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THE 5E INSTRUCTIONAL MODEL: AN IMPLICATION FOR LEARNERS' SCIENTIFIC SKILLS ACQUISITION AMONG SECONDARY SCHOOLS IN VIHIGA COUNTY, KENYA

Alice Nabie[1], Ong'unya, Raphael Odhiambo[2] and Toili, William Wamalwa[3]

[1]A PhD student in Science Education, Department of Science and Mathematics Education, School of Education, Masinde Muliro University of Science and Technology. Email: nabiealice@gmail.com

[2]A Senior Lecturer of Curriculum Evaluation, Department of Science and Mathematics Education, School of Education, Masinde Muliro University of Science and Technology. Email: rongunya@yahoo.com

[3]A Professor of Science Education, Department of Science and Mathematics Education, School of Education, Masinde Muliro University of Science and Technology.

ABSTRACT

This study investigated the effects of 5E instructional model on Biology students' acquisition of scientific skills in Vihiga county, Kenya. The objective of the study was to determine the effect of using 5E instructional model approach on student's acquisition of scientific skills. The secondary education curriculum in Kenya has been adversely criticized by researchers and the production industry for not meeting the societal expectations. It is accused of focusing on knowledge rather than enabling learners to acquire skills required for the world of work. The government has therefore adopted the Competency Based Curriculum (CBC) to allow learners acquire skills and values to address the challenges posed by the job industry. The secondary education curriculum has since been designed to embrace learner centered activities with a greater collaboration with the community to meet their demands. The study engaged 550 students of biology. A pre-test and post-test on acquisition of scientific skills were used for data collection. Validation of the instruments was by Kenya National Examination Council experts in Biology. Reliability of the tests was determined by Cronbach's reliability using split half method. Data analysis was done using T-test at 0.05 level of significance. The results indicated a significant difference in acquisition of scientific skills between learners in the treatment group and the control group. It was therefore concluded that the 5E instructional model improved scientific skills acquisition among students of Biology in secondary schools in Vihiga County, Kenya. The study therefore recommended that teachers should adopt 5E instructional model to improve learner's acquisition of scientific skills in Biology lessons.

KEYWORDS: Scientific Skills, 5E Instructional Model, Secondary Education Curriculum

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INTRODUCTION

Biology is a critically important science that gives in-depth understanding of diverse life forms and their interaction in nature. It enables learners to apply scientific concepts, principles, skills and attitudes in solving everyday life problems. It therefore allows learners to acquire pre-requisite scientific skills, knowledge and values necessary in the professional fields like medicine, nutrition and agriculture for a healthy nation. In medicine, knowledge of biology is utilized in diseases prevention and control. The subject also plays a vital role in the field of biochemistry, genetics, physiology anatomy, anatomy, and ecology (Olutola et al, 2016) thereby forming a central focus in some human activities including being a solution to problem of food scarcity, health, hygiene, poverty eradication, management and conservation of natural resources as well as infrastructural materials. Taiwo and Emeke (2014) observe that biology exposes the students to the world of knowledge of self, the immediate and distant environment. Similarly, Aina (2013) believes that biology education is important to any growing economy. Quality academic achievement in biology at Kenya Certificate of Secondary Examination (KCSE) is therefore critical for development.

Despite the role of biology in a nation, students consistently post low performance index of in the subject (WAEC, 2011; Taiwo & Emeke, 2014). There is a downward trend in students' achievement in biology over the years as follows: 35.74% (2010); 35.61(2011); 33.57(2012); 33.94 % (2013) and 33.87 (2014) (WAEC Reports, 2014). This trend is not different in KCSE performance by students in biology in Kenya as shown in the table 1:

Table 1 KCSE Performance in Biology from 2015 to 2018

YEAR	2015	2016	2017	2018
Mean Mark (%)	34.0	29.0	18.9	25.69
Mean Grade	D+	D	D-	D

Source: KNEC annual KCSE Reports, (2015-2019)

Dewey (2011) observed that poor performance of students in science has often been regarded as symptomatic of poor learning approaches, however Makgato and Mji (2006) argue that poor teaching methods have a direct influence on the performance of learners in the science subjects. In support of the same, Muzah (2011) observes that the teaching methods used by a science teacher reduces science to preparation for exams rather than enhancing the learner's ability to explore ideas by means of hands-on-activities. Instead of teachers conducting passive classes, a practical approach needs to be adopted so that the learner may relate it to their daily situations. This may enhance acquisition of scientific skills necessary for realization of desired manpower as intended by the Competency Based Education (CBE). Being a holistic, skill and value-oriented education learning process prioritizes individual learning, critical thinking and creative imaginations embedded in practical skills development. This

demands for a paradigm shift on the role of the teacher in the classroom, from authoritative and all-knowing to that who engages learners to relate the Science facts to the real-life situation by facilitation. This is emphasized by Akubuito (2004) who observes that teacher's methodology has significant effect on student's performance in biology, and that students with effective methodology are likely to come out with good performance while students not taught well will perform poorly. Research findings indicate that application of 5E Model in learning improves performance of the learner. Bybee (1997) argues that the use of this approach helps students redefine, organize, examine and change the idea they already have through peer interactions and environment. Senan (2013) reported that the technology-enriched 5E learning model is a good tool for students to acquire 21st century skills as well as for teachers to teach a specific concept. 5E therefore allows education to create a unique learning experience and helps students build a strong foundation of knowledge thus active participation. However, the 5E instructional approach has not been utilized in secondary schools in Kenya so far to allow this unique experience.

METHODOLOGY

The study employed quasi- experimental design since it was ideal in allowing the researcher to use intact classes in schools which were included in the research. Study population was third year students of biology in secondary schools in Vihiga county. Stratified random sampling was used to select a sample size of 550 students based on school category. The sample was then divided into two groups. One group was assigned as experimental/treatment and the other as a control group. Both groups were subjected to pre-test to establish whether they were evenly distributed based on participant's abilities to determine internal validity (George and Mallery, 2003). The two groups were then taught the concept of cell division in the topic reproduction. The experimental group was taught using 5E instruction model while the control group was taught using the conventional method of instruction. A post-test was then administered to the two groups and their scores established. The scores were then analysed to determine if there was a difference in acquisition of scientific skills between learners who were taught using 5E instructional model and those taught using conventional approach. Independent group t-test was used to establish if there was a significant difference in the student's acquisition of scientific skills between the treatment group and the control group. T- tests was used based on the assumptions that there is; normal distribution of data, homogeneity of variance and independence of samples.

RESULTS AND DISCUSSION

The objective of this study was to determine the effect of using the 5E instructional model approach and the conventional teaching approach on students' acquisition of scientific skills in biology. Scientific skills under investigation included; observing, drawing, measuring and recording necessary for effective learning of biology and other science subjects. Good science skills are believed to help students understand biology concepts easily and correctly. This tool therefore aimed at determining acquisition of scientific skills by the two groups after intervention. Science skills achievement tests (SSAT) were by the researcher. They comprised of five questions of practical orientation with a total

of 25 marks done within 45 minutes. Scientific skills that were assessed consist of: observing, drawing, measuring, recording and analyzing. The pre-test was administered to all students in the sample by the subject teachers with the help of research assistants before intervention while the post-test was administered after intervention. The data collected was sorted according to groups, coded and entered in the SPSS version 16 for descriptive and inferential analysis. Descriptive analysis generated percentages, mean, mode and standard deviation of pre-test and post-test scores. Inferential analysis involved the use the independent sample t-test at 0.05 significant levels. These tests were used based on the assumptions that there is; normal distribution of data, homogeneity of variance and independence of samples.

Achievement in Scientific Skills before Intervention

Findings of a t test done were as presented in table 2

Parameter of Learning	**Group**	**N**	**Mean**	**SD**	**T**	**P**
Observing	Exp	251	15.07	3.12	0.39	0.593
	Cont	254	14.55	3.16		
Drawing	Exp	251	13.73	2.74	0.42	0.891
	Cont	254	13.79	3.09		
Measuring	Exp	251	9.11	2.45	0.28	0.663
	Cont	254	9.02	2.33		
Recording	Exp	251	10.47	2.77	0.36	0.610
	Cont	254	10.64	2.24		

Critical t at 0.05=1.96, df = 50

Study findings in Table 2 reveal differences in means of experimental group and control group on all the parameters of learning (Observing, Drawing, Measuring and Recording) that are not significant. For instance; on Observing, the experimental mean (15.07) and the control mean (14.55) were not significantly different with a p value of 0.593. for Drawing, the experimental mean (13.73) is not significantly different from the control mean (13.79) with a p value of 0.891. Pertaining to Measuring, the experimental mean (9.11) is not significantly different from the control mean (9.02) with a p value

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of 0.663. Based on the outcome on Recording, the experimental mean (10.47) is not significantly different from the control mean (10.64) with a p value of 0.610.

Achievement in Scientific Skills after Intervention

The experimental and the control group were compared on scientific skills of observing, drawing, measuring and recording after the intervention and findings presented in table 4.10.

Table 3 Experimental and control group performance on scientific skills after intervention

Parameter of Learning	Group	N	Mean	SD	T	P
Observing	Exp	251	19.14	5.47	9.91	0.000
	Cont	254	12.37	4.39		
Drawing	Exp	251	17.06	3.50	14.04	0.002
	Cont	254	14.38	3.27		
Measuring	Exp	251	15.77	2.92	12.86	0.000
	Cont	254	12.46	3.13		
Recording	Exp	251	18.51	3.52	16.35	0.000
	Cont	254	12.42	3.19		

Critical t at 0.05=1.96, df = 50

it is evident that the performance of the experimental group was significantly different from the performance of the control group. For instance, looking at observing, the mean of the experimental group (19.14) was higher than the mean of the control group (12.37) with a p value of 0.000 implying significant difference. Based on finding on D, the mean of the experimental group (17.06) was higher than the mean of the control group (14.38) with a p value of 0.002 implying significant difference. As regards M, the mean of the experimental group (15.77) was higher than the mean of the control group (12.46) with a p value of 0.000 implying significant difference. As regards M, the mean of the experimental group (18.51) was higher than the mean of the control group (12.42) with a p value of 0.000 implying significant difference.

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CONCLUSION

Based on findings on the post-test, it is evident that the performance of the experimental group was significantly different from the performance of the control group. For instance, looking at Observing, the mean of the experimental group (19.14) was higher than the mean of the control group (12.37) with a p value of 0.000 implying significant difference. Based on finding on Drawing, the mean of the experimental group (17.06) was higher than the mean of the control group (14.38) with a p value of 0.002 implying significant difference. As regards Measuring, the mean of the experimental group (15.77) was higher than the mean of the control group (12.46) with a p value of 0.000 implying significant difference. As regards recording, the mean of the experimental group (18.51) was higher than the mean of the control group (12.42) with a p value of 0.000 implying significant difference.

Study findings using ANCOVA revealed that there was a statically significant difference between students taught using the 5E instructional model and those taught using the conventional teaching method with regard to Scientific skills acquisition (observing, drawing, measuring and recording) ($F=1.731$; $P<0.05$).

RECOMMENDATIONS

The use of 5E instructional model is highly recommended given that it enables learners to actively construct new knowledge on the foundation of pre-existing knowledge and facilitates learning in the classroom environment where learners actively construct meaning out of a new concept by integrating it into previous experiences. The 5E instructional model is also recommended since it allows collective sharing of knowledge among the teachers and the learners and the authority of the teaching and learning process is shared between the teachers and learners.

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