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ABSTRACT

The study investigated the effectiveness of Co-operative E-learning approach (CELA) on students' attitude towards Chemistry. The Solomon Four Group, Non-equivalent Control Group Design was employed in the study. The study was carried out in Koibatek sub-county, Kenya where there has been persistent low achievement in the subject. Form three students from twelve county schools, purposively selected from the sub-county were taught the same course content on mole for a period of five weeks. The experimental groups received their instructions through the use of CELA approach and control groups using the conventional teaching method. The researcher trained the teachers in the experimental groups on the technique of CELA before treatment. Student Attitude Questionnaire (SAQ) was used for data collection. One way ANOVA, ANCOVA and t-test were used in data analysis. Hypothesis of the study was tested at level of significance. The results indicated that students in experimental groups outperformed the control groups in attitude towards Chemistry. It was concluded that CELA enhanced better performance in Chemistry than the conventional method. Chemistry teachers should be encouraged to incorporate this method in their teaching and should be included in regular in-service of teachers in Kenya.

Key words: *Cooperative E-learning Approach (CELA), Attitude towards Chemistry, Conventional Teaching Method.*

Introduction

One objectives of science education is to develop students' interest in science and technology as today's society depends largely on development in science and technology. Emphasis is also placed in the application of science and technology education to the needs of daily life and development of society (UNESCO, 1997). Teachers are expected to device ways of making their students to develop positive attitudes towards science and science related disciplines (Sola & Ojo, 2007). Attitude towards Chemistry is an essential factor in Chemistry learning. Students belief and attitudes have the potential to either facilitate or inhibit learning (Yara, 2009; Abulude, 2009). Adesoj (2008) argued that a number of factors have been identified as related to students attitude to Chemistry including, teaching methods, teachers attitude, influence of parents, gender age, career interests and scientific social implications of Chemistry. According to Johnson and Johnson (1989), cooperative learning experiences promote more positive attitudes towards learning than competitive or individualistic methodologies. People Constantly form new attitudes and modify old ones when they are exposed to new information and new experiences (Adesina & Akimbola, 2005).

Gilbert (2006) listed several problems that he believes have the potential to affect attitude towards and interest in learning Chemistry. His list consists of issues such as overload of the subject matter, failure to present a holistic approach to Chemistry (i.e. presentation of isolated facts). Inadequate emphasis regarding selection and depth of the topics taught especially for those who are not going to embark on a career in Chemistry related sciences. CELA is an acronym got by integrating existing cooperative learning and E-learning approaches. It was the approach used in teaching the experimental group in this study to see whether it improved learners attitude towards the Chemistry. This method of teaching had not been tried out in Chemistry teaching and learning in Koibatek sub-county Kenya, where performance in the subject had continued to decline.

Research Hypothesis

The purpose of the study was to determine the effects of Cooperative E-learning Approach (CELA) on students attitude towards Chemistry.

The following null hypothesis was tested in this study at significant level of 0.05.

Ho1: There is no statistically significant differences between the attitude towards Chemistry of Students who are exposed to CELA and those who are not exposed to it.

Research Design

The study used Solomon Four Non-equivalent Control Group Design. This is because there was non-random selection of students to the groups. Secondary school classes exists as intact groups and school authorities do not normally allow the classes to be dismantled and constitute for research purposes (Fraenkel & Wallen, 2009).

Four groups of participants, the Experimental Group One (E_1). Experimental Group Two (E_2), Control Group One (C_1) and Control Group Two (C_2) was used. Groups E_1 and E_2 formed the experimental groups which received treatment (CELA) while C_1 and C_2 were the Control Group that did not receive treatment. Groups E_1 and C_1 received pre-test while E_2 and C_2 did not. All groups received the post-test at the end of the course. To avoid interaction of students from different groups that may contaminate the results of the study; one class from a school constituted one group of students, hence four groups were required for this study. Table 1 shows Solomon four Non-equivalent control group.

Table 1
Solomon Four Non-equivalent Control Group Design

Group	Pre-test	Treatment	Post-test
E_1	O_1	X	O_2 Experimental
C_1	O_2	-	O_4 Control
E_2	-	X	O_5 Experimental
C_2	-	-	O_6 Control

Source: Fraenkel & Wallen, 2009

(O) – Indicates observation or outcomes

(X) – Indicates treatment

(------) – Indicate the use of non-equivalent groups

Sample

The actual sample size that participated was 489 form three students, selected using purposive sampling method. Table 2 shows the sample size.

Table 1

Sample Size of the study

Group	Number of students
E_1	141
E_2	123
C_1	120
C_2	105
Total	**489**

Development and Use of Teaching Materials

The content used in the class instruction was developed and based on the revised KIE, 2002 Chemistry syllabus teachers guide, students' text book and other relevant materials. Teachers module included the content to be covered, lesson plan to be used in teaching the topic mole in form three Chemistry and the use of computers. Student manual was the CELA modules which introduced the learners to the use of computers in learnings this topic. The teachers in the experimental groups were trained by the researcher on the use of the module and cooperative learning for one week to the commencement of the treatment. They were given the modules by the researcher. In the control groups, the conventional teaching/learning methods were used. Classes in all the four groups used the same curriculum materials and spent five weeks on the topic mole as recommended in the syllabus

Student Attitude Questionnaire (SAQ)

The Student Attitude Questionnaire (SAQ) was adopted from (Rockwood et al., 1997; Abulude, 2009) and modified to suit the study. Each item in the questionnaire was developed to address research hypotheses of the study. The instrument was pilot tested in two secondary school with similar characteristics but did not take part in the study. Reliability of the instrument was

estimated by the use of Cronbach's alpha (Thorndike & Thorndike, 1994). SAQ had a reliability coefficient level above 0.78. Reliability coefficient level is above 0.7 hence acceptable (Fraenkel & Wallen, 2009). The maximum score for each item was five. The items were closed ended and based on the five point Likert Scale; Strongly Agree SA (5); Agree – A (4); Undecided (3); Disagree – D (2); Strongly Disagree – SD (1).

Data Collection Procedure

The students in the study were randomly assigned into the four groups experimental group 1 (E_1), experimental group 2 (E_2), control group 1 (C_1) and Control group 2 (C_2). A pre-test was conducted in experimental group (E_1) and control group (C_1) in order to measure the student entry behavior before the treatment. In experimental group E_1 and E_2 CELA was used while in control groups C_1 and C_2 conventional teaching method was used. At the end of the treatment period the post test (SAQ) was administered to all the groups. The researcher supervised the teaching and scored the pre-test and post-test results.

Data Analysis

To test for differences between two means, t-test was used. However, for more than two means ANOVA and ANCOVA was used. The hypothesis was t-tested at $\alpha = 0.05$ level of significance.

Results

The pre-test was administered to groups E_1 and C_1 to determine the student's entry behavior before teaching started. Table 3 shows the pre-test results.

Table 3

The Independent Samples t-test of the pre-test Mean Score on SAQ

TEST	GROUP	N	MEAN	SD	df	t-value	P-Value
SAQ	E_1	141	13.35	0.50	255	.55	.58
	C_1	116	12.93	0.54			

Table 3 revealed that students score in the SAQ between E_1 and C_1 were not statistically significant at $t(255) = 0.55$, $p>0.05$. This indicates that the groups used in the study exhibited comparable characteristics and therefore suitable for the study.

Effects of CELA on Students Attitude towards Chemistry

To determine the relative effect of CELA on students attitude towards Chemistry. An analysis of the students post-test (SAQ) mean scores was carried out. The hypothesis of the study sought to find out whether there was a statistically significant difference between the mean scores of attitudes towards Chemistry of students who are exposed to CELA and those who are not exposed to it. Table 4 shows the SAQ mean scores obtained.

Table 4

Students Attitude towards Chemistry Post-test mean Scores

Group	N	Mean	Standard Deviation
E_1	141	3.87	0.41
E_2	120	3.83	0.63
C_1	116	3.64	0.57
C_2	101	3.76	0.63

Table 4 indicates the experimental groups E_1 and E_2 had higher mean score than the control group C_1 and C_2. This shows that CELA had an effect of improving performance as compared to the conventional teaching method. ANOVA was carried out to establish whether the groups means scores on the SAQ were statistically significantly different as shown in Table 5.

Table 5

ANOVA of the Post-test Scores on the SAQ of Students Exposed to CELA

Test	Group	Sum of squares	df	Mean square	F	p-value
	Between groups	3.68	3	1.23	3.89	.01
	Within groups	149.48	4.74	3.20		
Total		153.16	477			

Table 5 indicates that a statistically significant difference exist between the subjects mean scores because the $F_{(3,474)} = 3.89$, $p < 0.05$ while the null hypothesis could be rejected, results do not

indicate which groups are similar and which are different. To establish this, least significant differences (LSD) post hoc test was carried out. Table 6 shows the post hoc comparison of the SAQ post-test means for four groups.

Table 6

Post Hoc Comparison of the SAQ Post-test mean for Four Groups.

Paired Group	Mean Difference	p-value
E_1-E_2	0.04	.94
E_1-C_1	0.23	.01**
E_1-C_2	0.11	.50
E_2-C_1	0.18	.02**
E_2-C_2	0.07	.84
C_1-C_2	-0.12	.51

Table 6 indicates that results of post hoc comparison. The SAQ mean scores of groups E_1 and C_1, groups E_2 and C_1 were statistically significantly different at 0.05 level of significant. There was no statistically significant difference in the mean scores between E_1-E_2, C_1 and C_2, E_1-C_2, E_2-C_2.

The study involved non-equivalent control groups design. There was need to confirm these results by performing analysis of covariance (ANCOVA) using students certificate of primary Education KCPE scores as covariant. Table 7 shows the adjusted post-test mean scores of SAQ with KCPE as the covariant.

Table 7

Adjusted Students Attitude towards Chemistry Post-test Mean Scores with KCPE as the Covariant.

Group	Mean	Std Error
E_1	3.87	0.05
E_2	3.83	0.05
C_1	3.64	0.05
C_2	3.76	0.05

Table 8 shows ANCOVA of the post-test scores of SAQ.

Table 8
Analysis of Covariance (ANCOVA) of the Post-test Scores of SAQ with KCPE as Covariant

	Type of squares	Df	MEAN	f-ratio	p-value
Group	3.28	3	1.09	3.46	.02**
Error	149.48	473	32		
Total	6983.85	478			

* Significant at 0.05 level

Table 8 shows ANCOVA results based on the adjusted means of the four groups displayed in Table 7. There was statistically significant difference in the SAQ mean scores of the four groups, $F(3,473)=3.46$, $p<0.05$. Pairwise comparisons was carried out to find out where the difference existed as shown in Table 9.

Table 9

Post hoc pairwise comparisons post-test scores of SAQ

Paired Group	Mean Difference	p-value
E_1-E_2	0.04	.94
E_1-C_1	0.23	.01**
E_1-C_2	0.11	.50
E_2-C_1	0.18	.02**
E_2-C_2	0.07	.84
C_1-C_2	-0.12	.51

Table 9 shows that, there was statistically significant difference in the following groups E_1 and C_1, group E_2 and C_1, but the difference between groups E_1 and E_2, groups C_1 and C_2, groups E_1 and C_2, groups E_2 and C_2 were not statistically significant. The results of ANOVA and ANCOVA confirm that there was statistically significant difference in the mean scores of the experimental and control groups. Therefore Ho1 was rejected.

DISCUSSIONS

The researcher found that the students who used CELA method achieved significantly higher mean scores in SAQ than those who did not use it. In this study the experimental groups outperformed the control groups. Table 5 shows this results $F(3,474)=3.89$ $p<0.05$; These observations are in agreement with the findings of similar carried earlier. Zakaria et al., (2010), reported that cooperative learning showed and improvement on students achievement in mathematics and positive attitude towards maths. Pandian (2004) investigated the effects of Cooperative computer assisted learning and traditional method. Results of the analysis showed that, students in the treatment group achieved better in Biology than those in traditional groups when cooperative learning was used to investigate students attitude towards the subject matter. The results indicated that students working in cooperative learning groups obtained more knowledge and improved attitude towards the subject (Le & Thanh-Pharn, 2010).

Vaughan (2012) from his studies suggested that students in Students Teams Achievement Division had positive attitude towards mathematics than those who were not. Slavin (2011), in his research showed that Cooperative learning was effective in helping students obtain practical learning skills and promoted positive students attitudes towards their learning. Johnson and Johnson (2005) confirmed that cooperative learning results in more positive attitudes towards learning. From other researchers it was noted that when cooperative learning was used there was higher academic achievement knowledge retention and attitudes towards learning (Tran, Lewis, 2012). In this study STAD was used and it also showed positive attitude towards Chemistry.

CONCLUSION

Based on this study the researcher concluded that CELA facilitates students learning in Chemistry better than the conventional method. Therefore the approach should be used in Chemistry teaching at secondary school level. Attitude towards Chemistry is likely to improve and performance at KCSE examinations would be better. Chemistry teacher are encouraged to incorporate this method at their teaching. The content of CELA should be included in the regular in-servicing of teachers.

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