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EFFECT OF COOPERATIVE LEARNING APPROACH ON STUDENTS' ACADEMIC ACHIEVEMENT IN PHYSICS IN PUBLIC SECONDARY SCHOOLS IN MERU, KENYA

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ABSTRACT

Physics occupies a significant position in secondary school curriculum because of its applications in everyday life. In spite of this importance, the academic performance of Kenyan students in the Physics subject has remained poor over many years. The fundamental challenge in teaching of physics is how to enhance students' achievement in the subject. Innovative and learner-centered teaching approaches engage the learners in the learning process. Such approaches are effective for mastery of concepts and also enhance learners' achievement in the Physics subject. Although Cooperative Learning Approach may help in enhancing students' achievement in physics its effects has not been determined in Meru County. Hence, the study investigated the effects of Cooperative Learning Approach on secondary school students' achievement in Physics in Meru County. Quasi experimental research design was employed and in particular Solomon's four group design was used. A sample of 180 respondents was obtained from an accessible population of 6347. Simple random sampling was used to draw the participating four schools from the purposively selected sub county secondary schools. The assignment of selected schools to either experimental or control group was done by simple random sampling. The research instrument that was used was physics Achievement Test. The Reliability was tested by subjecting the instrument to a pilot study in a school in Tharaka Nithi County. The reliability coefficient of the instrument was 0.786. Statistical package for Social Sciences version 25.0 was used for data analysis. The raw data obtained was analyzed descriptively using Mean, Standard deviation, Percentages and inferentially using parametric tests (one-way ANOVA and t-test). The level of significance for acceptance or rejection of null hypotheses was at $\alpha = 0.05$. The findings of the study showed that the students taught using cooperative learning approach had relatively higher scores in the physics achievement test than those taught using conventional teaching approaches. Thus, cooperative learning approach enhances students' achievement in physics more than convectional teaching approach. Physics teachers should incorporate cooperative learning approach in teaching to enhance students' achievement in physics subject examinations.

Keywords: Conventional Teaching Approach, Physics Achievement

INTRODUCTION

Science education in a global and local perspective must foster understanding of concepts among students as a result of their intellectual commitments and practices. Such knowledge of science concepts is necessary in developing students' skills and abilities in preparation for their exposure to the outside world. Skills like critical thinking, problem-solving, and information literacy are tools for life-long learners who in turn contribute to the growth of a nation (Gonzales & Reyes, 2016). Evidence show that science education is a key driver for development because technological and scientific revolutions underpine economic advances, improvements in health systems and infrastructure (Kola, 2013). Scientifically produced products are transforming business practices in many economies and lives of all who have access to their effects. Thus science and technology is perceived to be an enabler of life outcomes such as employement, income or wealth generation, safety, security and social status in such economies. This observation is supported by Roy (2012) who holds that science driven improvements in sectors such as health services have improved the lives of people through access to timely and quality medical services.

The challenge in teaching science is to create experiences that involve the student in his or her own understanding and application of the scientific concepts required to make sense of the experiences in the environment. Secondary Schools attempt to achieve the educational goals through instruction within the school disciplines. Physics education

is, therefore, about achieving educational goals through a context of physics (Meheux, 2017). In many countries therefore, education curriculum especially in science education at the secondary school level emphasises the study of Physics along with other science subjects such as Biology and Chemistry. Amongst these subjects, Physics is perceieved to greatly contribute in the development of scientific knowledge, skills and attitude required by the learners transiting the secondary school level to fit into the highly competitive society. For instance Minish, Muni, Mutai, Mwangasha, Omolo and Munyeke (2004), maintain that the study of physics plays a key role in the progress of mankind through equipment of individuals with essential knowledge, skills, abilities and attitudes that contribute to inventions such as computer, laser, transistor and the world wide web that has formed the basis of technological advancement. Other developments that heavily rely on Physics knowledge include, use of sophisticated medical equipment in sterilisation and treatment of illnesses such as cancer, effective security systems and construction of maginificent buildings, tunnels and bridges (Telima, Alamina & Temitope, 2013). The agricultural sector thrives on the use of farm machinery and equipment such as combine harvesters, threshers, water pumps and others that function on Physics principles. According to Twoli (2006) the knowledge and skills acquired through the study of Physics have been instrumental in analysing and solving urgent environmental and energy problems.

In Kenya, physics is becoming recognised at undergraduate level as providing education of great value for many careers outside Physics such as commerce, banking and medicine. Similarly, Twoli (2006) discusses that persuance of Physics by learners at all levels has helped set standards of rational thought in the face of irrationality thus upholding the primacy of observation and therefore certain myths and beliefs have been discarded as a result of exposure to Physics content. The Physics content enhances human understanding of other scientific disciplines such as Chemistry, Biology and Environment (Minish *et al.,* 2004) and therefore has generated fundamental knowledge which is essential for the required technological advancement needed to propel the economic engine of the world. At secondary school level Physics students develop attitudes such as critical mindedness, interllectual honesty, objectivity, open-mindedness, questioning, curiosity, humility, risk taking, inventiveness, responsibility, suspended judgement and respect for evidence (Minish *et al.*, 2004). These attitudes are important for national unity and harmonious coexistence as documented in the objectives of education. Therefore the ultimate goal of teaching and learning Physics should be the understanding of its scientific processes and applications in everyday activities.

However and despite its importance, evidence indicate that a majority of students continue to register low achievement in the subject in many countries, both developed and developing which is a matter of concern to education stakeholders (Kola, 2013). In Kenya, a decline in achievement in physics is being witnessed with existing data showing a worrying trend of learner low achievement in the subject(KNEC, 2019). The Government of Kenya recognizes the importance of Science and Mathematics in the attainment of its Vision 2030 where the community seeks to become a globally competitive and prosperous country by 2030 (Kerich, 2004). One great challenge teachers are facing is how to improve students' performance nationally in Physics since the low Physics achievement has persisted as is illustrated in Table 1. (KNEC, 2019; KNEC, 2017; KNEC, 2015).

Table 82: National Physics Performance in KCSE from 2014 to 2019

Year	Candidate	Percentage Mean Score
2014	131410	38.84
2015	139100	43.52
2016	149790	39.77
2017	160182	35.05
2018	172676	34.27
2019	184589	35.09

Source: KNEC (2019)

The mean scores are below average since they ranged from 34.27% to 43.52%. Scores that are lower than average are regarded as weak which implies that a student who attains these grades has weak and poor mastery of the subject matter (KNEC, 2014). Such a student is regarded as having failed to attain the expected basic mastery of the subject content and skills that consequently influences future career prospects of students due to the fact that the grades that a student attains in different subjects at KCSE examination determine admission for further education and training at universities and other tertiary institutes (Muraya & Kimamo, 2011). A similar trend of poor achievement in physics at KCSE examination is observed for Meru students in 2014 and 2019 as illustrated in Table 2. Since the inception of Meru in 2008, the average percentage score in physics has been below 41% (County Education office, 2019).

Table 83: The Performance in Physics in Meru County

Year	Candidature	Percentage mean score
2014	20587	32.19
2015	20806	43.51
2016	20983	39.62
2017	21567	33.18
2018	21781	31.12
2019	21956	30.67

Source: Meru County Education Office

From Table 2, performance in physics since 2014 has been below average within Meru County. The scores portray a drop every year between 2015 and 2019. The highest mean score was in the year 2015 whereas the lowest mean score was in the year 2019. The dropping achievement trend in the national level and in particular Meru County shows that there is need to improve performance in physics. This can be done by use of appropriate teaching approaches in physics. A close analysis of questions performed poorly by the candidates show that students have weakness in answering questions which include poor interpretation of questions, poor scientific language, poor understanding of scientific concept, inability to relate physics knowledge to real life situations and inappropriate teaching approaches (KNEC 2017, 2019). These weaknesses are probably derived from poor teaching approaches (Njoroge, Changeiywo & Ndirangu, 2014). Teaching approaches employed by physics teachers therefore should be a matter of concern to education stakeholders.

There are learning models, approaches and learning methods that can support the process of learning physics. In order to achieve the objectives of physics education at this level of education, the subject should be well presented to students through proper teaching approaches (Puspitasari, Lesmono & Prihandono, 2015). The teachers' choice and use of suitable teaching approach for the acquisition of knowledge is paramount. To facilitate the process of knowledge transmission, teachers need to apply appropriate teaching approaches that best suit specific objectives that constitutes good teaching and learning (Thomas & Israel, 2013, Ezenwafor & Molokwu, 2015). Classification of teaching approaches are categorized into learner-centered and teacher-centered approaches (Gengle, Abel & Mohammed, 2017). Teacher-centered approach is an approach of teaching whereby the teacher dominates the teaching and learning activities (Gengle, Abel & Mohammed, 2017). This makes the teacher to be a knowledge dispenser and the student a knowledge-memorizer. (Abimbola & Abidoye, 2013; Hossain & Tarmizi, 2013). Teacher-centered approach does not motivate students to actively participate in learning process.

To address such shortfalls, teaching should not merely focus on dispensing rules, definitions and process for students to memorize, but should also actively engage students as primary participants (Zakaria, Chin & Daud, 2010). In order to achieve the objectives of physics education at this level of education, the subject should be well presented to students through proper instructional approaches. The teachers' choice and use of suitable instructional approach for which the acquisition of knowledge, skills or attitudes is paramount. There are various approaches adopted by the teachers in order to make teaching and learning effective and hence affect the students' academic achievement (Akinbobola, 2015). Instructional approaches are a significant determinant of students' academic achievement and process skills acquisition in science and specifically in physics. The selection of proper instructional approach in a science lesson ensures the achievement of the stated instructional objective effectively.

Teaching is only meaningful if learning takes place. Hence, modern teaching approaches need to focus on the learner. Learner-centered approach is an instructional process, in which the learners are kept at the center of the learning process and they share much responsibility while the instructor helps them to create an environment in which students can make connections of points (Gengle, Abel & Mohammed, 2017). The focus of learner-centered approaches are the students and the teacher act as a guide. Learner-centered teaching allows the students to actively participate in the decision-making process about what to learn, how to learn and how much to be learned (Abdurrahaman, 2010). Vasiliki, Panagiota, and Maria (2016) asserted that teachers should select and apply teaching approaches that are compatible with the needs, interests and the abilities of the learner. For effective and successful teaching to take place, the students need to be engaged with activities. According to Khan (2017), the teacher is not the sole source of knowledge; therefore, it is important that the teachers see the students capable of contributing to own learning. An increasing amount of research points out that the interactive process between individual student and the teacher is very important in determining the nature and quality of learning and development that result from instruction (Ayeni, 2011). Teaching approaches employed by teachers in the course of teaching and learning of physics should be interactive so as to create an environment that encourages students to interact with materials and construct meaningful knowledge.

Studies on effect of teaching approaches have been carried out in Kenya in an attempt to curb the low achievement in physics (Wachanga, 2002; Wambugu, 2006; Njoroge, Changeiywo & Ndirangu, 2014). Wachanga, Johnson & Francis (2013) found out that experiential cooperative concept mapping instructional approach facilitated students' physics learning and also increased students' achievement in physics. According to Otieno (2015), concept mapping based instructional approach enhanced the teaching of secondary school physics in Nairobi County. Moreover, work done by Njoroge *et al*. (2014) in the teaching of physics by using inquiry-based teaching approach revealed that students taught using this approach outshined their counterparts taught using convectional teaching approach. A few studies have been carried out to investigate the effect of cooperative learning approach though in other science subjects other than physics.

Cooperative learning is a teaching approach in which small teams, each with students of different ability, use a variety of learning activities to improve their understanding of a particular subject. Each member of the group is responsible for not only learning what is taught but also help team mates learn. According to Adegoke (2011) cooperative learning is defined as a division of labour undertaken to solve a problem for any given task, students divide the work and come together to present their findings. Each student makes an individual contribution. Yar'adua (2008) expounded that cooperative learning is grounded in the belief that learning is most effective when students are actively involved in sharing ideas. Abdulazeez (2011) asserted that cooperative learning is a pedagogical technique that makes students work together in small and mixed groups on a structured learning task with the aim of maximizing each other's' learning.

The usage of cooperative learning approach engages every member of the classroom into small groups performing specific task together. Students are forced to develop social relationship skills that creates a room for innovation and problem solving. It well understood that science related subjects especially physics are occupied with problem solving tasks, cooperative learning approach helps students to solve problems collectively which may lead to maximal academic achievement. Most students are faced with challenges of inability to confront problems individually because they may believe they do not possess required skill. But when working together collectively, the teacher is able to note the positive contribution of such students. By this they gain confidence to solve similar problems independently.

There are many benefits of cooperative learning. Cooperative learning helps to raise academic achievement of learners, build positive relationship, learners, provides experiences that develop both good learning skills and social skills. Also, Azmin (2016) in his work recommended that cooperative learning helps to produce: higher achievement, increase retention, more positive relationship, higher self-esteem, better attitude towards the teachers. Unlike the traditional teaching approach which involves a one-way verbal communication, unaccompanied by discussion, questioning or immediate practice (Olorukooba, 2001) cooperative learning approach is not only verbal communication to deliver instructions but also sharing ideas and practical demonstration in the classroom. However, educators have gradually incorporated cooperative learning in the classrooms (Kolawole, 2007). Keramati (2010) and Kolawole (2007) in their studies found that student that were taught using cooperative learning approach obtained higher achievement than students who were taught in using the conventional teaching approaches. According to Dallmer, 2007 the student learns from their colleagues through consultation in cooperative learning environment. Moreover, empirical evidences on the use of cooperative learning approach shows hypothetically that cooperative learning approach enhance learners' academic performance in Physics (Gambari 2010). Hanze and Berger (2007), Attiparmak and Nakaboglu (2009), Mattingly and Vansickle (2009) supported through their various findings that cooperative learning is result-oriented.

Research studies in diverse school settings and across a wide range of content areas have revealed that students engaged in cooperative learning approach tend to have higher academic test scores, higher self-esteem, higher-level reasoning skills, collaborative skills, greater numbers of positive social skills, fewer stereotypes of individuals of other races or ethnic groups, and a greater comprehension of the content and skills they learn (Johnson et al., 2000). In a study where Junior Secondary Students were taught social studies in Nigeria, those taught through cooperative learning approach performed better than their counterparts who were taught through the traditional teaching approach (Adeyemi, 2008). Aronson (2002) reports that elementary students taught through Jigsaw cooperative learning approach learnt material faster and performed significantly better on examinations than a control group of students learning the same material through regular teaching methods. Effandi and Zanaton (2007) further reports that an experimental group of students who were instructed through cooperative learning approach showed significantly higher scores in a mathematics achievement test and problem-solving skills than a control group that was instructed through the traditional lecture method.

In a study by Wachanga et al. (2004) reported that secondary school students who were taught chemistry through the cooperative learning approach in Nakuru district, Kenya outperformed those who were taught through the traditional teaching approaches. Armstrong et al. (2007) in a study that compared cooperative learning approach and traditional lecture method in an undergraduate biology course reported that the experimental group that was instructed through cooperative learning approach showed greater improvement in overall test scores than control group that was taught using a traditional lecture approach. He further noted that the experimental group performed significantly better on questions requiring both factual knowledge and comprehension than students in the control group who were instructed through the regular lecture format. Wachanga and Mwangi, (2004) found no significant differences between boys and girls who were exposed to cooperative learning in chemistry. In addition, boys and girls in the experimental groups who were instructed through cooperative learning in chemistry outperformed their counterparts in the control group who were instructed through the traditional teaching approach

In a study conducted by Alshammari (2015) revealed that students who were taught using cooperative learning approach had a better understanding of the content as compared to the students who were taught using the lecture method. Similarly, Azmin (2016) reported that students enjoyed using cooperative learning and performed better after the intervention. Over the years the students' poor performance in Physics is alarming and if this is not checked may jeopardize the placement chances of students in tertiary institution, not only in Physics education but also in other science related subjects. Various studies have identified that the teaching approaches employed in the teaching of physics influence students' achievement (Adegoke 2011; Gambari 2010). Learning according to Taber (2009), is a personal activity and each student has to construct his or her own knowledge from it. For meaningful and effective learning to be realized, students should reflect on what is taught; develop interest on subject matter and construct new knowledge based on their understanding of the concepts. Science teaching therefore, ought to be proactive and student-centred. This study sought to determine the effect of cooperative learning approach on students' achievement in physics.

The poor performance in physics by secondary school students in the subject as reflected by the KCSE Examinations results has continued to trigger a lot of concern among educationists and other stakeholders nationally and in Meru over the years. The poor performance could be as a result of lack of interest in the subject caused by inappropriate teaching approaches used by most teachers. Such approaches of teaching make the learners to be passive during the teaching and learning process. Although cooperative learning approach to teaching may enhance students' achievement, its effects have not been determined in physics. The study therefore sought to determine the effect of cooperative learning approach in secondary school students' achievement in physics in Meru.

The study sought to find out the effect of cooperative learning approach on students' achievement in physics when students are taught through CLA compared to those taught through CTA. The hypothesis was that there is no statistically significant difference in achievement in physics between students taught using CLA and those taught through CTA.

METHODOLOGY

The study used Quasi-experimental design, specifically Solomon four-group design. The design enables the researcher to control and measure the main effects of testing. It also allowed the researcher to carry out studies in natural and real-life setting as the students are already constituted by the school administration and the researcher worked with existing streams (Nachmias & Nachmias, 2004). The design enabled the researcher to make a more complex assessment of the cause of the change in the dependent variable and even tell whether changes in the dependent variable was due to interactions effect between the pretest and treatment. In addition, it allowed the researcher to exert complete control over the variables and to ensure that the pretest did not influence the results, (Shutttleworth, 2009). Solomon four-group design involves four groups. The Experimental group E1, was pretested (O1), receive treatment (X) and post tested (O2). Control group C1, was pretested (O3), no treatment and received posttest (O4). Experimental group E2, received treatment (X) and posttest (O5). Control group C2, only received posttest (O6). C1 and C2 was taught using conventional teaching approach while E1 and E2 was taught using cooperative mastery learning approach. Posttest O5 and O6 eliminated the interaction between testing and treatment.

The target population was physics students in secondary schools in Meru County, Kenya. The accessible population was 5347 Form two physics students in Sub-county secondary schools where the study sample was drawn. Face validity and content validity was ascertained. To ensure face validity, the instruments was presented to experts from the Department of Education and Resource Development for validation and recommendations. To achieve content validity PAT was presented to a Head of Department of physics in secondary schools to judge the extent to which

the tested items present a representative sample of the universe of the content that the test is designed to measure.

Reliability was ascertained by subjecting the instrument to piloting in a school in Tharaka Nithi County with similar characteristics in the population. According to Borg and Gall (1995) a pilot study should include more than 20 subjects. Hence a sample of 45 form two students was involved. This enhanced reliability and helped in verifying the time allocated to the test items and ambiguity in the physics achievement test. A reliability coefficient level of at least 0.7 and above is considered sufficient and acceptable (Fraenkel & Wallen, 2000). The reliability as estimated by Kunder Richardson obtained for PAT was 0.786. This was acceptable for the study.

Data were collected using a physics Achievement Test (PAT). The items in this instrument were adapted from KNEC physics past examination papers and modified to make them suitable for use in the study. The instrument contained items to test the student's achievement in physics. The items were structured in such a way as to start with those of low order thinking skills and progressively move to slightly more complex ones. This instrument was used to measure the learners' level of achievement in physics before and after treatment.

The units for sampling were secondary schools because secondary schools operate as intact groups (Borg & Gall, 1996). The republic of Kenya consists of 47 counties. Meru county was purposively selected from the list of counties that are performing poorly in physics. Meru county consists of 178 single gender and mixed schools. Purposive sampling technique was used to select the schools with the desired characteristics from the list of mixed schools in Meru County. The desired features for the schools that qualified for the study was class size of forty-five and a bove form two physics students and mixed Sub-county secondary school. The sub county schools were selected because nearly all schools in the county fall into the sub county schools' category, thus by picking the sub county schools, the findings were more generalizable to the whole county. A total of four schools were drawn using simple random sampling from a list of mixed sub county schools. The assignment of selected schools to either experimental or control group was done by simple random sampling. The stream that was considered for analysis where the sampled school had multiple streams was selected using simple random sampling. The ministry of education science and technology recommends 45 students per class. The schools sampled were assumed to have an enrolment of 45 students per class. Frankel and Wallen (2000) recommend at least 30 cases per group for experimental research. The researcher picked four schools randomly.

The researcher scored the pretest and posttest, organized and coded and entered in the computer for the analysis using the statistical package for social sciences (SPSS) version 25.0. Descriptive statistics and inferential statistics were used for data analysis. Descriptive statistics which included mean, percentage, standard deviation and variance was used to summarize raw data. Descriptive statistics enables the researcher to describe a distribution of measurements (Mugenda & Mugenda, 1999). Inferential statistics enables one to make descriptions of data, draw inferences and conclusions from the respective data (Nassiuma & Mwangi, 2004). Independent samples t-test was used for pretest and post-test mean scores in order to measure entry behaviour and the effects of the treatment. One-way ANOVA test was used to determine if the four groups differed significantly among themselves on variable being studied. Posthoc analysis was used to compare the means of all groups involved in the study. All the tests of significance were performed at significance level of alpha (α) equals to 0.05.

Demographic Information of the Students

This study analyzed the gender distribution as a demographic information of the respondents (Table 3). The findings indicate that 57.8 % of the experimental group consisted of males and 42.0 % females while the control group had 53.3 % males and 46.7 % females. Therefore, more males (55.6 %) than females (44.4%) take physics as a subject.

Results of the Pre-test

The experimental group (E1) and control group (C1) were exposed to pre-test before the start of the treatment. Pre-test was carried to ascertain whether the students selected to participate in the study had comparable characteristics before the study. The independent samples t-test was used to analyze whether there were significant differences in the mean scores of experimental group (E1) and the control group (C1). Table 4 shows the t-test results of the pre-test Mean scores in PAT for E1 and C1.

Table 3*:* Gender of the respondents

	Experimental		Control			
	N	%	N	%	N	%
Male	52	57.8	48	53.3	100	55.6
Female	38	42.0	42	46.7	80	44.4
Total	90	100	90	100	180	100

Table 4: T-test results of the pre-test mean scores on PAT

Group	N	Mean score (%)	SD	df	t-value	p-value
E1	45	37.25	5.445	88	0.333	0.740
C1	45	37.59	5.328			
Total	90					

C1 had a higher mean score (37.59 %) than E1 (37.25 %). The standard deviation of E1 was 5.445 while that of C1 was 5.328. The results indicate that the difference in the means was not statistically significant at α=0.05, significant level ($t(88) = 0.333$, $p > 0.05$). Thus, experimental group (E1) and control group (C1) were similar on PAT measure, this implied that the level of achievement prior to administration of the intervention of the two groups were similar; that is the groups were equivalent before administration of treatment.

Effects of Cooperative Learning Approach on Students' Academic Achievement in Physics

All the four groups took post-test PAT. Achievement was measured by use of PAT post-test. Experimental groups (E1) and (E2) were taught using cooperative approach. Control groups (C1) and (C2) were taught using conventional teaching approach. The results of the students' PAT post-test scores were as shown in Table 5.

Table 5: PAT post-test mean scores obtained by students in the four groups

Group	N	Mean Score (%)	SD
C1	45	40.91	5.854
C2	45	42.92	5.952
E1	45	47.11	5.793
E2	45	49.04	5.362
Total	180	45.00	5.802

The mean scores of the E1 (47.11 %) and E2 (49.04 %) were higher as compared with those of the C1 (40.91 %) and C2 (42.92 %). This shows that experimental groups had higher scores than the control groups in PAT. The standard deviation of E1 was 5.793 while that of E2 was 5.362. The standard deviations of the control groups C1 and C2 were 5.854 and 5.952 respectively. The findings indicate that students taught using CLA achieved higher in PAT as compared to those students taught using CTA. Further illustration of the PAT means scores for the four groups are shown in Figure 1.

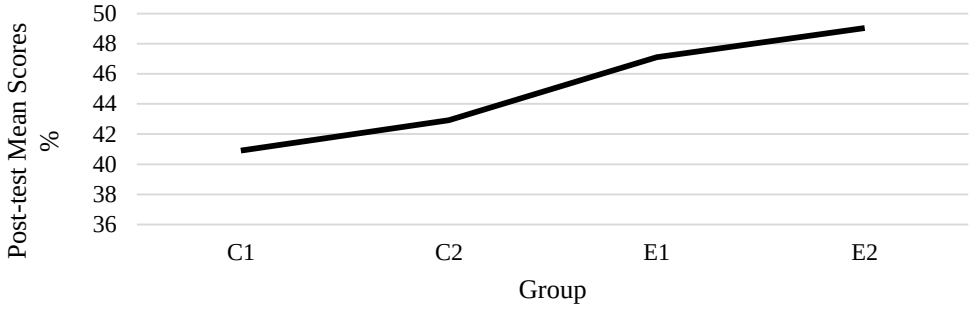

Figure 1. Relationship between Post-test Mean Score in PAT in the four groups

The highest mean score was attained by Experimental group (E2) followed by Experimental group (E1) then Control group (C2) and finally Control group (C1). Table 6 shows the ANOVA of posttest mean scores on PAT.

Table 6: Analysis of variance for the posttest PAT mean scores of the four groups

	Sum of squares	df	Mean squares	f	p-value
Between Groups	1867.373	3	662.458	10.934	0.000
Within Groups	5888.765	176	32.875		
Total	26455.644	179			

The findings in Table 6 show that the differences between the post-test mean scores on PAT were statistically significant ($F(3,179) = 10.934$, $P < 0.05$). Therefore, the hypothesis was rejected, which stated that there is no statistically significant difference in the level of achievement to learn physics between students who are taught using cooperative mastery learning and those who are taught using conventional teaching approach. The results suggest that cooperative mastery learning approach as an intervention had positive effect on student achievement. To determine where the difference existed, a post-hoc analysis test using a post -hoc analysis using Least Significant Difference (LSD) was used to compare all pairs of the groups as shown in Table 7.

Table 7: Post hoc comparisons of post-test of PAT mean scores for the four groups

Group Name(i)	Group Name (j)	Mean difference(i-j)	Significance
E1	C1	6.200*	.000
	C2	4.190*	.001
	E2	-1.932	.110
C1	C2	-2.010	.113
	E1	-6.200*	.000
	E2	-8.132*	.000
E2	C1	8.132*	.000
	C2	6.122*	.000
	E1	1.932	.110
C2	C1	2.010	.113
	E1	-4.190*	.001
	E2	-6.122*	.000

* Significant at 0.05 confidence level.

The results indicate that the differences in mean scores of groups E1 and C1, groups E1 and C2, C2 and E1, C2 and E2, E2 and C1 were statistically significant at 0.05 levels. The mean scores of E1and E2 and C1 and C2 were not statistically significant. This suggests that CLA teaching approach had a significant and positive effect on students understanding of physics concepts among the students. The results suggest that the use of cooperative teaching approach promotes students' achievement in that the students taught using cooperative learning approach performed higher than those that were taught using conventional teaching approach. The results agree with those of Gambari (2010). research findings, which provided evidence for positive effects on students‟ achievement in physics when taught using cooperative learning approach. The research findings concur with the findings of Adeyemi (2008) where Junior Secondary Students were taught social studies in Nigeria, through cooperative learning approach performed better than their counterparts who were taught through the conventional teaching approach.

The results of the study are in line with the findings of a study by Aronson (2002) that reports that elementary students taught through Jigsaw cooperative learning approach learnt material faster and performed significantly better on examinations than a control group of students learning the same material through regular teaching methods. The findings of the study are also consistent with the findings of Hanze and Berger (2007), Attiparmak and Nakaboglu (2009), whose findings indicated that cooperative learning is result-oriented. The results are in line with the Azmin (2016) findings, whose research revealed that students enjoyed using cooperative learning and performed better after the intervention. The results also concur with the findings of Alshammari (2015) that revealed that students who were taught using cooperative learning approach had a better understanding of the content as compared to the students who were taught using the conventional teaching approach.

CONCLUSIONS

The study findings showed a statistically significant difference in academic achievement in physics between the students taught using cooperative learning approach and those taught using the conventional teaching approach. Student taught physics using cooperative learning approach had a higher score in physics achievement test as compared to those taught using convectional teaching approach. This indicates that cooperative learning approach is more effective than the convectional teaching approach in improving the student academic achievement in physics. This shows that students who are taught physics through cooperative learning approach learn better than those taught using conventional teaching approach. Therefore, it can be concluded that cooperative learning approach facilitates students' academic achievements towards learning physics more than conventional teaching approach.

RECOMMENDATIONS

Based on the findings of the study, Physics teachers should be encouraged to incorporate the use of cooperative learning approach in teaching physics in order to enhance teaching physics and improving academic achievement in physics in KCSE.

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