledge and misconception would be redressed in the course of the learning. Elicit phase should stand alone as a reminder of its importance in constructive learning. Students will actively participate during the elicit phase. As the central idea about the concept is provided to them, students will try to connect the given concept with their previous knowledge. In this phase the students will be given spaces for projecting their own ideas and creativity.

Engage stage is a phase of the learning cycle that the student is engaged in a new concept through the use of short activities. The teacher takes up an attempt to grasp the interest of students, raise questions in their minds and increase their attention and enthusiasm; subsequently they get ready to learn. It focuses student thinking on content providing conversation opportunities for all students. Students do brainstorm during the engage phase. They will use think-pair-share technique to express their ideas to their peer groups. This phase raises many questions in students' minds. They will ask to themselves some questions like what do I already know about this? Why this thing happened? What can I conclude from this?

Explore stage provides students with a common base of activities within which concepts, processes and skills are identified and conceptual change is facilitated. Here students get to record data, isolate variables, design experiments, create graphs, interpret results, and organize findings while the teacher checks for the students' understanding. In this phase the students are given various opportunities to think freely but within the limits of the activities. The student's role in this phase is vital and the teacher will play a passive role though he will address and guide the students towards building a new concept during this phase. The teacher encourages the learners to work together in a collaborative and cooperative manner. He may ask probing questions for redirecting the learner's investigation. The teacher provides time for the learners to puzzle with the problem given to them. The students test predictions. They make certain hypotheses based on the evidence collected, record data and interpreting the data and finally organizing their findings. In this phase peer discussion is given due importance, students discuss their findings with their peer groups.

In Explain stage, the teacher adopts a more central role while discussing information and explaining the concepts associated with the students' exploration. It provides teachers opportunities to directly introduce a concept, process or skill. The teacher explains theories, principles, laws and facts with the help of video, concept maps or presentations as well as lecturing directly. In this phase, "the teacher guides students toward coherent and consistent generalizations, helps students with distinct scientific vocabulary, and provides questions that help students use this vocabulary to explain the

results of their explorations." (Eisenkraft, 2003, p58). In this phase students are given opportunities to verbalize their conceptual understandings. Both the teacher and the student play an active role in this phase. The teacher encourages the students to explain the concept in their own words. The teacher will then formally introduce the definitions or the scientific terms. Students' growing understanding is assessed by the teacher. In this phase students try to comprehend their explanations. They explain possible alternatives or solutions. They will listen critically to their peer group explanation. Students can also question other's explanation. They are given an opportunity to assess their own understanding.

Elaborate phase helps in extending learner's conceptual understanding. Students get deeper understanding of the concepts by performing similar kinds of activities. Their practical skills will be enhanced and refined through this phase. The teacher helps the students to think of alternative explanation of the concept. More opportunities are provided to the students to enhance and refine their practical skills. Similar activities can be shown to the student in order to get deeper understanding of the concept. Students are encouraged to use their understandings to new areas by conducting additional activities in this stage. This may give raise to new questions and hypotheses to explore. This phase ties directly to the psychological construct called 'transfer of learning" (Thorndike, 1923). Students uses their previous knowledge to ask more questions, make decisions, propose solutions etc. They tend to draw reasonable conclusion from the evidence.

Evaluate stage provides the teacher with an opportunity to evaluate students' progress through formative or summative, formal or informal evaluation. The teacher assesses the extent to which the set objectives have been achieved. It is a phase which also encourages students to assess their understanding and abilities. In this phase teacher assesses the change in students' thinking abilities. The teacher may ask open ended questions, may provide mind map to complete the information they have learned during the process. Students will answer open ended questions asked by the teacher. They may be asked to interpret data. Students may also be asked to complete a summary report during the evaluation phase.

Finally extend stage is added to elaboration stage with the intention to remind teachers of the importance for students to practice transfer of learning. Students are challenged to extend their understanding in a new context, compare and contrast ideas, theories and concepts in relationship with the knowledge gained. Also find out real life situation the concept can be applied (Kajuru & Kauru, 2014). The aim for adding this phase is to inform the teachers that applying traditional assessment ways is not the last process. The addition was intended to remind the science educators explicitly the importance of practicing the transferability of learning. Science educators need to make sure that the concept studied by the students is not just confined to elaboration and evaluation but once a particular skill or a concept is learned, it must be applied in a novice or an unfamiliar situation. The transfer of concepts in a new situation will help students to retain the concept for a longer duration.

Studies of 7E Learning Cycle Model on Gender Performance

Study Design and Methodology

The study was done in Chesumei Sub-County found in Nandi County, Kenya. The study adopted quasi-experimental design with a pre-test post-test, where intact classes in the experimental and control groups participated in the study.

GROUPS	PRE-TEST	PROCESS	POST TEST
Experimental group	√	√	√
Control group	√	×	√

Source: Field Design

The treatment entailed allocating participants in intact classes into experimental and control groups. Biology teachers in the selected schools were inducted so that they participated as research assistants. Biology teachers in the experimental group were given 7E Learning Cycle Model Manual on how to use 7E Learning Cycle Model to teach Classification. Students in both Experimental and Control groups were given a pretest to ascertain if there was a significant mean difference between the two groups with respect to their performance in Classification in Biology before the instruction. After pretest, experimental groups were taught using 7E Learning Cycle Model while the control groups were taught using Conventional Instructional Method. During the instruction process Classification was covered within 7 weeks as per Biology syllabus approved by KICD. One week after completion of the instruction, a post test was administered to test the effect of treatment on the experimental group.

Mixed methods were used where Biology Achievement Test yielded quantitative data while the questionnaire yielded both quantitative and qualitative data. The study targeted 3421 form three Biology students in 45 schools where a sample of 346 participants of mixed gender drawn from 6 schools were selected to take part in the study. There were 175 males and 171 females who took part in the study.

RESULTS

Data was analyzed both by descriptive and Inferential statistics. The pretest scores were as follows:

Pre-test Scores

Pre-test was administered to both experimental and control groups. The data was then separated by gender and the results obtained were as follows:

Table 1: Students' mean and standard deviation in pre-test

Type of Group	N	Mean	SD
MALES	175	12.82	5.671
FEMALES	171	11.20	5.124

Source: Field Data

Table 1 presents the comparison of means and SD for the females and the males who took part in the study. There were 175 males and 171 females who sat the pretest Biology Achievement Test. The males mean score and a standard deviation of (mean =11.82; SD=5.171) while the females attained a score of (mean = 12.20; SD=5.624). Both the males and the females in the study had similar mean scores as seen in the SD.

Table 2 contains the results of a t-test carried out to establish the difference in means for the pre- test comparing scores between males and females. The p-value that was obtained was 0.000. Since the p-value was less than 0.05, these implied that the means were not equal. Therefore, the mean scores for females (11.20) and males (12.82) were different. This meant that the females and males were of varied ability at the pre-test, the mean score for the females was lower than that of the males.

Table 2: T-Test for Equality of Means Between Male and Female (Pre-Test)

	t-test for Equality of Means						
	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
						Lower	Upper
Pre-test Scores	4.813	138	0.000	9.971	2.072	5.875	14.068

Post Test Scores

The experimental period was done in a period of 7 weeks. The topic "classification" is taught within this period as recommended by the Kenya Institute of Curriculum Development (KICD). The experimental class were taught using the 7E Learning Cycle Model while the class in the control group were taught by the conventional instructional approaches. At the end of the experiment period, post-test was conducted to the same participants after one week of completion of the instructional process. The results are illustrated in the Table 2.

Table 3: Students' mean and standard deviation in post-test

Type of Group	N	Mean	SD
FEMALES	171	48.240	11.4591
MALES	175	25.081	9.7586

Source: Field Data

Table 3 indicates that Female participants attained a mean score and a standard deviation of (mean = 48.240; SD=11.4591) while Male participants attained a score of (mean = 25.081; SD=9.7586). From the results, the Female Participants had higher mean scores than their male counterparts. This implies that the female students

Table 4: t-test for equality of means between Male and Female (Post-test)

	t-test for Equality of Means						
	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
						Lower	Upper
Post-test Scores	2.434	68	0.018	7.629	3.135	1.375	13.883

Table 4 contains the results of a t-test carried out to establish the difference in means for the post- test comparing scores between males and females. The p-value that was obtained was 0.018. Since the p-value was less than 0.05, there was sufficient evidence to say that the means were not equal. There was a difference in Biology achievement between boys and girls instructed through the conventional approaches of teaching process.

From the t-test for the posttest scores presented on table 4, it can said that both Males and Females improved after the treatment using the 7E Learning cycle model. Worth noting is that the females' participants in the experimental group in the study scored better than their male counterparts. These results concur with the findings of Sam, Owusu and Anthony-Kruger (2018) where they found out that the experimental groups performed better on the post test scores as compared to the control group. Just like the 7E learning cycle model used in this study, they also noted that the 3E learning cycle model was effective in improving the performance of the low achievers.

As Kenya prepares to face out the 844 curriculum and replace it with the CBC curriculum which gives special emphasis on the skill development, methodologies also

need to match the needs of the new curriculum. 7E learning Cycle Model is promising since the methodology gives hands-on activities at each stage and emphasis critical thinking. In the wake of the CBC, teachers have to adopt teaching methodologies that work efficiently more so if they align to the needs of the learners. Every learner is unique in the way he/she interprets and responds to issues and experiences in an exceptional way.

CONCLUSION AND RECOMMEDATIONS

From the results of this study, the 7E learning cycle model is a remedy to unlock gender differences in Biology academic achievement in Chesumei Sub-County. This can be attributed to the fact that the female students in the treatment group who participated in the study improved after being taught by the 7E learning cycle model and scored much better than their female counter parts in the study. This reason underscores the importance of the 7E learning cycle model strategy as a powerful instructional tool in the 21st century classrooms with an emphasis on hands on activities for meaningful learning to take place. The study therefore concludes that the 7E learning cycle model is an instructional strategy that can unlock gender differences in the achievement in Biology. The study recommends Biology instructors to endeavor to employ a constructivist approach such as 7 E learning cycle model to unlock gender differences in academic achievements. The 7E learning cycle Model allows students to construct their own knowledge along with active participation in class activities hence meaningful learning. In addition, the Kenya Institute of Curriculum Development (KICD) should incorporate constructivist approaches such as 7 E learning cycle model into the biology curriculum for teaching Biology in secondary schools to unlock gender differences in performance.

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