

Effect of Using Cooperative Learning Methods on Secondary School Students' Achievement in Kinematics in Kenya

Peter Kelonye Sogoni¹, Amadalo Maurice Musasia²

¹Science Lecturer, Eregi Teachers' Training College

²Department of Science and Mathematics Education, Masinde Muliro University of Science and Technology

Abstract: Performance in physics at secondary school level in Sabatia sub-county in Kenya has shown no significant improvement in recent years. This poor performance has mainly been attributed to techniques of teaching physics. There is a need to compare traditional teaching strategies and emerging instructional methods. The purpose of the study was to investigate effect of using cooperative learning on secondary students' achievement in kinematics in Sabatia sub-county in Kenya. The research objectives were to find out whether there is any difference in achievement amongst the students due to cooperative learning, determine whether there is any difference in achievement in kinematics between county and sub-county school due to cooperative learning and determine whether there is any difference in achievement amongst boys and girls due to cooperative learning. A quasi-experimental pre-test, post-test non-equivalent research design was adopted for the study. The study population involved form three students doing physics in public mixed secondary schools in Sabatia sub-county. Stratified random sampling and purposive techniques were used in the study. This involved categorizing the schools into county and sub-county public mixed secondary schools then purposive sampling was used to select the only two county mixed secondary schools after which, simple random sampling was used to select ten schools from the sub-county schools. Finally, Simple random sampling was used to select one class that does physics per selected school. All the students doing physics in the selected class were included in the sample for the study. Experimental and Control groups were drawn from different schools. A total of 272 respondents were selected for the study. All the respondents were pre-tested in achievement. The control group was taught using conventional learning and the experimental group was taught using cooperative learning. The two groups were then post-tested in achievement. The research instruments were piloted in two schools in Sabatia sub-county. Reliability of the instruments was determined through a test-retest technique. The ATK1 yielded a reliability of 0.84, ATK2 yielded 0.85. The instruments had a reliability coefficient of above 0.7 which is deemed satisfactory. Data was collected using students' achievement tests in kinematics. Data was analyzed using inferential and descriptive statistics. Results were presented using tables. The results showed that students who were taught using cooperative learning performed better than those who were taught using conventional learning in achievement. The results also indicated that gender and school types had no effect on achievement in kinematics. It was concluded that use of cooperative learning improved achievement in kinematics. The study recommends teachers teaching physics in public mixed secondary be encouraged to use cooperative learning and curriculum developers to design programs that would help teachers fully utilize cooperative learning in order to improve achievement in kinematics.

Keywords: Achievement, Cooperative Learning, Conventional Learning

1. Introduction

Physics is regarded as the most basic science subject whose laws and interventions are widely used in the study of other subjects. Most forms of technology result from advances in physics. However, the performance of students in physics has persistently remained poor in most schools in many countries. Physics is also done poorly in many secondary schools in Kenya despite numerous efforts to reverse the trend. The low performance is worse in mixed public secondary schools. This low performance in physics is also reflected in schools in Sabatia Sub-county as was the case in KCSE performance in 2009. The overall mean score for the district was 3.877 representing a mean grade of D+. If this trend continues, the country cannot attain the technological advancement and goals of Vision 2030. The poor performance has been attributed to conventional methods of teaching.

In trying to address the issue of learning methods, the Government of Kenya (GOK) has continued to invest in quality education through cost sharing by funding In-Service Education and Training (INSETs) (Ministry of Education,

2007). The SMASSE INSET is one such initiative that focuses on the attitudes of teachers and the learners towards the subjects, pedagogy, teaching and learning materials and resources as well as mastery of content. However, according to the Social Cognitive Theory of Learning by Bandura, teachers may not just adapt teaching approaches after learning them or when facilitators instruct them to apply. Rather, they make choices and use what suits their learners, the learning environment and what they are comfortable with. This could explain the slow pace of adaption of more modern methods of learning such as cooperative learning and simulation (Makewa, Role & Biego, 2011).

Physics is taught under many topics such as mechanics. Many educators and researchers agree to the point that mechanics has a special place amongst other domains of physics (Mesic, 2015). Carson and Rowlands (2005) consider mechanics to be a logical entry for enculturation in scientific thinking whose understanding is essential for understanding physics as a whole.

Kinematics is a sub-domain of mechanics which serves as the starting point for enculturation of scientific thinking

(Carson & Rowland, 2005). Kinematics, the foundational topic of physics has concepts that must be well taught and be mastered by students for good performance in subsequent physics topics. In a baseline survey carried out in Zambia 2006 on opinions on topics in physics, many learners felt that kinematics was an easy topic. This was contrary to the actual results in the examinations. In Kenya, performance in questions involving kinematics in KCSE has been poor and this poor performance is worse in females than in males showing a gender disparity. The performance of boys remained slightly better than of girls, (KNEC 2009, 2010).

In 2010 KCSE physics results, questions in kinematics and related aspects were found to be difficult. The students have problems understanding various concepts in kinematics. As a result of this, there is need to change teaching strategies instead of conventional learning strategy in the learning kinematics. Researches on improving education quality indicate that it can be done through improving teacher quality, making them more effective in the way they teach (Ewing, 1995; World Bank, 2006).

According to KNEC analysis, practical questions involving kinematics are performed poorly. The poor performance was attributed to conventional teaching methods that are being used by the teachers. It is generally accepted that if an existing strategy of teaching does not yield results, then, other teaching strategies should be adopted. In view of the foregoing, there is need for a paradigm shift in methods of teaching and learning in order to address the poor performance. When appropriate learning methods are used, the learners develop proper attitudes and skills during the learning process. Mckeachie and Marilla (2006), concluded that the most effective teaching method are student – centered whereby students teach other students. Over the past years, a major educational innovation has emerged that is affecting classroom learning with emphasis on student – centered methods of learning (Ambelu, & Kahsay, 2011). Dominador (2007) also asserts that teachers are now implementing programs in which students are organized into small groups to accomplish a task, solve a problem, complete an assignment and study for a test through engagement in hands on activity. According to Beichner and Saul (1997), student-centered methods improve conceptual understanding and ability to solve problem hence enhancing performance. This is the essence of cooperative learning. It is hoped that this study will help the teachers' use cooperative learning in order to help learners improve performance in kinematics.

2. Statement of the Problem

The performance of students in kinematics in public mixed schools in Sabatia sub-county has remained poor over the

years. This has mainly been attributed to poor teaching methods. One of these poor teaching methods is conventional learning. Conventional learning was observed to be commonly used in teaching physics hence kinematics in public mixed schools in Sabatia sub-county (SMASSE District Report, 2010). In order to improve this trend, more appropriate teaching methods need to be used in teaching physics (KNEC Analysis Report, 2010-2012). One such method is cooperative learning. Cooperative learning has been observed to improve performance in science in schools that have used it in teaching. Therefore, this research seeks to investigate the effect of cooperative learning on students' performance in kinematics.

3. Research Objectives

The specific objectives of the study were to:

- 1) Find out whether there is any difference in achievement in kinematics due to cooperative learning.
- 2) Determine whether there is any difference achievement in kinematics between county and sub-county schools due to cooperative learning.
- 3) Determine whether there is any in kinematics amongst boys and girls due to cooperative learning.

3.1 Research Hypotheses

H01: There is no difference in achievement in kinematics amongst due to cooperative learning.

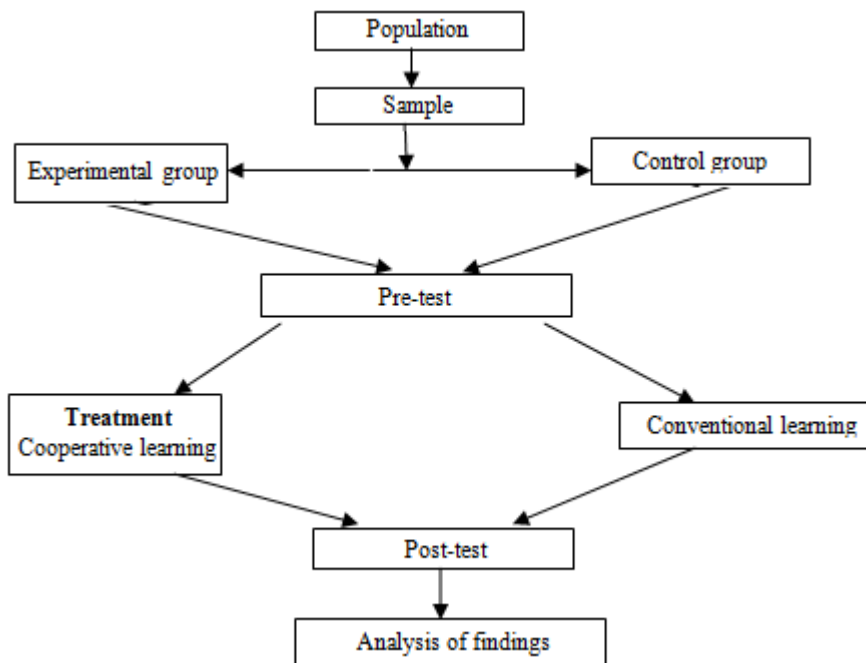
H02: There is no difference in achievement between county and sub-county schools due to cooperative learning.

H03: There is no difference in achievement amongst boys and girls due cooperative learning.

4. Research Design

This study used a quasi-experimental pre-test post- test non-equivalent design. This design was used because secondary school classes exist as intact groups. It was convenient to keep these classes intact. Quasi-experimental designs do not require re-organization of classes. In the study, the conditions under which the instruments were administered were kept similar in order to control instrumentation and selection. The respondents were randomly assigned to control and experimental groups in different selected schools. Each school had either a control or experimental group. The experimental group was pre-tested before intervention and then post-tested after intervention. The control group was pre-tested and no intervention done. The control group was then post-tested. This is indicated in

The research design is shown in figure 1



4.1 The Sample

The study involved form three physics students from Sabatia sub-county. A total of 272 students took part in the study. There were 76 boys and girls for the experimental group. There were 68 boys and 55 boys for the control group. There were 76 respondents in county schools and 197 respondents in the sub-county schools. Table 1 indicates the details of the study sample.

Table 1: The Study Sample

School Type Group	Experimental Group		Control Group		Respondents
	Boys	Girls	Boys	Girls	Total
County	21	20	19	15	75
Sub-county	55	53	49	40	197
Total	76	73	68	55	272

4.2 Research Instruments and Methodology

Two instruments were used to collect data in the study; achievement test in kinematics test 1 and test 2. Achievement in Kinematics (ATK 1) 1 was given as a pre-test in order to determine the achievement and entry behavior of the respondents in kinematics before intervention with conventional and cooperative learning strategies. The test covered motion word problems on distance, displacement, speed, velocity and acceleration. An Achievement Test in Kinematics 2 (ATK2) was given as a post-test to determine the achievement after intervention with cooperative learning. The test covered interpretation of kinematics graphs and equations of linear motion. The kinematics graphs involved in ATK2 were distance-time, displacement-time, speed-time and velocity-time graphs. The equations of motion covered in ATK2 were the first, second and third equations of linear motion.

The pilot study involved respondents from two randomly selected schools in Sabatia sub-county. The schools that were used in the pilot study were excluded from the final study. The purpose of the pilot study was to help clarify

questions, check on the level of language used and identify areas of difficulty in interpretation which could affect effective response. The pilot study revealed some inconsistencies and ambiguities which were restructured to improve on clarity.

The achievement tests (ATK1 and ATK2) were pre-tested in a selected school that was not used in the actual study. Test-retest technique was used to assess the reliability of the instruments. The retest was undertaken after two weeks of the first test to the same group of students. During the re-test the respondents were exposed same tests that were used in the first test. The results were coded and subjected to the Pearson Product-Moment Correlation formula in order to establish the extent to which the contents at the instruments are consistent in eliciting the same responses every time the instrument is administered. The ATK1 yielded a reliability of 0.84 and ATK2 .The instruments yielded reliability coefficient of above 0.7 which is considered acceptable in judging the instruments as reliable for the study (Frankel and Wallen, 2000).

5. Results and Discussion

The results were discussed as in the sub-sections below.

5.1 Pre-test Findings on Achievement Test in kinematics

The Pre-test yielded the findings for both the experimental and control groups. The group means and Student's t-test calculated as well as tabulated values are indicated in Table 2

Table 2: Independent t-test of the Pre-test test findings

Groups	Mean	t-calculated	t-tabulated
E (n=149)	56.4	0.01	0.496
C(n=123)	56.3		

From Table 2, The calculated t-value of 0.01 was less than the tabulated t-value of 0.496This indicated that the

difference in means and standard deviations was not significant. The t-test indicates that the students had a similar entry behavior.

5.2 Post-test Findings on Achievement Test in Kinematics 2

Table 3 is a summary of findings on ATK2 for mean scores and standard deviations for the experimental group and control group.

Table 3: Findings on ATK2

Group	Post-test		
	Mean score%	n	SD
E	83.6	149	7.55
C	57	123	9.14

An examination of Table 4.2 indicates the experimental group had a mean scores of 83.6 and control group had 57.0. The standard deviations of the experimental group and control groups were 7.55 and 9.14 respectively. This showed a difference in the means. A one tailed t-test was done to determine if there was a significant difference in the means. The calculated value was 26.5 and the table value was 14.651 with 147 degrees of freedom. The t- test indicated that there was significant difference in the means. The null hypothesis was rejected at $p < 0.05$. Therefore treatment was effective. Thus cooperative learning improved performance in kinematics.

5.3 Findings on Post-test for School Type Achievement in kinematics.

In order to determine the effect of using cooperative learning and conventional learning on students' achievement in kinematics due to school types, the students' post- test scores were compared for experimental and control groups. The findings are indicated in Table4.

Table 4: Mean Scores and Standard Deviations on ATK2 for School Types

Groups	School types				
	County		Sub-county		
	Mean	SD	Mean	SD	Mean DF
E	84.1(n=41)	7.41	83.4(n=108)	7.63	0.7
C	55.7(n=35)	10.03	55.9(n=88)	9.42	0.2

From Table 7, the experimental group had a mean scores of 83.1 and 83.4 for the county and sub-county schools respectively. This represented a mean difference of 0.7. The standard deviations of the experimental group were 7.41 and 7.63 for county and sub-county respectively. This showed a difference in the means. An examination of the table also indicates that the control groups had mean scores of 56.3 and 55.9 for county and sub-county schools respectively. This represents a mean difference of 0.2. The standard deviations of the control group were 10.03 and 9.43 for county and sub-county schools respectively. There was some difference in the means. A one tailed t-test was done to determine if there was a significant difference in the means. The calculated value was 0.51 and the table value was - 1.6589 with 147 degrees of freedom. The t- test indicated that there was no significant difference in the means at $p <$

0.05. This means that the null hypothesis was accepted. Therefore there was no significant difference in means. This implies that there was no school type effect on performance in kinematics.

5.4 Findings on Post-test for Gender on Achievement in Kinematics

In order to determine the effect of using cooperative learning and conventional learning on students' achievement in kinematics due gender, the students' post- test scores were compared. The findings are indicated in Table5.

Table 5: Summary of mean scores and Standard Deviations of the post-test for Gender Achievement in Kinematics

Group	Gender				
	Boys		Girls		
	Mean	SD	Mean	SD	DF
E	83.6(n=77)	7.59	83.6(n=72)	7.56	0.00
C	56 (n=68)	9.80	55.6(n=55)	9.80	0.4

From Table 10, the experimental group had a mean score of 83.6 and 83.6 for boys and girls respectively. This represented a mean difference of 0.0. The standard deviations of the experimental group were 7.59 and 7.56 for the boys and girls respectively. This showed a difference in the means. An examination also indicates that the control group had a mean scores of 56.0 and 55.6 for boys and girls respectively. This represented a mean difference of 0.4. The standard deviations of the control group were 9.80 and 9.80 for boys and girls respectively. This indicated little difference in the means. A t-test was done to determine if there was a significant difference in the means. The calculated value was 0.00 and the table value was - 1.659 with 147 degrees of freedom. The t- test indicated that there was no significant difference in the means at $p < 0.05$. This means that the null hypothesis was accepted. Therefore there was no significant difference in means. This implies that there was no gender effect on performance in kinematics.

5.5 Discussion of Findings on Achievement in Kinematics

The implication of the above results is that achievement in kinematics is higher when students are taught using cooperative learning as compared to conventional learning.

There was no significant difference in pretest mean scores in both experimental (E) and control (C) groups on ATK1 findings. This meant that the respondents had similar entry behavior in the achievement test.

In the post-test (ATK2) findings, the experimental group had a higher mean score gain as compared to the control group. The findings imply that the treatment effect was significant. Thus cooperative method of teaching and learning enhanced achievement in the experimental group. The findings agree with studies carried out by Kiboss (1999) and Yager (1985)

Kiboss (1999), study on relative effects of a computer- based Instruction in physics on students' attitudes, motivation and understanding about measurement and perception of classroom environment, found out that students taught using

cooperative learning did better than those for conventional learning. Yager et al (1985), study on oral discussion groups-to-individual transfer and achievement in cooperative learning groups, reported that students who work in a cooperative environment perform better than those who work alone. The study further pointed out that, cooperative groups perform higher on their daily work accuracy compared to conventional learning groups.

The study found out that there was no significant difference between scores for county and sub-county schools in the post-test. The results indicate that achievement in kinematics was not influenced by school types when students are exposed to cooperative learning.

The study also found out that there was no significant difference in scores between boys and girls in the post test. The test indicated that achievement in kinematics was not influenced by gender differences when students are exposed to cooperative learning. This is in agreement with studies done by Sherman(1989) , Rice& Gabel(1990) and Rogas, Harry and Ann (2007)

Sherman's(1989) study in Biology involving high school students found no significant differences between boys and girls taught using cooperative learning and those for conventional learning. Rice & Gabel (1990), in a study involving pre-service elementary teachers found no significant differences in scores between boys and girls in experimental and control groups in a college service course. They concluded that cooperative and conventional learning has no effect on achievement by subjects based on gender. Another study by Rogas et al (2007) on gender differences in cooperative learning with college students in a multiple choice test, found no significant differences between boys and girls.

However, other studies were in disagreement with the findings. A report by Bartsch (2015) on disadvantages of using cooperative learning, indicates that the demands of organizing cooperative learning makes it difficult to effectively relate performance to each individual learner. The report noted that without proper use of the techniques of cooperative learning, performance has been observed to be low in some instances. Another study by Jones (1990), to compare effectiveness of cooperative learning versus traditional learning, did not find any significant difference between results of the two methods. However, this study was conducted in elementary schools unlike the present study.

6. Conclusions

The main objective of the present study was to find out the effect of cooperative learning and conventional learning on achievement in kinematics. It sought to find out how students' gain when taught using cooperative learning and when they are taught using conventional learning. From the study it was revealed that use of cooperative learning improved achievement in kinematics.

The study also revealed that there were no differences in achievement for school types and gender due to cooperative

learning. Overall, cooperative learning had to a large extent been successful in enhancing achievement in kinematics.

7. Recommendations of the Study

In the summary of findings, it is recommended that public mixed secondary schools be encouraged to use cooperative learning in teaching and learning physics in order to improve achievement in kinematics.

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