Effect of Cooperative Mastery Learning Approach on Secondary School Students' Self concept in Kirinyaga County, Kenya

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ABSTRACT

Through the study of Physics, technological advancement promoting standard of living, creation of wealth, health and industrialization has been realized. The Kenyan government has put much effort to improve Physics performance in secondary schools. However, and despite these efforts, the desired outputs have not been realized. The fundamental challenge facing the teaching of physics is how to enhance students' self concept in physics which is an important aspect of academic performance in science learning. While cooperative mastery learning approach has been shown to improve self concept in other science subjects' studies addressing the effect of cooperative mastery learning approach towards student's self concept in Physics are inadequate. Hence this study investigated the effects of Cooperative Mastery Learning Approach on secondary school students' self concept in Physics in Kirinyaga County. Solomon's four quasi experimental group design was used. A sample of 180 respondents was obtained from an accessible population of 5850. Simple random sampling was used to draw the participating four schools from the purposively selected Sub-county 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 a students' self concept questionnaire (SSCQ). The Reliability was tested by subjecting the instrument to a pilot study in a school in Embu County. Reliability coefficient for students' self concept questionnaire was 0.795. Statistical Package for Social Sciences (SPSS) version 25.0 was used for data analysis. The raw data obtained was analyzed descriptively using Mean, Standard deviation, percentages and inferentially using non parametric tests (Kruskak- Wallis test, Mann Whitney U test and Posthoc Analysis). The level of significance for acceptance or rejection of null hypotheses was at $\alpha = 0.05$. The study established that cooperative mastery learning approach enhances students' motivation in Physics. Further the study findings show that there was statistical significance in student self concept between students taught using cooperative mastery learning approach and those taught using conventional teaching approach. From the findings of the study cooperative mastery learning approach is effective in improving student self concept in Physics. Therefore, Physics teachers should incorporate the cooperative mastery learning approach in teaching in order to improve students' self concept in Physics.

Keywords: Self concept, Cooperative Mastery Learning Approach and Conventional Teaching Approach

INTRODUCTION

Physics being one of the STEM subjects is taught in secondary education and serves as a preparation for further training and prepares students to be useful citizens within the society. Physics is taught through learning activities in schools by a set of activities that are designed to support student learning (Prima, Utari, Chandra, Hasanah, & Rusdiana, 2018). The principle of learning physics is to prioritize scientific processes to produce products and to be based on scientific attitudes. Physics education therefore enables the learner to acquire problem-solving and decision-making skills that provides ways of thinking and inquiry which help

them to respond to widespread and radical changes in industry, health, climatic changes, information technology and economic development. These changes demand knowledge of scientific principles in order to tackle them (Otieno, 2015). The teaching of Physics provides the learners with understanding, skills and scientific knowledge needed for scientific research, fostering technological and economic growth in the society, where they live thus improving the standards of living (Wambugu, 2006). Although the government has done its part the role of the teacher in the classroom is important in enhancing effective teaching and learning of physics.

The primary purpose of teaching at any level of education is to bring a fundamental change in the learner (Tebabal & Kahssay, 2011). To facilitate the process of knowledge transmission, teachers should apply appropriate teaching approaches that best suit specific objectives and level exit outcomes. Many teachers have been widely applying teacher-centered approaches to impart knowledge to learners' comparative to student-centered approaches. There is a shift from teacher centered to learner centered approaches in an attempt to achieve the objectives of secondary school education and improving students' motivation in physics. 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). Teaching approaches employed by teachers in the course of teaching and learning of physics should therefore be interactive so as to create an environment that encourages students to interact with materials and construct meaningful knowledge that may enhance students' self concept to learn. According to Arimba (2012), teaching approach has an effect on affective domain such as student self concept.

Individuals who appear to be similar to each other may have different thoughts about themselves and may exhibit different behaviors depending on how they perceive themselves and on their beliefs about what they can achieve (Bong & Skaalvik, 2003). This belief of the individuals about their personality, roles, skills and relationships with other individuals is called self-concept. In the most general sense, self-concept refers to people's perceptions about themselves. There are different conceptualizations of self-concept in the literature. McInerney *et al*. (2012) emphasized the way individuals perceive their own strength and weaknesses, skills, attitudes and values, whereas Wang and Lin (2008) considered self-concept as a sense of confidence that individuals feel about themselves and as an important factor for predicting success or failure in academic duties. In this context, self-concept is related to individuals' personal perceptions about their own academic abilities or skills, it is usually developed through experience and through an interpretation of the learning environment, and it is seen as one of the most important factors in learning (Marsh & Martin, 2011). This suggest that students' perceptions about their own academic abilities have a significant effect on academic performance. Therefore, effort of physics teachers should be geared towards improving students' self concept.

Research gives strong indication of different factors that seem to influence positively the self concept of students to learn (Akanwa ,2016)). One of the factors is teaching approaches. Studies on effect of teaching approaches have been carried out in an attempt to curb the low self concept of students towards physics (Gambari & Yusuf 2014, Oludipe, 2013). A study by Crawford (2013) indicated that students' self-concept influences their academic performance; however, the level of effort exerted by students in learning to a large extent contributes significantly to students' self-concept in boosting their academic performance. Ifesanwo, (2012) in her study found that academic self-concept alone accounted for 15% of the total variation in students' achievement in financial accounting. Similarly, Omotayo, (2012) reported that academic self-concept predicted 14.9% of the total variation in students' achievement in Economics. According to Preckel

& Brull (2010) learning opportunities should be conducted in a variety of mixed-ability and like ability groupings that down-play social comparison because too much of either type of grouping can have adverse effects on children's academic self-concept in the way they view themselves in relation to their peers.

Gambari and Yusuf (2014) attributed poor performance of students in science particularly in physics to poor student's self-concept, lack of qualified teachers, poor instructional approaches, poor infrastructure, and non-availability of school laboratory and poor utilization of instructional materials. Student self-concept is an important aspect of academic achievement in science learning. Sahranavard and Hassan (2012) described science self-concept as the confidence in one 's own capability to accomplish scientific tasks through organizing and executing knowledge and skills required to manage a science content or process. According to Chang (2008), students who believe in their abilities tend to perform more successfully than those who do not. Mason and Kahie (2009) have articulated that student who engage in active learning experiences develop higher self-concept than those who do not. Studies have found significant positive relationships between self-concept and achievement.

Dramanu and Balarabe, (2013) while investigating the relationship between academic self-concept and academic performance of Junior high school students in Ghana, they reported a positive relationship between academic self-concept and academic performance of students. Utibeabasi (2011) conducted a study which indicated that physics students with higher self-concept achieved high in physics. In a study by Oludipe (2013) predicting students' achievement in physics using academic self-Concept and Locus of Control Scale Scores involving 200 senior secondary school II physics students (100 Boys and 100 girls, with mean age of 16.5 years randomly drawn from six public co-educational secondary schools in Irepodun local government area of Kwara state, Nigeria revealed that academic self-concept is potent factor to be taken into account when explaining student's achievement in physics. Therefore, examining the effect of academic self-concept on student achievement and making relevant deductions are important for improving students' academic self-concept and increasing their academic achievement in physics.

A study by Goreyshi *et al*. (2013) investigated the effect of cooperative mastery learning approach on working memory capacity, self-efficacy and academic achievement in grade skipping. Sample of the study consisted of 25 students middle school in Tehran, Iran who were eligible to take grade skipping test were randomly selected and were then examined with working memory capacity test and self-efficacy questionnaire. The sampled students participated in a 45-day teaching program for 11 hours a day in summer. After the students had completed the educational program the same test and questionnaire given prior to the educational program were re-administered and followed by the grade skipping test. The same tests were administered for a third time, one year later. To examine academic achievement, in the pre-test, the grade point average (GPA) of the first year of the middle school, in the post-test the GPA of the grade skipping exam and in the follow-up the GPA of the third grade of the middle school were taken into account. The repeated measures ANOVA showed a significant increase in working memory capacity and its components, storage and processing, and self-efficacy which had a positive effect on students' academic success. Another research by Krank and Moon (2001) pointed out that a combination of mastery learning and cooperative learning yields greater change in academic self-concept compared to either mastery learning alone or cooperative learning alone. This implies that choice of appropriate teaching approach has a direct consequence on learner's academic self-concept. The use of cooperative mastery learning approach may improve student's self-concept in physics by improving the attention of students as they work together in the cooperative mastery learning groups.

The teaching approach that a teacher adopts may enhance students' self concept to learn and therefore affect their achievement (Shihusa & Kerora 2009). Thus, self concept being a factor directly linked to success, there was need to seek the effect of cooperative mastery learning approach on students self concept towards learning of physics. Cooperative mastery learning situations enables students to work together by

themselves most of the times. This in turn maximizes learning and motivates students. Motivated students make the teacher's job of managing instruction program simpler. When students are academically motivated, their teacher often becomes professionally motivated. The use of cooperative mastery learning approach is likely to improve the attention of students as they work together in the cooperative learning groups. Since group goals will be set in advance, the students are likely to have a feeling that the physics content is valuable to them. Furthermore, the encouragement from fellow group members may boost the students' confidence. It is also expected that the achievement of the set goals will result in a sense of satisfaction in the students. Although the relationship between academic self-concept and academic performance is well established in the literature, rarely no research work has been done on effect of cooperative mastery learning approach on student self-concept in physics in the secondary level. This study is therefore, intended to make contribution on effect of cooperative mastery leaning approach on students' self- concept in physics.

Statement of the Problem

Physics is poorly performed at KCSE level. An analysis of the pattern and trends in achievement in physics in KCSE examination clearly indicates that the achievement is below an average score of 50%. The poor performance of candidates in physics results has continued to trigger a lot of concern among educationists and other stakeholders nationally and also in Kirinyaga County over the years. This poor performance is attributed to inappropriate teaching approaches that results to low students' self concept in physics. Even though student centered approaches such as cooperative mastery learning approach have been shown to improve self concept in Chemistry, Biology and Mathematics, such information is little in relation to the teaching of physics. Specifically, there was need to know how cooperative mastery learning approach would influence student's self concept in physics. Therefore, it was on this basis that the study assessed the effect of cooperative mastery learning approach on student self concept in physics in Kirinyaga County, Kenya.

Objective of the Study

The objective of the study was to investigate whether there is a difference in self concept in physics between students taught using co-operative mastery learning approach and those taught using conventional teaching approach.

HYPOTHESES

H_{01}: There is no statistically significant difference in self concept in physics between students taught using co-operative mastery learning approach and those taught using conventional teaching approach.

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 units for sampling were secondary schools rather than individual students because secondary schools operate as intact groups (Borg & Gall, 1996). The republic of Kenya consists of 47 counties. Kirinyaga county was purposively selected from the list of counties that are performing poorly in physics. Kirinyaga county consists of 160 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 Kirinyaga County. The desired features for the schools that qualified for the study was class size of more than forty-five 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 (over 68% of schools in the county) 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 that were 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 students' self concept questionnaire was used to measure student's self concept towards physics. This instrument was intended to measure students' self-concept in physics. Items in the questionnaire were adopted from Liu & Wang (2005). The questionnaire (Appendix E) contains items on the students' socio-background factors and students peer relation in a physics class, perception of the relationship to the physics teacher and student perception of self as a learner. This instrument was used in assessing students' perceived physics student support with four items, perceived physics teacher support with six items and perceived task performance in physics with eight items. The instrument was divided into two parts. The first part required the participants' demographic information while the second part contained the items on student's perception as he/ she interacted with the learning environment. SSCQ was used to measure students' self-concept in physics. The SSCQ Questionnaires was made up of 18 close-ended question items developed utilizing Five point Likert scales extending from strongly Agree with score of 5 points and strongly disagree with a score of 1 points where the Students were required to state whether strongly Agree (SA), Agree (A), Undecided (U), Disagree (D), or strongly disagree (SD). The higher number of the scale represents an agreement with the item on the scale. In this study a perception of the student was taken to be a measure along the continuum from the strongly negative to a strongly positive effect.

RESULTS AND DISCUSSION

Demographic Information of the Students

This study analyzed the gender distribution as a demographic information of the respondents. The results are presented in Table 1.

Table 1: Gender of the Respondents

	Experimental		Control			
	N	%	N	%	N	%
Male	63	70	64	71.1	127	70.6
Female	27	30	26	28.9	53	29.4
Total	90	100	90	100	180	100

The findings indicate that 70% of the experimental group consisted of males and 30% females while the control group had 71.1% males and 28.9% females. Therefore, more males (70.6%) than females (29.4%) take physics as a subject.

Results of the Pre-test

The experimental group (E1) and control group (C1) were exposed to SSCQ pre-test before the start of the treatment to ascertain whether the students selected to participate in the study had comparable characteristics before the study. The Mann-Whitney test was used to analyze whether there were significant differences between mean ranks in SSCQ of experimental group (E1) and the control group (C1). The results are as shown in the Table 2.

Table 2: Mann-Whitney Test Results of the Pretest of Student Self-concept on Experimental Group 1 and Control Group 1

Group	N	Mean Rank	Sum of Ranks	Mann-Whitney U	Wilcoxon W	Z	Sig.
Experimental Group 1	45	49.02	2206.00	854.000	1889.000	1.282	0.200
Control Group 1	45	41.98	1889.00				
Total	90						

The findings indicate that the mean ranks were 49.02 for Experimental group (E1) and 41.98 for control group (C1). The values of group mean for E1 and C1 were relatively close implying that the learners had similar characteristics hence homogeneous. The Mann-Whitney Test results in Table 2, further reveals that pre-test of SSCQ mean ranks of both experimental group E1 and control group C1 were not significantly different at 0.05 alpha level ($U=854.0$, $p=0.200$, $p > 0.05$). The results reveals that the level of students' self-concept towards physics in the two groups were comparable before exposure to the intervention implying that the learners were had similar characteristics hence suitable for the study.

Effects of Cooperative Mastery Learning Approach on Students' Self concept

The objective of the study sought to find out whether there was any significant difference in self-concept in learning physics between students taught using cooperative mastery learning approach and those taught using conventional teaching approach. Self-concept is a collection of believe about oneself. In this study, self-concept was taken to mean personal beliefs that the students develop about academic abilities in physics. Operationally, Student's self-concept was defined as a composite variable derived from mean ranks of non-missing students' response on 18 items measuring construct on a five point-likert scale, that is Strongly Disagree (SD) =1; Disagree (D)=2; Undecided (U)=3; Agree (A)=4 and 39 Strongly Agree (A)=5. The results of posttest results for the experimental group 1 and control group 1 in self-concept are presented in Table 3.

Table 3: Mann-Whitney Test Results of the Posttest of Student Self Concept on Experimental Group 1 and Control Group 1

Group	N	Mean Rank	Sum of Ranks	Mann-Whitney U	Wilcoxon W	Z	Sig.
Experimental Group 1	45	56.43	2539.50	520.500	1555.500	3.974	0.000
Control Group 1	45	34.57	1555.50				
Total	90						

The mean ranks were 56.43 for experimental group (E1) and 34.57 for control group (C1). The experimental

group E1 that was taught using cooperative mastery learning approach had higher mean rank than control group C1 that was taught using conventional teaching approach. The Mann-Whitney test results in Table 20 reveals that post-test of SSCQ mean ranks of both groups E1 and C1 were significantly different at 0.05 alpha level (U=520.5, Z= 3.974, p=0.000, $p < 0.05$). The p value was less than 0.05 indicating that there is statistically significance difference in self concept between students taught using cooperative mastery learning approach and conventional teaching approach in physics. The results of post-test results for the experimental group 2 and control group 2 in self-concept are presented in Table 4.

Table 4: Mann-Whitney Test Results of the Posttest of Student Self concept on Experimental Group 2 and Control Group 2

Group	N	Mean Rank	Sum of Ranks	Mann-Whitney U	Wilcoxon W	Z	Sig.
Experimental Group 2	45	54.51	2453.00	607.000	1642.000	3.275	0.001
Control Group 2	45	36.49	1642.00				
Total	90						

The findings in Table 4 indicates that the mean ranks were 54.51 for experimental group (E2) that was taught using cooperative mastery learning approach and 36.49 for control group (C2) that was taught using conventional teaching approach. The experimental group E1 had higher mean rank than control group C1. This implies that the students' self concept in physics was higher when the students were taught using cooperative mastery learning approach compared to when students were taught using conventional teaching approach. Comparing the results of experimental group and control group, cooperative mastery learning approach proves to have a positive effect on students' self concept. This suggest that cooperative mastery learning approach enhances students' self concept in physics and it is an effective approach. The Mann-Whitney test results in Table 4 shows that post-test of SSCQ mean ranks of both groups E2 and C2 were significantly different at 0.05 alpha level (U=607.0, Z= 3.275 p=0.000, $p < 0.05$) revealing that there is statistically significant difference in self concept in physics between students taught using cooperative mastery learning approach and those that are taught using conventional teaching approach. Table 5 shows the Independent-Samples Kruskal-Wallis test Summary of the Post test for the four Groups.

Table 5: Independent-Samples Kruskal-Wallis Test Summary of the Posttest for the Four Groups

Total N	Kruskal-Wallis H	df	Sig.
180	26.175[a]	3	0.000

The findings in Table 5 show that the differences between the post-test mean ranks on SSCQ were statistically significant ($H(3) = 26.175$, $p = 0.000$, $p < 0.05$). The p value was less than 0.05 and therefore, the hypothesis of the study H_{03} was not accepted, which stated that there is no statistically significant difference in self concept in physics of the students taught using cooperative mastery learning approach 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 self-concept on experimental groups E1 and E2. To determine where the difference existed, a post-hoc analysis test using Bonferroni adjusted alpha levels was used to compare all pairs of the groups as shown. The results are shown in Table 6.

Table 6: Post Hoc Comparisons of Posttest of SSCQ Means for the Four Groups

Sample 1-Sample 2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj.Sig.[a]
Control Group 1-Control Group 2	-9.556	10.977	-0.870	0.384	1.000
Control Group 1-Experimental Group 2	43.833	10.977	3.993	0.000	0.000

Control Group 1-Experimental Group 1	43.989	10.977	4.007	0.000	0.000
Control Group 2-Experimental Group 2	34.278	10.977	3.123	0.002	0.011
Control Group 2-Experimental Group 1	34.433	10.977	3.137	0.002	0.010
Experimental Group 2-Experimental Group 1	0.156	10.977	0.014	0.989	1.000

The findings in Table 23 shows the pairwise comparisons of groups. Post hoc Mann Whitney tests using a Bonferroni adjustment alpha level of 0.05 were used to compare all the pairs of groups. Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same. The finding shows that the groups C1 and C2, E1 and E2 had a p value of 1.000 and 1.000 respectively. The p value was less than 0.05 implying that the groups were not significant hence revealing that there was no significance difference in students' self concept in physics in the control groups that were taught using conventional teaching approach and experimental groups that were taught using cooperative mastery learning approach. The findings show that the groups C1 and E2, C1 and E1, C2 and E2, C2 and E1 had a p value of 0.000, 0.000, 0.011, and 0.010 respectively revealing that there was a significance difference in groups. This implied that cooperative mastery learning approach had a positive influence on students' self concept in physics. Cooperative mastery leaning approach enhanced students' self concept in physics indicating that it is an effective approach capable of enhancing students' self concept in physics.

The findings of the study concur with the research findings of a study by Krank and Moon (2001) that revealed that cooperative mastery learning approach yields greater change in academic self-concept compared to either mastery learning alone or cooperative learning alone in undergraduate social science students enrolled in three sections of a required course. The results of the study are also in line with the findings of Goreyshi *et al* (2013) that investigated the effect of cooperative mastery learning approach on working memory capacity, self-efficacy and academic achievement in grade skipping which showed a significant increase in working memory capacity, its components, storage, processing, and self-efficacy. The findings of the study also agree with a study by Kahie (2009) that revealed that students who engage in active learning experiences develop higher self-concept than those who do not. This implies that choice of appropriate teaching approach has a direct consequence on learner's academic self-concept. The use of cooperative mastery learning approach may improve student's self-concept in physics by improving the attention of students as they work together in the cooperative mastery learning groups.

CONCLUSIONS

The study findings showed a statistically significant difference in self concept in physics between the students taught using cooperative mastery learning and those taught using the conventional teaching approach. Student taught physics using cooperative mastery learning approach had a higher mean rank in self concept towards physics as compared to those taught using conventional teaching approach. Therefore, this indicates that cooperative mastery learning approach is more effective than the conventional teaching approach in improving the students'self concept in physics. This shows that students who are taught physics through cooperative mastery learning approach achieve high self concept than those taught using conventional teaching approach. Therefore, it can be concluded that cooperative mastery learning approach facilitates students' self concept towards learning physics more than conventional teaching approach.

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