PERFORMANCE IN KINEMATICS USING COOPERATIVE LEARNING AMONG SECONDARY SCHOOL STUDENTS IN SABATIA SUB-COUNTY, KENYA.

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A thesis submitted in Partial Fulfillment for the Requirements of the award of the Degree of Master of Science in Science Education of Masinde Muliro University of Science and Technology

November, 2017

DECLARATION AND CERTIFICATION

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Declaration by the Candidate

This thesis is my original work prepared with no other than indicated sources and support and has not been presented for an award of a degree for any other award in this or any other university.

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The undersigned certify that they have read and hereby recommend or acceptance of Masinde Muliro University of Science and Technology a thesis entitled: "Performance in Kinematics using Cooperative Learning among Secondary School Students in Sabatia Sub-County, Kenya."

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DEDICATION

I dedicate this work to my loving wife Mrs. Catherine Kayesi Kelonye and my lovely children Mitchel, Keryl and Cyril whose support gave me determination and inspiration.

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ABSTRACT

Performance in physics at secondary school level in Sabatia sub-county has shown no significant improvement in recent years. Analysis by the Kenya National Examinations Council indicates that students do poorly in kinematics and this affects their overall performance in physics. This poor performance has mainly been attributed to conventional methods of teaching physics. It has been observed that schools that perform well emphasize the use of emerging instructional methods such as cooperative learning. There was therefore a need to investigate performance in kinematics using cooperative learning among secondary school students. Therefore, the purpose of the study was to determine the effect of using cooperative learning on performance among the secondary school students in Sabatia Sub-County, Kenya. The research objectives were to determine the effect of cooperative learning on academic achievement in kinematics, measure the effect of cooperative learning on development science process skills in kinematics , and determine the effect of cooperative learning on attitude in kinematics .A quasi-experimental pre-test, post-test non-equivalent research design was adopted for the study. The study population involved 270 form three students doing physics in public mixed secondary schools in Sabatia sub-county. Purposive sampling was used to select two schools that were used in the pilot study. Simple random sampling was used to select 10 schools from where the respondents were drawn. After which simple random sampling was used to select one class from each school and all the students in the selected class were assigned to either experimental or control group. Experimental or Control groups were drawn from different schools. Reliability of the instruments was determined through a test-retest technique for the achievement tests, through observation of development of skills and demonstration of scientific attitudes in experiments in kinematics for the checklists. The Achievement Test in Kinematics 1 yielded a reliability of 0.84, Achievement Test in Kinematics 2 yielded 0.85, Science Process Skills Observation Checklist yielded 0.785 and Science Attitudes Observation Checklist yielded 0.767. Therefore each of the piloted instruments had a reliability coefficient of above 0.7 which was deemed satisfactory. Data were collected using students' achievement test in kinematics, students' science process skills observation checklist and students' attitudes observation checklist. Data was analyzed manually using inferential and descriptive statistics. It was concluded that cooperative learning was effective in enhancing performance in kinematics among the students. Finally, the study recommended the use cooperative learning in order to improve performance in kinematics among secondary school students.

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ABBREVIATIONS AND ACRONYM

FEK	:	Final Experiment in Kinematics
ISPS	:	Integrated Science Process Skills
KCSE	:	Kenya Certificate of Secondary Education
KICD		:Kenya Institute of Curriculum Development
KNEC	:	Kenya National Examination Council
MMUST	:	Masinde Muliro University of Science and Technology
MoE	:	Ministry of Education
PEK	:	Final Experiment in Kinematics
SAOC	:	Students' Attitudes Observation Checklist
SMASSE	:	Strengthening of Mathematics and Science in Secondary Education
SPS	:	Science Process Skills
SPSOC	:	Science Process Skills Observation Checklist

CHAPTER ONE

INTRODUCTION

1.1 Overview of the Chapter

This chapter describes the background of the study, statement of the problem, purpose of the study, objectives of the study, research hypotheses, significance of the study, assumptions of the study, scope of the study, limitations of the study, theoretical framework, conceptual framework and operational definition of terms.

1.2 Background to the Problem

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. This means that there should be an emphasis on physics in the curriculum for a country to advance in technology. The emphasis should therefore be on students performing well in physics. However, the performance of students in physics varies from country to country and the general observation is that performance in physics has persistently remained poor in most schools in many countries. In Nigeria where learning is mainly teacher centered, only 3.68% of secondary school students got a credit pass in a national physics examination in 2010 (Vanguard,2010) and this is equivalent to a C in Kenya Certificate of Secondary Education (KCSE). In England where learning is mainly student centered, more than 90% of students attained above grade C in the year 2015 and 2016 in the General Certificate of Secondary Education Examinations (https://schoolweek.co.uk>gcse). This implies that in England, students generally do well in physics. In Kenya, performance in physics is generally poor considering that the national mean score in KCSE in 2014 was 4.02 and only 32% of the students got D+ and above (KNEC Report,2015). This was a poor performance .The report further noted that students in mixed schools performed quiet poorly in the examination. According to a report by an educational body known as Strengthening Mathematics and Science in Secondary Schools (SMASSE) in 2015, the overall mean score for Vihiga County schools in 2015 in KCSE physics was 3.85 representing a mean grade of D+. This was below the national mean of 4.47. This low performance was also reflected in schools in Sabatia Sub-county where the average mean score in 2015 was 3.50 in 2015. 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 (Ganyaupfu, 2013).

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 science 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 *et al*, 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. According to Carson and Rowland (2005), Kinematics is a sub-domain of mechanics which serves as the starting point for enculturation of scientific thinking, describes the motion of points and bodies without considering the mass of each or forces that cause the motion.

Kinematics is useful in many aspects such as in astrophysics; where it describes motion of celestial bodies, in mechanical engineering and biomechanics; where it describes motion of disjointed parts (https://en.mwikipedia.org>wi). In this regard Kinematics being a foundational topic of physics (www.spung.com>content>sid), has concepts that must be well taught and be mastered by students for good performance in subsequent physics topics. These concepts include distance/displacement, speed/velocity and acceleration. In a baseline survey carried out in Zambia 2006 (https://www.researchgate.net), 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 college examination in France, it was observed that many students struggled with questions on kinematics (https://www.totalregistration). In Kenya, performance in questions involving kinematics in KCSE has been poor over the years (KNEC Reports 2014,2015). The students have problems understanding various theoretical concepts in kinematics. The reports, point out that practical questions involving kinematics are performed poorly. The reports attributed this to conventional teaching methods that are being used by the teachers.

According to Saga (2015), if an existing strategy of teaching does not yield results, then, other teaching strategies should be adopted. In view of the fore going, 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 (Saribas ,2009). As a result of this, there is need to change from conventional learning strategy which are commonly used in teaching and learning kinematics.

According to KNEC Analysis Reports (2014, 2015), practical questions involving kinematics are performed poorly. The reports attributed to conventional teaching methods that are being used by the teachers. In view of the fore going, 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 as was observed by a study Hoelwarts &Moeter (2011). The study showed that when instructors switched from traditional instruction to active learning, students learning improves. Another study by 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 Froyd and Simson (2010), student-centered methods improve conceptual understanding and ability to solve problems hence enhancing performance. This is the essence of cooperative learning. Cooperative learning has been observed to improve learning outcomes when used by instructors in various fields of learning. A study by Castle (2014) on cognition, observed that cooperative learning enhanced cognition development among college students. It is hoped that this study will help the teachers' use cooperative learning in order to help learners improve performance in kinematics.

1.3 Statement of the Problem

The performance in physics in most Kenyan secondary schools has been poor over the years, for example , the national mean score in physics in 2014 was 4.02(D+) and in 2015 was 4.47(D+). This is a low performance as the maximum score based on KCSE scoring is 12 for grade A. In Sabatia Sub-County, the average mean scores in physics in the years 2014 and 2015 were 3.56(D+) and 3.50(D+) respectively. These average mean scores were lower than the national means in the two years. Munene (2014) observed that the main factor that leads to poor performance in learning physics in Kenyan secondary schools is the use of conventional learning. Conventional learning has also been observed to be commonly used in teaching physics in the public mixed secondary schools in Sabatia Sub-County (SMASSE Sub-County Report, 2014). In view of this, KNEC Analysis Reports (2014,2015) suggest that for improvement in performance in physics more appropriate teaching methods need to be used. One such method is cooperative learning which has been observed to improve performance in mathematics (Muhenge, 2006). Therefore from the foregoing this research sought to investigate the performance in kinematics using cooperative learning among secondary school students in Sabatia Sub-County in Kenya.

1.4 Purpose of the Study

The purpose of the study was to determine the effect using cooperative learning on performance among secondary school students in Sabatia Sub-County in Kenya.

1.5 Objectives of the Study

The specific objectives of the study were to:

i. Determine the effect of cooperative learning on academic achievement in kinematics.

ii. Measure the effect of cooperative learning on development of science process in kinematics.

iii. Determine the effect of cooperative learning on attitudes in kinematics.

1.6 Research Hypotheses

The study was guided by the following null hypotheses:

H_{01}: There is no significant mean difference in academic in kinematics among the treatment groups.

H_{02}: There is no cooperative learning effect on development of science process skills among the students.

H_{03}: There is no cooperative learning effect on attitude in kinematics among the students.

1.7 Significance of the Study

The study is significant in the fact that its findings will provide an insight to the ministry of education on cooperative learning as one of the ways of improving academic achievement in kinematics, enhancing the development of science process skills and enhancing positive attitudes in kinematics. Furthermore scholars and academicians will use the study as a source of information regarding learning kinematics. Finally the study will contribute to the knowledge gap and add value to literature on methods of enhancing learning kinematics.

1.8 Assumptions of the Study

The assumptions of the study were that:

i. The teaching period was the same in all the schools as the post test and the final experiment in kinematics were to be administered on the same days.

ii. Teachers were not familiar with cooperative learning techniques and therefore needed to be inducted on its application in teaching.

1.9 Scope of the Study

The study focused to investigate students' performance when taught using cooperative learning in Kenya. The subjects in the study were form 3 students from mixed secondary schools in Sabatia sub-county. The study was restricted to public mixed secondary schools in Sabatia sub-county in Kenya and cooperative learning was restricted to jigsaw teaching technique.

1.10 Limitations of the Study

One of the limitations of the study was the lack of randomization on the subjects when forming the groups. This was minimized through pre-testing. The other limitation was the use of respondents from mixed schools only. This could affect generalizability of the results for the whole sub-county. This was minimized by selecting respondents from a variety of schools.

1.11 Theoretical Framework

The study was based on social constructivist theory by Vygotsky (1978). The theory emphasizes that the background and social interaction influence how learners arrive at the truth. The background of the learners helps to shape knowledge and truth. The thinking abilities are developed through interaction with other people and the physical world. Therefore learners should be actively involved in the learning process in trying to get the truth. The theory therefore emphasizes "harkness' discussion method in which learners sit on a table in a circle, motivating and controlling their own discussion. The learners will act as a team and work cooperatively to attain a desired goal. The teacher acts only as a facilitator. The emphasis turns towards the learner and away from the instructor and content. The learning process becomes active. The process of sharing collaboratively amongst the learners results in learners constructing understanding that would not be possible individually. Finally, the facilitator and the learners are equally involved in learning from each other. This makes learning both objective and subjective. This creates a dynamic interaction between task, instructor, resources and the learner thereby enhancing the construction of knowledge. This theory is the basis of the conceptual framework in the study.

1.12 Conceptual Framework

The conceptual framework emphasizes on the different variables that are important in the process of learning. According to Sridevi) (2008), students' academic in achievement, development of basic science process skills and demonstration of scientific attitudes in kinematics are influenced by the teaching instruction. According to Mykra (2015), learner centered methods have better learning out comes than teacher centered methods and therefore should be adopted for teaching. However, student centered methods are still commonly used in schools. Therefore a comparison between learner centered and teacher centered methods would show which approach produces better outcomes in terms of academic achievement, basic science process skills and scientific attitudes in kinematics. Therefore the conceptual framework is based on Social Constructivist Theory. In social constructivist classrooms collaborative learning is a peer interaction that is mediated by the teacher and learning is effective thereby leading to better learning output (Andrews). The teacher mediates through appropriate teaching methods. Since a particular teaching method is one of the factors that determine the learning out comes, therefore, in the frame work, cooperative learning and conventional learning are the independent variables. According to Singh and Sengeeta (2015), during constructivism teaching there is a period of exploration when practical activities are done and this is when science process skills and scientific attitudes are developed. Teacher characteristics also have an effect on learning out comes (Wenglinsky, 2001) and therefore they needed to be controlled and hence they were the extraneous variables. Teacher characteristics were controlled for through inducting the teachers who taught the students on cooperative learning as it was assumed that the use of cooperative learning was unfamiliar to them. The effect of resources was controlled for by ensuring that the selected schools for the study had similar resources and the researcher also ensured the required resources were availed for use in case of inadequacy. A summary of the conceptual framework explaining the interrelationship among the study variables is illustrated in figure 1.1.

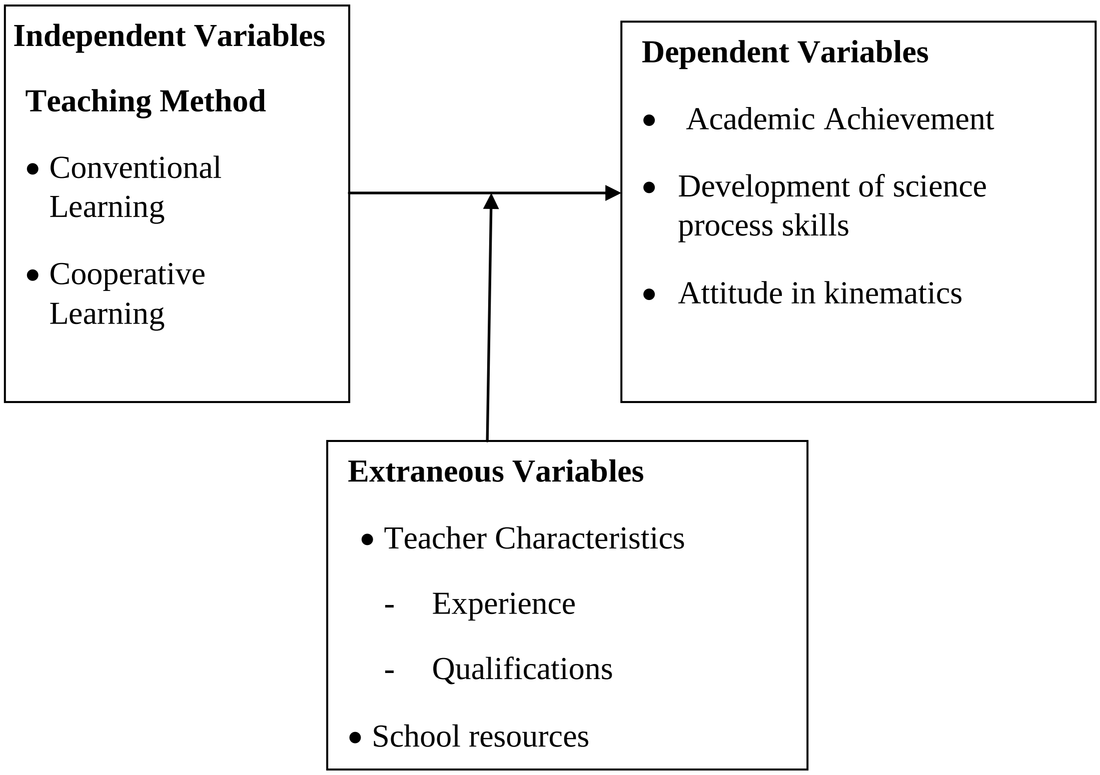

Figure 1.1 Conceptual Framework Depiction

1.13 Operational Definition of Terms

The following definitions were operationalized for the purpose of the study:

Attitudes: internal feelings demonstrated through cooperation, open-mindedness and responsibility.

Science Process Skills: skills involving in science investigative activities with emphasis on observing, recording, measurement and using numbers.

Conventional Learning: instructional method of learning which is mainly teacher centered.

Cooperative Learning: instructional method of learning involving jigsaw technique and where students work together in small learning groups, helping each other to accomplish individual and group tasks.

Performance: achievement in a test, a measure of skills development or a measure of attitude in kinematics.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

The section provides literature related to methodology in kinematics instruction, students' academic achievement, science process skills, attitudes in kinematics and knowledge gap.

2.2 Methodology in Kinematics Instruction

The choice of teaching and learning methods depends on a number of factors such as the skills level of students, past instructional methods, topic, class size and resources (Rachel, 2015). According to Rachel (2015), if students are of same skill level, a wider range of instructional methods can be used; for example discussion, cooperative learning and direct instruction for the whole group. If students have varied skill levels, each group skill level will require a particular method of instruction.

According to Carpenter (2006), the class size determines the number of students to be used in groups. If the number of students is large, then the class is divided into smaller groups for a particular method of teaching being used to be effective. Class size has been observed to affect discussion- based learning.

The topic at hand will determine which method to be used. Some topics will require discussions while others will require hands-on activities including field trips. If a topic is difficult a resource person can be used. If the topic is easy, the learners can be used to teach each other in groups. The teacher can also use class assignments to cover easier topics.

Resources determine group sizes, hands-on activities and experiments. If resources are few, then the teacher may use demonstration method. If resources are not available for practical work, then lecture method audio-visuals are used. If resources are far from the school then an educational trip can be used. Finally, a new method of instruction may reinvigorate learners' interest and a new instructional methods will make teaching and learning to be fresh (Rachel, 2015).

The preference of a teaching method depends on both the teacher and the learner (Qualters, 2001). Teachers can therefore influence the learning process by choice of appropriate teaching methods. Teachers should use their experiences and abilities to choose teaching methods that help the learners acquire desirable concepts. A number of teaching methods exist. Some of the teaching methods are learner centered and others are teacher centered and each method has different learning outcomes. The learning outcome as a result of any of the methods used can be summed up by a quote from Richard Feynman about the strange theory of light.

He stated the following:

> "What am going to tell you
> about is what we teach our physics students …It is my task
> to convince you not to turn away because you don't
> understand it…That is because I don't understand it .
> Nobody does…"

The quote explains the difficulties experienced by both the teacher and learner during the learning process. Teachers have a challenge of making it easier for learners to understand different concepts. The learners too have their own preferences on which method of learning that stimulates them in order to grasp concepts easily.

Some of the teaching methods are used include lecture and cooperative learning. Lecture which is a conventional learning method is a teacher centered and has been commonly used in teaching science over the years yet scientific concepts are still a problem to students. In contrast, Cooperative learning is student centered and has been used as alternative learning method and been observed to enhance performance (Jaya, 2010). The outcome of various learning methods has been studied by many scholars, for instance; Hunt, Haidet, Coverdale, and Richards (2003) examined student performance in team based learning methods and found out positive outcomes as compared to traditional (conventional) methods. Likewise, Sonia(2015) notes that the traditional chalk and talk method of teaching that has persisted for hundreds of years is now acquiring inferior results when compared with more modern that are available for use in schools today. In contrast, a study by Barnes and Blevins (2003) on active learning, suggests that active learning methods are inferior to traditional lecture methods. From the foregoing, it appears that different scholars differ in their conclusions on which method of teaching is superior in enhancing learning outcomes. In spite of the foregoing this study, focused on investigating with a view of comparing cooperative learning and conventional learning in order to find out which method would enhance performance in kinematics. The choice of cooperative learning was due to the fact that it is student centered in relation to conventional learning which is teacher centered.

2.2.1 Conventional Learning in Kinematics

Conventional learning involves methods that are teacher centered such as lecture and teacher demonstration and in these methods power and responsibility are held by the teacher (Boumova, 2008). The methods consider learners as highly deficient in knowledge and it is only the teacher who has knowledge to deliver. In this regard, the teacher is seen to be the one that causes learning to occur (Novak, 1998). Conventional learning methods emphasize verbal answers and reliance on rote memorization with no effort at understanding the meaning of what is being taught. In addition, there is emphasis that all students must be taught the same materials at the same point. Those students that do not learn quickly enough fail and are not given time to succeed at their own pace (Rusbult, 2001).

Muhenge (2006), asserts that conventional learning methods and in particular lecturing, have been identified to be commonly used by teachers and are regarded as major contributing factors in poor performance and negative attitude in learning. When these methods of teaching are used, students are turned into passive participants as the teacher becomes the most dominant factor in the learning process, in effect, very little learning is achieved by the learners (Luther, 2000). Thus a paradigm shift in the teaching and learning process is necessary. Teachers should adapt to more modern methods of teaching and learning such as cooperative learning (Welker, 2017)

There are several reasons why teachers use conventional learning methods. According to Kariuki *et al* (2008), teachers use lectures in order to cover the syllabus quickly, reduce on the cost of doing hands-on activities, prepare for lessons easily and for the convenience in teaching a large number of students. Likewise, the reasons for using teacher demonstration include saving on time if learners did the practical activities, safety reasons especially in case of dangerous experiments, inadequacy of apparatus, and in showing a new practical skill.

However, according to Ngaroga (2006)**,** the learners are disadvantaged to the fact that they are passive in the learning instruction; the disadvantages include low knowledge retention, low motivation, poor development of process skills and low demonstration of scientific attitudes. This in turn results in poor performance in kinematics.

2.2.2 Cooperative Learning in Kinematics

Cooperative learning is a teaching method in which small teams, each with students of different levels of ability, use a variety of learning activities to improve on their understanding of a subject. Each member of a team is responsible not only for learning what is taught but also for helping teammates learn, thus creating an atmosphere of achievement. Learners are given assignments then they work through them until all group members successfully understand what to do (Dorminador, 2007).

Researchers have found that cooperative learning can be a strategy for improving achievement (Slavin, 2014). When the conditions of group rewards and individual accountability are met, cooperative learning improves achievement across different grades and in tasks that range from basic skills to problem solving (Johnson & Johnson, 2003). Cooperative learning is a departure from the traditional teacher/learner-center environment (Smith & MacGregor, 1993). The culture of the classroom shifts from instructor's explanation of material to students constructing meaning with others in connection to the classroom experience (Smith & MacGregor, 1993).

A classroom that actively applies cooperative learning to the curriculum aims to provide students with an atmosphere of equality. Cooperative learning insists on the teacher playing the role of a facilitator and collaborator in the classroom. Cooperative learning also challenges the traditional assumption of the teacher as the truth-holder and knowledge-transmitter. It attempts to create a condition in the classroom in which the teacher's authority gives way to the authority of students' collaborative groups- the community of knowledgeable peers (Omwuegbuzie, 2001).

Cooperative learning processes can be incorporated into a typical 40-minute class lessons depending on their nature. Some lessons would require a thorough preparation; such as long-term projects, while others require less preparation, such as posing a question during lecture and asking students to discuss their ideas with their neighbors. However, Smith and Mac Gregor (1993) state that in collaborative classrooms, the lecturing/ listening/ note-taking process may not disappear entirely, but it lives alongside other processes that are based on students' discussion and active work with course material. They concluded that, regardless of the specific approaches taken, the goals are the same; to shift learning from teacher-centered to student-centered models such as cooperative learning.

However, different student-centered learning models must meet certain conditions to be effective. In cooperative learning, efforts may be considered to be more positive and competitive than in conventional learning if the following conditions are met: Positive Independenc**e** also referred to as sink or swim together; face-to-face interaction which promotes each other's success; individual accountabilit**y** so that there is no hitching or no social loafing; collaborative or social skills and processing (Johnson & Johnson, 2009).

Cooperative learning has many techniques, such as Jigsaw, Learning Together (LT), Student Teams Achievement Divisions (STAD), Teams Games Tournament (TGT), Team Accelerated Instruction (TAI) and Group Investigation (GI).This study adopted the jigsaw technique of cooperative learning developed by Eliot Aronson (1978) because it was more convenient to use as compared to the other techniques. In this technique, groups are formed and each member of each group is given a specific task, problem or topic. The students from all the groups who have been assigned the same topic then meet to discuss it in an "expert group", and then go back to the "home group" to share the results of their discussions. This method enables students to become experts on part of the instructional material about which they are learning. This makes them become responsible for their own learning. The choice of cooperative learning in comparison to conventional learning in kinematics was supported by results of some studies done earlier on by Hake (1998),Mills (1999) and Sengupta & Farris(2014).

Sengupta and Farris (2014) study on computational thinking found out that the use of cooperative learning enhanced understanding of motion graphs in kinematics. The study in particular recommended the use of cooperative learning as a method of teaching that can greatly enhance understanding of graphs in kinematics. Another study done by Hake (1998) on interactive engagement based on cooperative learning verses traditional method of instruction on kinematics found out that cooperative learning students performed better in a test in kinematics than those taught using conventional learning. Finally, Mills *et al* (1999), also found out that cooperative learning enhances performance in kinematics as compared to traditional method of instruction.

From the literature review, there was a knowledge gap as the researcher had not come across any study that had been done to investigate the effect of using cooperative learning on performance in kinematics. This led the researcher to investigate performance in kinematics using cooperative learning among the students.

2.3 Students' Academic Achievement in Kinematics

Student achievement is the measure o the amount of academic content in a determined length of time and there are many factors that impart successful student achievement and most critical factor being classroom instruction (Study.com/academy/lesson/student-achievement-definition-research.html). A link between achievement and the way various concepts are mastered by learners was observed in a study by Crouch and Mazur (2001) that found out that students' engagement in more modern methods of learning with emphasis on small group discussions improved understanding of concepts.

According to KNEC analysis (2001-2010), questions involving word problems were found to be easy while questions involving interpretation of motion graphs, calculations on equations of motion and interpretation of projectile motion were found to be difficult. According to Rosenbatt (2012), students have difficulties in the concepts of velocity and acceleration and this affected performance in questions involving kinematics graphs. It was suggested that students to be engaged in activities such as observing motion of object so as to develop abilities between abstract conceptual representation and real world representation of concepts in kinematics. Morkos and Tinker (1997) noted that there is the thinking of a graph as a literal picture of motion. For example students tend to think that if an object rolls down a bumpy road then the graph will look like a bumpy road. Hale (2002) also noted that students fail to distinguish between slope and height. Therefore, according to Planinic (2012), these ideas about motion and its causes cannot be corrected using traditional style of teaching. Crouch and Mazur (2001) suggested students' engagement in more modern methods of learning with emphasis on small group discussions as a way to improve understanding of concepts. Bektasil, B. (2006) emphasized the teaching of given topics in kinematics to be more student centered than lecture in order to improve graphical skills.

Araujo, L.S. et al. (2008), noted that students should be given opportunity to consider their own ideas about kinematics and this encourages them to modify those ideas where necessary .Therefore teachers cannot simply tell students what graphs should be. It is apparent that traditional style of instruction does not work well for imparting knowledge in kinematics. From the review of related literature, the researcher had not come across a study on the effect of cooperative learning on achievement in kinematics. Therefore this provided an area of study.

2.4 Science Process Skills in kinematics

According to Jerkin (2000), one of the most important and pervasive goals of schooling is to teach students to think. Science contributes to the unique skills of thinking in comparison to the other subjects. Scientific method, scientific thinking or critical thinking are terms that have been used to describe science skills.

Jerkin (2000), defines science process skills as a set of broadly transferable abilities appropriate to many science disciplines and reflection of behavior of a scientist. According to Curriculum Development Center of Malaysia, there are different categories of science process skills such as the Basic Science Process Skills. Some of the Basic Science Process Skills are observing, recording, measuring and using numbers. According to Ango (2002), since there are many process skills in the conduct of science learning, it is not appropriate to teach them all at once. Science curriculum provides a guide regarding when they should be learnt.

2.4.1 Importance of Science Process Skills

Science process skills are the thinking skills that are used to process information, to think about solving problems, and formulate conclusions (Tan & Temiz, 2003). These skills are the creative thinking for recognizing and solving daily problems encountered (Aktamis & Ergin, 2007). Okoli (2006), asserts that when one acquires the science process skills, such a person becomes specially equipped with tools required for scientific inquiry or problem solving as well as ability in the laboratory for a variety of investigations. A study by Kamisah and Vebrianto (2012) on science process skills and achievement revealed that students who possess science process skills were able to improve pupils' achievement through their modified behavior.

2.4.2 Development of Science Process Skills

Several studies have been done on development of science process skills in different fields. Ince, E. and Acar,Y.(2016), Conducted a study on the effect of prediction-observation-explanation and inquiry-based learning methods on science process skills and critical thinking disposition of pre-service teachers in general physics laboratory pre-service science teachers .The study revealed inquiry based laboratory activities enhance development of science process skills. White (1999) studied the development of content influence on science process skills instrument for general biology. The study revealed no relationship between process skills and learning styles. From review of the literature the researcher that had not come across a study done on cooperative learning effect on science process skills development in kinematics and therefore it became appropriate to carry out a study on this.

2.5 Attitudes in Learning Kinematics

According to Kariuki, Muriuki and Kamau (2008), an attitude is a behavior or feeling towards something. Attitudes can be looked at as scientific attitudes and attitudes towards science. Scientific attitude is the disposition to act in a certain way or a demonstration of feelings and thoughts (www.crstaloutreach.ualberta.c). Scientific attitudes include curiosity, cooperation, honesty, open-mindedness, responsibility, genuine interest and practical approach to problem solving. However, attitudes towards science are different from scientific attitudes. Attitudes towards science are the feelings, beliefs, and values held about an object that may be the endeavor of science and technology on society, or scientists (https://www.eduhk.hk>akcay>). These attitudes are useful and should be developed when teaching kinematics.

In addition to knowledge and science process skills, recognition has been given to attitudes. According to Anele (2012), attitudes encourage one to look at the good, the bad and the horrible in the world without ascribing to supernatural forces. That, attitudes fostered by science are invaluable assets for coping with the ever-changing mysterious universe. Attitude towards science is a major concern in science education, due to its significant relationship with academic achievement (Osborne, 2003; Zang and Cambell, 2010). A study by Perkins, Adams, Polluck and Wieman (2003), observed a positive correlation between students attitudes and conceptual learning gains. In many countries such as Iran (Soltani and Nasr, 2010) and India (Khan, 2005), it is confirmed that attitude towards science is highly correlated with academic achievement in science subjects. Therefore positive attitudes towards science might elevate students' achievement in science subjects (Ahmad, Rowland & Azman 2010; Kind, 2007. This idea is shared by a Mwamwenda (1995), who asserts that achievement in a subject is determined by a student's attitude towards the subject. According to Ojwang and K'Opiyo (2003), positive attitude towards the learning process is a prerequisite for good performance in science.

Several studies have been done on scientific attitudes and have come with different conclusions. A study by Marjorie (2015) on scientific attitudes of student majors found out that major high school students had a high level in open- mindedness and curiosity while moderate in judgement and rationality. However, the study did not clarify the method of instruction during the research .A study done by Anowar *et al.*(2012), on effects of cooperative learning on attitudes and achievement in mathematics found out that students' attitudes were affected by cooperative learning. However, this study was done in mathematics and therefore a knowledge gap was identified in the to exist in the past studies based on the effect of cooperative learning on performance in kinematics.

2.6 Knowledge Gap

Review of related studies reveal that research has been done to measure the success of cooperative learning as an instructional strategy regarding achievement across all levels from primary grades through college. Research has been done on cooperative learning in interpretation of graphs in kinematics. Many studies have been done on cooperative learning and conventional strategies in mathematics and very few in physics. Most of the studies done did not cover basic science process skills and attitudes. The researcher did not come across any study done in Sabatia that deals with students' performance using cooperative and conventional learning with a focus on achievement, basic science process skills and attitudes. Based on this background the study set out to investigate performance in kinematics using cooperative learning using cooperative learning among students in Sabatia, sub-county in Kenya.

CHAPTER THREE

RESEARCH DESIGN AND METHODOLOGY

3.1 Introduction

This chapter describes research design, study location, study population, sampling techniques, research instruments, piloting of research instruments, reliability and validity of the research instruments research and data analysis procedures.

3.2 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. This design enables the researcher to see the effects of some type of treatment on a group (Beaumont,2009). The research design is indicated in Figure 3.1.

Group	**Pretest/ Preliminary observation**	**Treatment**	**Post-test/ Final Observation**
Experimental	O_1	X	O_2
Control	O_2	C	O_3

Figure 3.1: Research Design Depiction

Key:

X- Cooperative Learning

C- Conventional Learning

O_1 and O_2 – Pretest/ Preliminary Observation

O_2 and O_3 –Post test/ Final Observation

3.3 Study Location

This study was conducted in selected public mixed secondary schools in Sabatia Sub-County in Vihiga County of the republic of Kenya. Due to Kenya National Examination Reports, reports poor performance in kinematics affects nearly all public mixed schools and that is why the researcher preferred Sabatia as it was convenient. It was convenient in terms of lowering the cost of research yet not compromising on generalizability of the findings. Sabatia is bordered by Vihiga Sub-County to the South, Kakamega South Sub-County to the North, Hamisi Sub-County to the East and Emuhaya Sub-County to the West. It covers a total area of 110.4 square kilometre.

3.4 Study Population

The study population is the whole group of individuals to which there is legitimate interest in applying conclusions (Kazerooni, 2001).The study focused on 780 form three students doing physics from 26 public mixed secondary schools in Sabatia sub-county. Respondents from public mixed were used in the study because of their continued poor performance as compared to single gender schools (KNEC Analysis 2010-2014). Students in form three were targeted because of the fact that it is at this level that kinematics is covered in regards to the physics syllabus in Kenyan secondary schools.

3.5 Sampling Techniques and Sample Size

The sampling techniques and sample size are provided below.

3.5.1 Sampling Techniques

The sampling techniques involved in the study were purposive sampling and simple random sampling. Purposive sampling was used to select two schools from 26 secondary schools for use in the pilot study . Simple random sampling was used to select the schools for the actual study. This was done by writing their names on 24 similar cards then the cards were coded with numbers from 1 to 24 and placed in a box after which schools were randomly selected by picking cards representing the schools from the box until the total number of selected respondents reached the desirable sample size according to Cochran's correction formula. Based on this, 10 schools were selected. The selected schools were coded again from 1 to 10 on similar cards and the cards placed in a box. Cards were picked randomly from the box in order to select different schools. The selected schools were assigned to provide respondents for experimental or control as follows: even numbers were assigned to experimental and odd numbers to the control groups. From each selected school simple random sampling was used to select on one class to be used in the study. All the students in a selected class were assigned to experimental or control groups.

3.5.2 Sampling Frame

This is the actual list of sampling units from which the sample is selected. It is a list of the study population. There were 780 form three students doing physics in the public mixed secondary schools. The sample frame is presented as in Table 3.1 below.

Table 3.1: Sampling Frame of Students in the Study Location

School Type	Boys	Girls	Total
County	138	100	**238**
Sub-county	300	242	**542**
Total	**438**	**342**	**780**

Source: Field Data

Table 3.1 indicates that 238 students were in county schools out of which 138 were boys and 100 are girls. The table also indicates that there were 542 students in the sub-county schools out of which 300 were boys and 242 were girls. The total number of boys was 438 and girls 342.

3.5.3 Sample Size

A sample is a smaller group obtained from the study population (Mugenda & Mugenda, 2003). The number of respondents was determined using Cochran's formula. The formula was used because the total population was less than 50,000 (https://.gist.github.com). The number of respondents was to be 256 as based on Cochran's formula, but since classes exist as entities and the number of students in the classes could not be reduced, the sample size ended up increasing to 270 respondents. This led to a difference of only 14 respondents and it was hoped that this difference would not greatly affect the outcome. Table 3.3 represents the sample size.

Table 3.2: Sample Size

Group	Number of respondents
Experimental	147
Control	123
Total	**270**

Source: Field Data

From Table 3.2, there were 147 respondents for the experimental group. There were 123 respondents for the control group giving a total of 270.

3.6 Research Instruments

The main instruments for data collection were Kinematics Test 1 and Kinematics Test 2, Science Process Skills Observation Checklist (SPSOC) and Science Attitudes Observation Checklist (SAOC). Kinematics Test 1 was used in determining academic entry behavior of the students in regards to academic achievement. Kinematics Test 2 was given as a post test. SAOC and SPSOC were used before teaching kinematics in a preliminary experiment in kinematics (PEK) to observe the entry behavior in regards to development science process skills and attitude in kinematics for both the control and experimental groups. SAOC and SPSOC were also used after 6 weeks of teaching during the final experiment in kinematics (FEK) to observe the development of science process skills and attitude in kinematics for both control and experimental groups. Each of the instruments was administered on particular days in all the schools. The instruments were administered by physics teachers of the respective schools who were teaching the respective classes involved in the study.

3.6.1 Kinematics Test 1

Kinematics Test 1 (KT1) in Appendix 1 was given as a pre-test by the physics teacher in order to determine the entry behavior of the respondents in kinematics before teaching using conventional learning or cooperative learning. The test was marked by the researcher according to the marking scheme in appendix 3. The test was adopted from sample questions from Secondary Physics Form 3 pupils book by K.I.C.D. (1999).The test consisted of 10 multiple choice questions that covered motion word problems on distance, displacement, speed, velocity and acceleration. A marking scheme for the test was developed and each correct item was awarded 10 marks to give a percentage mark.

3.6.2 Kinematics Test 2

Kinematics Test 2 (KT2) in Appendix 2 was given as a post-test by the physics teacher to determine the academic achievement after teaching for 6 weeks by using conventional learning or cooperative learning.. The test was marked by the researcher according to a marking scheme in Appendix 4. The test was adopted from Secondary Physics Form 3 pupils' book by K.I.C.D (1999). The test covered interpretation of kinematics graphs and equations of linear motion .The test had 8 items on interpretation of graphs and 4 items on equations of motion. The kinematics graphs involved in kinematics test 2 were distance-time, displacement-time, speed-time and velocity-time graphs. The equations of motion covered in kinematics test 2 were the first, second and third equations of linear motion. A marking scheme was developed and the total mark for the items was converted to percentage.

3.6.3 Science Process Skills Observation Checklist

The Science Process Skills Observation Checklist in Appendix7 was adapted from the Science Process Skills Inventory (SPSI) that was developed by Bourdeau and Arnold (2009) to measure the ability to practice the full cycle of steps in the scientific inquiry process. The checklist was used by the physics teacher in measuring the level of development science process skills (SPS) before teaching and after teaching kinematics using conventional or cooperative learning during the preliminary experiment in kinematics in Appendix 5 and final experiment in kinematics (see

Appendix 8). The skills that were included in the instrument for investigation were basic science process skills involving recording, measuring and using numbers. Points were awarded according to the observed level of development of the basic science process skills. The total score of the points obtained by each respondent were graded as follows: 1 point – poor, 2-fair , 3points-fairly good, 4 points- good and 5 points-excellent. During analysis, the points were classified as follows: 1-2 is Low Development (LD), 3 points-Fair Development (FD) and 4 -5 points-Excellent Development (ED) of skills.

3.6.4 Students' Attitude Observation Checklist (SAOC)

A Students' Attitudes Observation Checklist (SAOC) in Appendix 8 was used by the physics to establish the attitude in kinematics before and after teaching kinematics using conventional or cooperative learning during the preliminary experiment in kinematics (PEK) and final experiment in kinematics (PEK). The SAOC was adopted from the Science Classroom Visitation Worksheet developed by RMC Research Corporation (2010).

The attitudes included in the checklist were scientific attitudes involving cooperation open-mindedness and showing responsibility during experiments. These attitudes are some of the elements of cooperative learning (Johnson and Johnson, 2009). Points were awarded according to the observed level of change in attitudes. The total score of the points obtained by each respondent were graded as follows: 1 point – poor, 2-fair, 3 points-fairly good, 4 points- good and 5 points- excellent. During analysis, the points were classified as follows: 1-2 is Poor Attitude (PA), 3 points-Moderate Attitude (MA) and 4 to 5 points-High Attitude (HA) in kinematics.

3.7 Piloting of the Research Instruments

The pilot study involved 20 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.

3.7.1 Validity of the Research Instruments

Validity is the extent to which an instrument measures what it is supposed to measure and as it is designed to perform. The researcher developed criterion- referenced tests ; Kinematics Test 1 and Kinematics Test 2 using Form 3 Physics textbooks approved by KICD and questions from KNEC past papers. The researcher also developed Science Process Skills Observation Checklist (SPSOC) and Student's Attitudes Observation Checklist (SAOC). The instruments were presented with rating scales to Science Education experts from MMUST, who assessed the content and face validity. The experts' opinion was that the instruments were valid for the study.

3.7.2 Reliability of the Research Instruments

Reliability is the degree of consistency that the instrument demonstrates in the results obtained. Kinematics Test 1 and Kinematics Test 2 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 Kinematics Test1 yielded a reliability of 0.84 (see Appendix 9) and Kinematics Test 2 yielded 0.85 (see Appendix 10). An experiment in kinematics was given during the first week of teaching then SPSOC and SAOC were used to assess the learners in the selected school. The same experiment given to the respondents after two weeks and the respondents assessed using SPOC and SAOC. The scores were coded and subjected to the Pearson Product-Moment Correlation formula. SPSOC yielded a reliability of 0.785 (see appendix11) and SAOC yielded a reliability of 0.811 (see Appendix 12) therefore the instruments all yielded a reliability coefficients of above 0.7 which was considered acceptable in judging the instruments as reliable for the study according to guidelines by Frankel and Wallen (2000).

3.8 Data Analysis Procedures

Qualitative and quantitative data were collected , organized and coded numerically to represent the variables. Frequencies, Means, standard deviations and; t-test at significant level at 0.05 were used to test significance of the hypotheses.

CHAPTER FOUR

PRESENTATION, INTERPRETATION AND DISCUSSION OF FINDINGS

4.1 Introduction

This chapter presents, interprets and discusses the findings on performance in kinematics using cooperative learning among students. This shall be done according to each objective.

4.2 Demographic Characteristics of the Respondents

The respondents were form three students doing physics from public mixed secondary schools. The respondents came 10 selected schools from 26 public mixed secondary schools. 20 respondents from 2 schools were involved in the pilot study. 270 respondents out of a target population of 780 were involved in the actual investigation.

4.3 Findings on Academic Achievement in Kinematics

The findings on achievement are presented and discussed as in the sub-sections below.

4.3.1 Findings on Kinematics Test 1

A summary of mean scores and standard deviations based on raw data in Appendix 16 is represented in Table 4.1

Table 4.1 Mean Scores and Standard Deviation on Kinematic Test 1

Groups	Mean	SD
E (n=147)	57.4	9.36
C(n=123)	57.2	9.34

An examination of Table 4.1 shows that the difference in the pre-test mean scores between the experimental group and control group was 0.2. The table also shows the standard deviations were 9.36 for the experimental group and 9.34 for the control group. The results show some differences in the means and standard deviations.

A two tailed t-test was carried out by calculating the t-value using the formula in Appendix 15 and comparing with the tabulated t-value to show if there was any significant difference in the means. The calculated t-value was 1.42 with 268 degrees of freedom and the tabulated t-value was 1.96 at $p < 0.05$. Thus the calculated t-value was less than the tabulated t-value. Hence the difference in means and standard deviations was not significant .Therefore the students had a similar entry behavior.

4.3.2 Findings on Kinematics Test 2

A summary of mean scores and standard deviations based on raw data in Appendix 16 is represented in Table 4.2

Table 4.2: Mean Scores and Standard Deviations on Kinematics Test 2

Group	Mean score%	SD	n
E	82.5	7.57	147
C	57.3	9.31	123

An examination of Table 4.2 showed a difference of 25.2 in the mean scores between the experimental group and control group. The standard deviations of the experimental group and control groups were 7.57 and 9.31 respectively. This showed a difference in the means. A two tailed t-test was done to determine if there was a significant difference in the means by first calculating the t-value using the formula in Appendix 15 and comparing with the table t-value . The t- calculated value was 201.6 with 268 degrees of freedom and the t- tabulated value was 1.96 at $p<0.05$.Thus the t-calculated value was greater than the t- tabulated value. The null hypothesis was rejected at $p<0.05$. This means that there was significant difference in the means. Therefore cooperative learning had enhanced achievement in kinematics as compared to conventional learning.

4.3.3 Discussion of Findings on Academic Achievement in Kinematics.

In the pre-test (Kinematics Test 1), the study found no significant mean difference between the scores of the students before learning kinematics and therefore the respondents had a similar entry behavior.

In the post-test (Kinematics Test 2), the group that was taught using cooperative learning (Experimental group) had a higher mean score as compared to the group that was taught using conventional learning (Control group). A t-test that was done found a significant mean difference in the scores implying that the treatment effect was effective. Thus cooperative method learning had enhanced academic achievement in the experimental group. The findings were consistent with a study carried out by Kiboss (1999) on the effect of cooperative learning which concluded that cooperative learning enhances learning. However, Kiboss (1999) study was on relative effects of a computer- based Instruction in physics on students' attitudes, motivation and understanding about measurement and perception of classroom environment unlike this study which is on effects of cooperative learning in kinematics. This study is also consistent with the findings of a study by Genc and Sahin (2004), that noted that cooperative learning eliminates negativity of crowded classes there by enhancing academic achievement.

However, the findings of this study were inconsistent with the findings of Bartsch (2015) on disadvantages of using cooperative learning which noted that the demands of organizing cooperative learning made it difficult to effectively relate performance to each individual learner. The report noted that without proper use of the techniques of cooperative learning, performance had been observed to be low in some instances during cooperative learning. Another study by Bryson (2007), on effectiveness of working individually versus in cooperative groups, also noted that group work in cooperative learning is not beneficial to students' achievement.

4.4 Findings on Students' Development Science Process Skills

The findings on students' development of science process skills are presented and discussed as in the sub-sections below.

4.4.1 Findings on Preliminary Observation on Development of Science Process Skills

Frequencies on preliminary observation on development of science process science skills are presented in Table 4.3 based on raw data from appendix 16. The frequencies and percentages in the table was based on a scale of 5 where, 1 and 2 is Low Development (LD) , 3 is Fair Development (FD) , 4 and 5 is Excellent Development (ED) of science process skills

Table 4.3: Findings on Preliminary Observation on Development of Science Process Skills.

Group	LD	FD	ED	Total
E	36	60	57	147
C	25	50	48	123

Table 4.3 shows that 36 respondents in experimental group had excellent development (ED) of SPS skills compared to 25 respondents in the control group. There were 60 respondents in the experimental group who had fair development (FD) of SPS compared to 50 respondents in the experiment group. There were 57 respondents in the experimental group who had low development (LD) of SPS compared to 48 respondents in the control group. Mean observation and standard deviations were determined and presented in table 4.4

Table 4.4: Mean observation Scores, Standard Deviation on Final Observation of Development Science Process Skills.

Group	Mean Observation Scores	SD
E	3.18	0.98
C	3.19	0.97

From table 4.4, there was some difference in the mean observation scores and standard deviations between the experimental group and control group. A two tailed t-test was carried out by first calculating the t-value using the formula in Appendix 15 and comparing it with the t- tabulated value in order to any significant differences in the mean observation scores. The t- calculated value was -0.67 with 268 degrees of freedom and the t- tabulated value was 1.96 at $p<0.05$. Therefore there was no significant difference between the mean observation scores between the control group and experimental group. Hence the respondents had a similar entry behavior in development of science process skills (SPS).

4.4.2 Findings on Final Observation on Development of Science Process Skills.

Frequencies on final observation on level of development of science process science skills (SPS) are presented in Table 4.5 based on raw data in Appendix 16. The frequencies and percentages in the table was based on a scale of 5 where, 1 and 2 is Low Development (LD), 3 is Fair Development (FD) , 4 and 5 is Excellent Development (ED) of science process skills

Table 4.5: Frequencies on Final Observation on Development Science Process Skills.

Group	LD	FD	ED	Total
E	5	48	114	147
C	25	52	46	123

Table 4.5 shows that 5 respondents in the experimental group had excellent development(ED) of SPS skills compared to 25 respondents in the control group. There were 48 respondents in the experimental group who had fair development (FD) of BSPS compared to 52 respondents in the experiment group. There were 114 respondents in the experimental group who had low development (LD) of BSPS compared to 46 respondents in the control group.

Table 4.6: Mean Scores, Standard Deviation and Final Observation on Development of Science Process Skills

Group	Mean Observation Scores	SD
E	3.76	0.78
C	3.19	0.93

From table 4.6 there was a difference in the observation mean scores of 0.57 in development of basic science process skills between the experimental group and control group. The experimental group had a higher mean observation score. A two – tailed t-test was carried out by first calculating the t-value using the formula in Appendix 15 and the comparing with the t- tabulated value in order to find out if there was any significant difference in the mean observation scores. The calculated t-test value was 36.5 with 268 degrees of freedom and the tabulated t-test value was 1.96 at $p<0.05$ .The t- calculated value was greater than the t- tabulated value hence the null hypothesis was rejected at $p<0.05$. The null hypothesis was rejected. Therefore there was a significant difference between the mean observation scores between experimental group and control group in development of basic science process skills. Thus students taught using cooperative learning had a better mean observation score than those taught using conventional learning in development of basic science process skills. This meant that cooperative learning was effective in enhancing development of science process skills.

4.4.3 Discussion of Findings on Development of Science Process Skills

The preliminary findings on development of Science Process skills indicate that

There was no significant difference in the mean observation scores between the students taught using cooperative learning (Experimental group) and those taught using conventional learning (Control group).Therefore, the students had a similar entry behavior as observed in the Preliminary Experiment in Kinematics (PEK).

The study further found out that there was a significant difference in the mean observation scores between the experimental and control groups in the Final Experiment in Kinematics (FEK). Therefore cooperative learning had enhanced the level of development of basic science process skills as compared to conventional learning. The findings of this study are consistent with findings from the study by Candler (2013) on hands on activities in science which found that cooperative learning enhances development of science process skills. However, the study was on hands on activities and in science in general unlike this study which is specifically on learning kinematics in physics. The study is also consistent with findings by Sherman (1994) on cooperative learning and science, which found out that cooperative learning had proven to enhance acquisition of science process skills through hands-on activities and experiments. However, the study was on hands on activities in elementary schools unlike this study which is on students in secondary education.

4.5 Findings on Attitude in Kinematics

The findings on attitude in kinematics are presented and discussed as in the sub-sections below.

4.5.1 Findings on Preliminary Observation Attitude in Kinematics

Frequencies on Preliminary observation on attitude in kinematics are presented in Table 4.7 based on raw data in Appendix 17. The frequencies and percentages in the table was based on a scale of 5 where, 1 and 2 is Poor Attitude (PA), 3 is Moderate Attitude (MA), 4 and 5 is High Attitude (HA) in kinematics.

Table 4.7: Findings on Preliminary Observation on Attitude in Kinematics.

Group	PA	MA	HA	Total
E	31	51	65	147
C	28	47	48	123

Table 4.3 shows that 65 respondents in experimental group had high attitude (HA) in kinematics compared to 48 respondents in the control group. There were 51 respondents who had a moderate attitude (MA) in kinematics compared to 47 respondents in the control group. There were 3 respondents in the experimental group who had a poor attitude (PA) in kinematics compared to 28 respondents in the control group. Mean observation scores were determined and presented in Table 4.8.

Table 4.8: Mean Scores, Standard Deviation on Attitude in Kinematics.

Group	Mean Observation Scores	SD
E	3.27	1.03
C	3.29	1.12

From table 4.8, there was some difference in the mean observation scores and standard deviations in attitude in kinematics. A two tailed t-test was carried out by first calculating the t-value using the formula in Appendix 15 and then comparing with the table t-value in order to find out any significant difference in the means of observation scores between the experimental group and control group The t-calculated value was -1.25 with 268 degrees of freedom and the t- tabulated value was 1.96 at $p<0.05$. Thus the calculated t-value was less than the calculated t-value. Therefore there was no significant difference in mean observation scores on attitude in kinematics between the control group and experimental group. Therefore, the respondents had a similar entry behavior in attitude in kinematics.

4.5.2 Findings on Final Observation scores on Attitude in Kinematics.

Frequencies on final observation on attitude in kinematics are presented in Table 4.7 based on raw data in Appendix 17. The frequencies and percentages in the table was based on a scale of 5 where, 1 and 2 is Poor Attitude (PA), 3 is Moderate Attitude (MA) , 4 and 5 is High Attitude (HD) in kinematics.

Table 4.9: Frequencies on Final observation scores on Attitude in Kinematics .

Group	PA	MA	HA	n
E	7	46	94	147
C	26	53	44	123

Table 4.9 shows that 94 respondents in experimental group had high attitude (HA) in kinematics compared to 44 respondents in the control group. There were 46

respondents who had a moderate attitude (MA) of scientific attitudes compared to 53 respondents in the control group. There were 7 respondents in the experimental group who had poor attitude (PA) in kinematics compared to 26 respondents in the control group. Mean observation scores and standard deviations were determined and presented in table 4.10.

Table 4.10: Mean Scores, Standard Deviation of Final Observation on Attitude in Kinematics.

Group	Mean Observation Scores	SD
E	3.78	0.84
C	3.26	1.05

From table 4.10, there was a difference in the mean observation scores of 0.52 in attitude in kinematics between the experimental group and control group. The experimental group had a higher mean observation score. A two tailed t-test was carried out in order to significant differences in the means of observation cores by first calculating the t-value using the formula in Appendix 15 and comparing with the tabulated t-value. The t- calculated value was 36.5 with 268 degrees of freedom and the t- tabulated value was 1.96 at $p<0.05$. The t- calculated value was greater that the t- tabulated value hence the null hypothesis was rejected at $p<0.05$. Therefore, there was a significant difference between the mean observation scores obtained between the experimental group and the control group in attitude in kinematics. Hence cooperative learning was effective in enhancing the level of attitude in kinematics.

4.5.3 Discussion on Findings on Attitude in Kinematics.

On demonstration of scientific attitudes, there was no significant difference in the post observation scores between the experimental and control groups and in the Preliminary experiment in Kinematics (PEK) in favor of the experimental group. Thus the students had a similar entry behavior on the level of attitude in kinematics. The study further found out a significant difference in the mean observation scores between the experimental group and control group. This meant that cooperative learning had enhanced the level of attitude in kinematics as compared to conventional learning. This was in agreement a study by Howard (2006), on the effects of cooperative learning on performance assessment and attitudes for journalism students which showed a marked improvement in attitudes developed due to cooperative learning. However, this study was on journalism unlike the present study which is on kinematics. The findings are consistent with a study by Lazarowitz and Karsentry (1990), which found that students attitudes were enhanced when they were engaged in hands-on science in biology when using cooperative learning. However, this study was mainly on practical work in biology unlike the present study which is covering both theoretical work and practical work and in physics.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter provides the summary of the summary of the major findings, conclusions drawn from the findings, makes recommendations and gives suggestions for further research.

5.2 Summary of Major Findings

The following were revealed from the study:

1. On academic achievement in kinematics, the study found out that:
    a) There was no significant mean difference between the experimental group and the control group in the pretest. This meant that the student had a similar entry behavior in academic achievement in kinematics.
    b) The experimental group had a higher mean score as compared to the control group in the post- test (Kinematics Test 2). This meant that cooperative learning was more effective in enhancing academic achievement in kinematics as compared to conventional learning.
2. On development of Science Process skills ,the study found out that:
    a) There was no significant difference in the initial mean observation scores on the level of development of science process skills. The respondents therefore had a similar entry behavior in development of science process skills in kinematics.

b) There was a significant difference in the final mean observation scores between the group taught using cooperative learning (Experimental group) and the group taught using conventional learning (Control group) .The experimental had a better development of science process skills in kinematics than the control group. Thus cooperative learning was found out to be more effective in development of science process skills in kinematics than conventional learning.

3. On attitudes in kinematics, the study found out that:

a) There was no significant difference in the initial mean observation scores on attitude in kinematics. The respondents therefore had a similar entry behavior on attitude in kinematics.

b) There was a significant difference in the final mean observation scores between the group taught using cooperative learning (Experimental group) and the group taught using conventional learning (Control group) .The experimental group had a better attitude in kinematics than the control group. Thus cooperative learning was found to be more effective in enhancing positive attitude in kinematics than conventional learning.

5.3 Conclusions

The main objective of the present study was to investigate performance in kinematics using cooperative learning among the students. It was revealed that students had better academic achievement in kinematics when taught using conventional learning than conventional learning. It was also revealed that cooperative learning was more effective in enhancing development of science process skills than conventional learning. The study further revealed that cooperative learning was more effective in enhancing attitude in kinematics than conventional learning. Finally, it was revealed that cooperative learning is a method which enhances interaction between resources and learners and seems to promote performance in physics and science in general. Overall, cooperative learning had to a large extent been successful in enhancing performance in kinematics.

5.4 Recommendations of the Study

The following were the recommendations:

1. Cooperative learning to be used in learning in order to improve academic achievement in kinematics.
2. Cooperative learning to be used in learning in order to improve development of science process skills in kinematics.`
3. Cooperative learning to be used in teaching in order to enhance attitudes in kinematics.

5.5 Suggestions for Further Research

The study did not cover all matters related to teaching and learning kinematics in public mixed secondary schools. There were other issues that came up in the study that require further investigation. These include:

1. Studies involving specific techniques of cooperative leaning other than the jigsaw technique.
2. Studies involving a larger sample and more schools to ascertain the consistence in the result in other sub-counties and the whole country.
3. Studies involving other topics in physics other than kinematics

4. Studies involving other classes other than form three classes.
5. Studies involving county and sub-county schools on performance in kinematics.
6. Studies involving gender differences on performance in kinematics
7. Studies using a different design.

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APPENDICES

Appendix 1: Kinematics Test 1

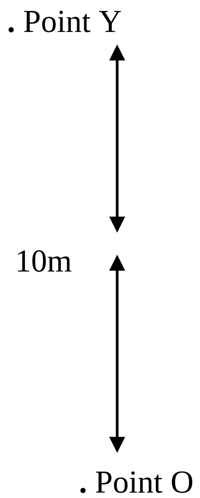
Instructions

This paper consists of multiple choice questions

Kindly read each question carefully before attempting it

Answer all questions by ticking against the correct choice in section

1. A stone is thrown vertically upwards from point O to point Y. It then falls back to the point 0 as shown below.



i) Determine the total distance covered in meters.

A.-20   B.-1O   C.10   D.20

ii) Determine the total displacement in meters.

A. -10   B.O   C.10   D.20

2. Town P and town Q are 50 metres apart. A car moves from town P to town Q in 2.5 seconds and move back to town A in 2.5 seconds. Determine:

i. average speed of the car in m/s from

(a) town P to town Q;

A. -50   B.-20   C.20   D.50

(b) town Q to town P.

A. -50   B.-20   C.20   D.50

ii. average velocity of the car in m/s from

(a) town P to town Q;

A. -50 B.-20 C.20 D.50

(b) town Q to town P.

A. -50 B.-20 C.20 D.50

3. A car starts from rest and attains a speed of 20m/s in 4s and comes to rest in the next 2s.

Determine its acceleration in m/s/s in the:

i) first 4s;

A. -20 B. -5 C. 5 D. 20

ii) last 2s .

A.-20 B. -10 C.10 D.20

Appendix2 : Kinematics Test 2

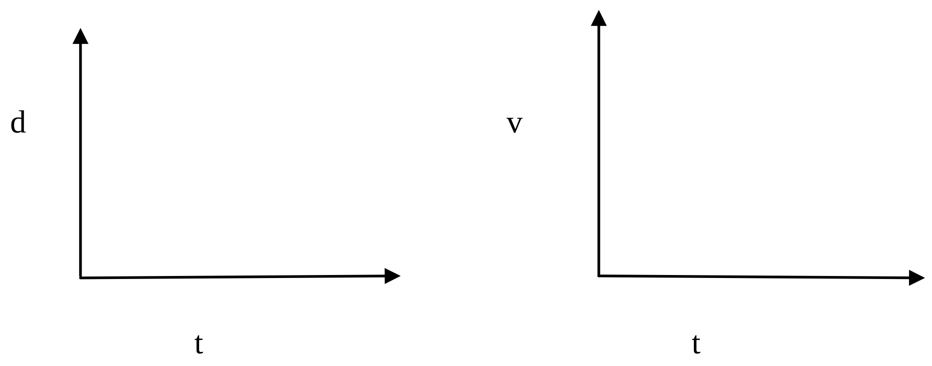
This paper consists of structured questions

Kindly read each question carefully before attempting it

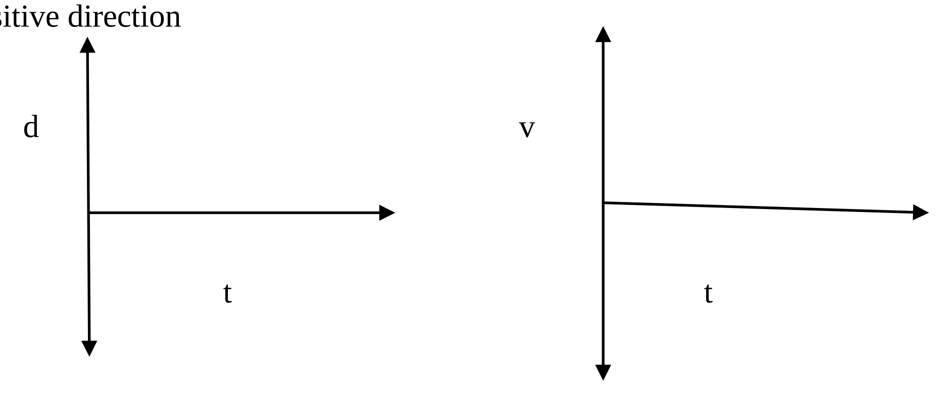
Answer the questions in the spaces provided

1. Sketch displacement-time and velocity-time graphs for the following motions:

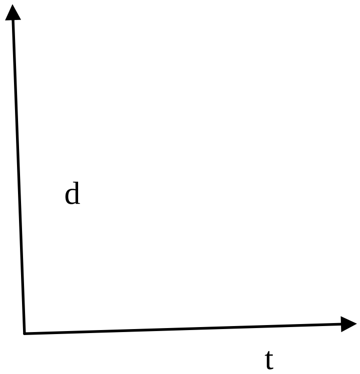
i. A body moving with constant velocity and moving away from the original position in a positive direction.

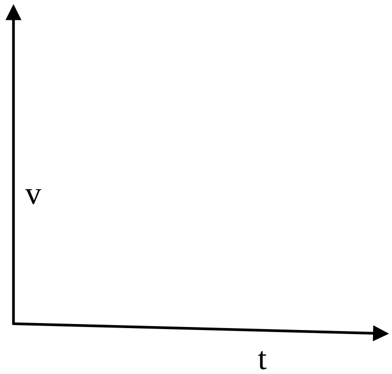


ii A body moving with constant velocity and moving towards the original position in a positive direction

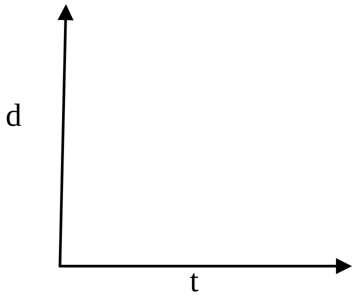


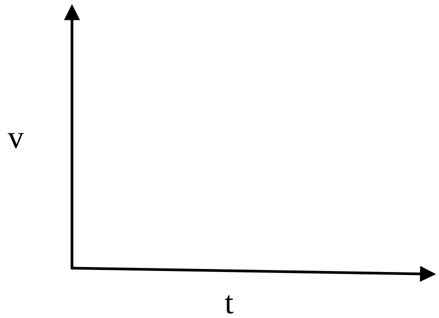
iii. A body accelerating uniformly





iv. A body thrown vertically upwards





2. A stone is thrown vertically upwards with an initial velocity of 14m/s. Neglecting air resistance, find the:

i. maximum height reached

ii. time taken before hitting the ground(Acceleration due to gravity=9.8m/s^2).

1. A car starts from rest and is accelerated uniformly at the rate of 2m/s^2 for 6 s. It then maintains a constant speed for half a minute. The brakes are then applied and the vehicle uniformly retarded to rest in 5s. Find the:

(i) maximum speed reached in km/h;

(ii) total distance covered in metres.

Appendix 3: Marking Scheme for Kinematics Test 1

(10 marks)

Multiply by 10 to get percentage score

1. (i) D (2 marks)

(ii) B (2 marks)

2. i) a) C (1 mark)

b) C (1 mark)

ii) a) C (1 mark)

b) B (1 mark)

3. i) C (1 mark)

ii) B (1 mark)

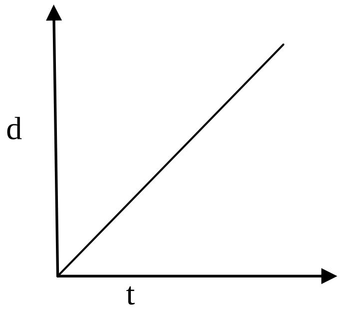
Convert the scored marks to percentage

Appendix 4: Marking Scheme for Kinematics Test 2

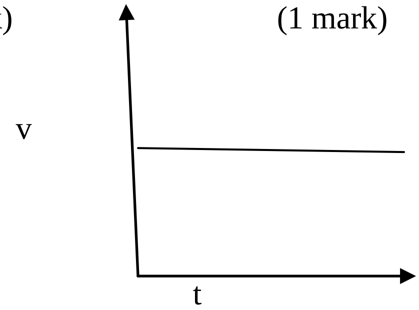
(20 marks)

Multiply by 5 to get percentage score

1. (i)

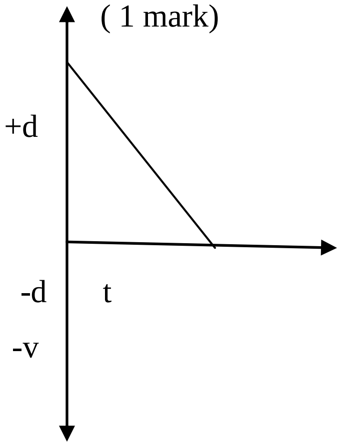


(1 mark)

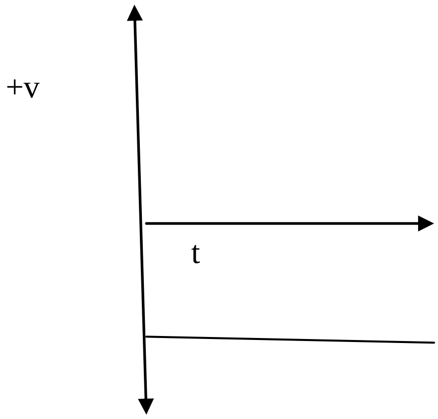


(1 mark)

(ii)

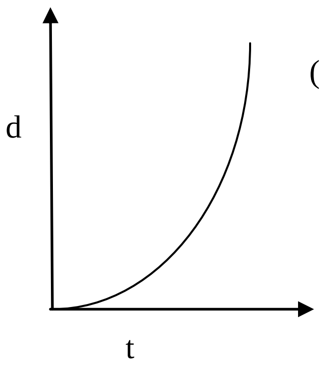


(1 mark)

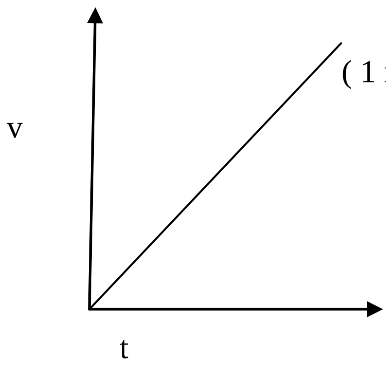


(1 mark)

(iii)

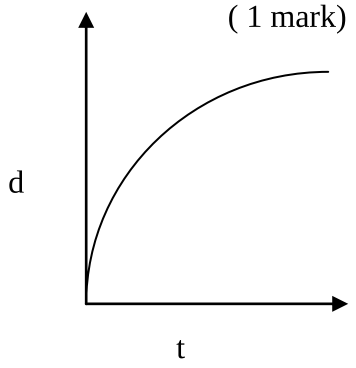


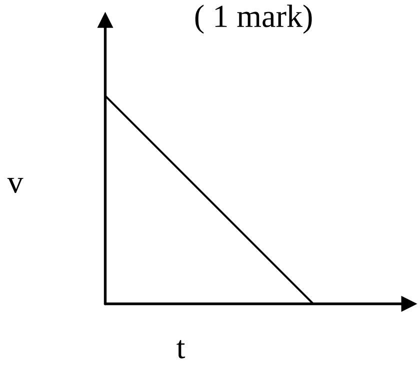
(1 mark)



(1 mark)

iv)





2. (i) Maximum height reached

u=14m/s v=0m/s a=-9.8m/s

Substituting into,

$v^2 = u^2 + 2as$ M_1

$0^2 = 14^2 + 2(-9.8)s$

s=10m A_1

(ii) Time to fall to the ground

Time to rise upwards

Substituting into,

v=u + at

0= 14- 9.8t M_1

t=1.43s. A_1

Time to fall

Substituting into,

$s = ut + 0.5\ at^2$

= $10 = 0xt + 0.5x9.8xt^2$ M_1

t=1.43s. A_1

Total time taken=1,43 + 1.43=2.86s. A_1

3. Maximum speed reached

V= u + at

U=om/s, t=6s, $a = 2m.s^{-2}$ M_1

V=0 +2x6m/s

= 12m/s

$=43.2km/h$ A_1

Total distance moved

$S = S_1 + S_2$

$S_1=ut + ½at^2$

$U=0, a=2m.s^{-2}, t=6s$ M_1

$S_1= 0 +½ x2x6x6m$

$=36m$ A_1

$S_2=ut +½at^2$

$U=12m/s, a=-2.4m.s^{-2}, t=5s$

$S_2 =12x5 - ½x2.4x5x5$

$=30m$

Total distance= $S_1 +S_2$

$=30+ 36$

$=66m$ M_1

Convert the scored marks to percentage

Appendix 5: Preliminary Experiment in Kinematics

Instructions

1. The experiment will be used by the teacher to determine the development of basic science process skills and demonstration of scientific attitudes by the respondents.
2. The experiment will be done at by the respondents before teaching kinematics.
3. Respondents will be assessed individually in the experiment.
4. The experiment will take 2 hours .

To determine the acceleration of a body using a ticker timer.

Materials

Stopclock

Ticker tape

Metre rule

Plank of wood

Trolley

Rubber bands

Procedure

Place the plank of wood to make a horizontal plane

Mark two points A and B, 1 meter apart on the plank of wood.

Fix a rubber band on one end of the trolley.

Pull the trolley with the rubber band while maintaining the amount of extension of the rubber band.

Measure the time taken for the trolley to move the marked points A and B.

Tasks

(a)Calculate the average speed of the trolley between point A and B

(b) Repeat the experiment 3 times.

(c) Calculate the average of the speeds.

Appendix 6: Final Experiment in Kinematics(FEK)

Instructions

1. The experiment will be used by the teacher to determine the development of basic science process skills and demonstration of scientific attitudes by the respondents.
2. The experiment will be done at by the respondents after 6 weeks of teaching.
3. Respondents will be assessed individually in the experiment.
4. The experiment will take 2 hours .

To determine the acceleration of a body using a ticker timer.

Materials

Ticker time

Ticker tape

Metre rule

Plank of wood

Trolley

Procedure

Use the plank of wood to make an inclined plane

Fix one end of the ticker tape to the trolley.

Fix the other end of the ticker tape to the ticker time.

Switch on the ticker timer.

Allow the trolley to roll down the inclined plane

Tasks

(a) Make a suitable chart in pieces of 10 dots using the ticker tape to represent the motion of the trolley.

(b) Use the chart to determine acceleration of the trolley.

Appendix 7: Science Process Skills Observation Checklist

School:____

Student's No.____

Gender (a) Male ( ) (b) Female ( )

Age____

This checklist is for investigating development of science process skills in the lessons in kinematics.

The check list will first be used before teaching kinematics to assess development of science process skills in an Preliminary Experiment in Kinematics (PEK).

The checklist will then be used after 6 weeks of teaching to assess the learners on development of science process skills in a Final Experiment in Kinematics(FEK) designed by the researcher .

The checklist will be used to observe the science process skills development per individual student in the first 1 hour of any of the two experiments in kinematics.

Award points to development of science process skills observed according to the marking scheme below.

Rating of awarded points (Tick) Poor –Fair---Fairly Good—Good—Excellent--

Skill		**Skill Demonstration**	**Points**
1.	Recording	Any table	1
2.	Measurement	Any value	
		Includes units in cm	2
		No units	1
3.	Using numbers	Accurate answer in m/s	2
		Any other answer	1
Total			5

Grade the points as follows:

Poor-1, Fair-2, Fairly Good-3, Good-4, Excellent-5.

Appendix 8: Students' Attitudes Observation Checklist

School:____

Student's No.____

Gender (a) Male( ) (b) Female ( )

Age---

This checklist is for investigating attitude in kinematics .

The check list will first be used before teaching kinematics to assess attitude in kinematics in a Preliminary Experiment in Kinematics (PEK) on measurement of speeds.

The checklist will then be used after 6 weeks of teaching to assess the learners on attitude in kinematics in the Final Experiment in Kinematics (FEK) .

The checklist will be used to observe the level of demonstration of scientific attitudes per individual student in the last 1 hour of any of the two experiments in kinematics.

Award points to the level of attitude in kinematics according to the marking scheme below

Attitude		**Points awarded**
Cooperation	Works harmoniously with others	2
Not working harmoniously	1	
Open-mindedness	Accepts new ideas easily	2
Reluctant to accept new ideas	1	
Responsibility	Ensures safety of others and apparatus	1
Total		5

Grade the points attained as follows:

Poor-1, Fair-1, Fairly Good-3, Good-4, Excellent-5.

Appendix 9: Training Manual on Cooperative Learning

This manual is important in minimizing interactive effects during the study and will be used by the teachers of physics in the study. The manual will be a guide on how to organize the lessons when teaching using cooperative learning in regards to jigsaw technique.

Instructions on Cooperative Learning Strategy

Assign to four-member learning teams made of high, average and low performing students, boys and girls. Present a lesson in a lecture or discussion. The team members study work sheets on that lesson .They work problems one at a time in pairs, or take turns quizzing each other, or discuss problems as a group, or use whatever means they wish to master the lesson. The students are also given answer sheets. Therefore it is clear to them that their task is to learn the concept; not to simply fill out the work sheets. The lesson study ends when all the teammates have understood .Finally, all the students take individual quizzes on the lesson. The teammates may not help each other on the quiz.

Lesson 1

Discuss the information given about distance and displacement in your groups and use the information to answer the questions given.

Distance and Displacement

Distance is the length of the path moved by a body. It has only magnitude.

It is a scalar quantity.

Displacement is the distance moved by a body in a particular direction. Direction includes; upwards or downwards, left or right, positive or negative.

It is a vector quantity.

There is therefore positive and negative displacement.

Questions

1.Two towns A and B are connected with a straight road.

A car moves from town A to town B and back to town A.

Calculate the total distance covered and displacement of the car?

2. A car round a circular path of radius of 70m and completes one rotation.

What is the total distance covered and displacement of the car?

Lesson 2

Discuss the information given about speed velocity in your groups and use the information to answer the questions given.

Speed and Velocity

Speed is the rate of change of distance with time. It is a scalar quantity.

Velocity is the rate of displacement with time.

It is a vector quantity.

It has positive and negative values.

A body moving from a fixed point can be considered to have positive velocity.

A body moving back to a fixed point can be considered to have negative velocity.

Speed=<u>Distance covered(d)</u>

Time taken(t)

Velocity=<u>Displacement</u>

Time taken

Units: m/s ,km/hr

Questions

1 .Two towns A and B are 2000m apart and are connected with a straight road.

A car moves from A to B in 10sec. and moves back to B in 10sec.

What is the speed of the car from A to B and from B to A?

Velocity

2 .Using the information above determine the velocity of the car as it moves from A to B and from B to A?

Lesson 3

Discuss the information given about acceleration and deceleration in your groups and use the information to answer the questions given.

Acceleration and Deceleration

If the velocity of a body changes during some time interval, the body is said to undergo acceleration or deceleration. Acceleration occurs when there is an increase in velocity and deceleration (negative acceleration or retardation) occurs when there is a decrease in velocity.

Acceleration=increase in velocity or Decrease in velocity

Time taken. Time taken.

SI units are m/s/s

1. A car moving at a velocity of 20m/s increases its velocity to 50m/s in 2seconds.

Determine its rate of acceleration

2. A car moving at 50m/s reduces its velocity to 20m/s in 2 seconds.

Determine its acceleration.

What is the other name of this type of acceleration?

The teacher is advised to give further questions related to the subtopic in case of each learning technique.

The teacher should use the appropriate technique as expressed in the manual to teach; distance-time, displacement –time, speed-time and velocity- time graphs.

Appendix 10: Pearson's Product- Moment Correlation Coefficient for Kinematics Test 1

Respondent	X	Y	$X-\bar{X}$	$Y-\bar{Y}$	$(X-\bar{X})\cdot(Y-\bar{Y})$	$(X-\bar{X})^2$	$(Y-\bar{Y})^2$
1	40	30	-17.6	-28.2	496.8	309.8	795.2
2	60	50	2.4	-8.2	-19.7	5.8	67.2
3	50	60	-7.6	1.8	-13.7	57.8	3.2
4	60	70	-2.4	11.8	28.3	5.8	139.2
5	50	50	-7.6	-8.2	62.3	57.8	67.2
6	60	60	2.4	1.8	4.3	5.8	3.2
7	50	60	-7.6	1.8	-13.7	57.8	3.2
8	80	90	22.4	31.8	712.3	712.3	501.8
9	60	60	2.4	1.8	4.3	5.8	3.2
10	90	80	32.4	21.8	706.3	1049.8	475.2
11	60	60	2.4	1.8	4.3	5.8	3.2
12	50	60	-7.6	1.8	-13.7	57.8	3.2
13	60	60	2.4	1.8	4.3	5.8	3.2
14	50	50	-7.6	-8.2	62.3	57.8	67.2
15	60	60	2.4	1.8	4,3	5.8	3.2
16	60	50	2.4	-8.2	-19.7	5.8	67.2
17	40	40	-17.6	-18.2	320.4	309.8	331.2
Mean	57.6	58.2					
Total					2329.4	2506.0	3047.1

$$r = \frac{\sum_{i=1}^{n}(X_i - \bar{X})(Y_i - \bar{Y})}{\sqrt{\sum_{i=1}^{n}(X_i - \bar{X})^2}\sqrt{\sum_{i=1}^{n}(Y_i - \bar{Y})^2}}$$

Key:

X - Pre-test scores

Y-Post- test scores

$\bar{X}$ - Pre-test mean score

$\bar{Y}$ - Post-test mean score

r- Pearson's Product –Moment Correlation Coefficient

r=2329.4/(√2506 x √3047.1)

r=0.84.

Appendix 11: Pearson's Product- Moment Correlation Coefficient for Kinematics Test 2

Respondent	X	Y	$X-\bar{X}$	$Y-\bar{Y}$	$(X-\bar{X})$-$(Y-\bar{Y})$	$(X-\bar{X})^2$	$(Y-\bar{Y})^2$
1	40	40	-12.5	-11.5	143.8	156.3	132.3
2	20	30	-32.5	-21.5	698.8	1056.3	462.3
3	60	50	7.5	-1.5	-11.5	56.3	2.3
4	70	60	17.5	8.5	148.8	306.3	72.3
5	70	50	17.5	-1.5	-26.3	306.3	2.3
6	50	40	-2.5	-11.5	28.8	6.3	132.3
7	70	80	17.5	28.5	498.8	306.3	812.3
8	40	30	-12.5	-21.5	268.8	156.3	462.3
9	40	50	-12.5	-1.5	18.8	2.3	2.3
10	80	70	27.5	18.5	508.8	756.3	342.3
11	70	70	17.5	18.5	323.8	306.3	342.3
12	60	50	7.5	-1.5	-11.3	56.3	2.3
13	40	50	-12.5	-1.5	18.8	156.3	2.3
14	80	70	27.5	18.5	508.8	756.3	342.3
15	40	40	-12.5	-11.5	143.8	156.3	132.3
16	40	40	-12.5	-11.5	143.8	156.3	132.3
17	30	30	-22.5	-21.5	483.8	506.3	462.3
18	50	60	-2.5	8.5	-21.3	6.3	72.3
19	60	70	7.5	18.5	138.8	56.3	342.3
20	40	50	-12.5	-1.5	18.8	156.3	2.3
Mean	52.5	51.5					
Total					4025	5575	4255

$$r = \frac{\sum_{i=1}^{n}(X_i - \bar{X})(Y_i - \bar{Y})}{\sqrt{\sum_{i=1}^{n}(X_i - \bar{X})^2}\sqrt{\sum_{i=1}^{n}(Y_i - \bar{Y})^2}}$$

X - Pre-test scores

Y-Post- test scores

$\bar{X}$ - Pre-test mean score

$\bar{Y}$ - Post-test mean score

r- Pearson's Product –Moment Correlation Coefficient

r = 4025/(√5575 X √4255)

= 0.85

Appendix 12: Pearson's Product- Moment Correlation Coefficient for SPSOC

	X	Y	X- $\overline{X}$ -	Y- $\overline{Y}$	(X- $\overline{X}$ -) (Y- $\overline{Y}$)	(X- $\overline{X}$)^2	(Y- $\overline{Y}$)^2
1	2	2	-0.8	-0.75	0.60	0.64	0.5125
2	3	3	0.2	0.25	0.05	0.04	0.0625
3	2	2	-0.8	-0.75	0.60	0.64	0.5125
4	3	3	0.2	0.25	0.05	0.04	0.0625
5	2	3	-0.8	0.25	-0.20	0.64	0.0625
6	3	2	0.2	-0.75	-0.15	0.04	0.5125
7	3	3	0.2	0.25	0.05	0.04	0.0625
8	4	4	1.2	1.25	1.5	1.44	1.5625
9	2	2	-0.8	-0.75	0.60	0.64	0.5125
10	2	2	-0.8	-0.75	0.60	0.64	0.5125
11	4	3	1.2	0.25	0.30	1.44	0.0625
12	3	4	0.2	1.25	0.25	0.04	1.5625
13	3	3	0.2	0.25	0.05	0.04	0.0625
14	4	4	1.2	1.25	1.50	1.44	1.5625
15	3	3	0.2	0.25	1.50	0.04	0.0625
16	2	2	-0.8	-0.75	0.05	0.64	0.5125
17	2	2	-0.8	-0.25	0.60	0.64	0.0625
18	2	2	-0.8	-- 0.25	0.60	0.64	0.0625
19	2	2	-0.8	-0.25	0.60	0.64	0.0625
20	3	2	0.2	-0.25	-0.15	0.04	0.0625
Mean	2.8	2.75					
Total					9.00	11.20	11.75

$$r = \frac{\sum_{i=1}^{n}(X_i - \bar{X})(Y_i - \bar{Y})}{\sqrt{\sum_{i=1}^{n}(X_i - \bar{X})^2}\sqrt{\sum_{i=1}^{n}(Y_i - \bar{Y})^2}}$$

X - Pre-test skill development scores

Y-Post- test skill development scores

$\bar{X}$ - Pre-test mean skill development score

$\bar{Y}$ - Post-test mean skill development score

r- Pearson's Product –Moment Correlation Coefficient

r = 9.00/(√11.20 X √11.75)

r= 0.785

Appendix 13: Pearson's Product- Moment Correlation Coefficient for SAOC

Subject	X	Y	X- $\overline{X}$ -	Y-$\overline{Y}$	(X- $\overline{X}$ -) (Y-Y)	(X- $\overline{X}$ -)^2	(Y-$\overline{Y}$)^2
1	3	2	0.15	-0.80	0.12	0.225	0.6400
2	4	4	1.15	1.20	1.38	1.3225	1.4400
3	2	2	-0.85	-0.80	0.68	0.7225	0.6400
4	2	2	-0.85	-0.80	0.68	0.7225	0.6400
5	3	3	0.15	0.20	0.03	0.225	0.0400
6	2	3	-0.85	0.20	-0.17	0.7225	0.0400
7	3	2	0.15	-0.80	-0.2	0.225	0.6400
8	3	3	0.15	0.20	0.03	0.225	0.0400
9	4	5	1.15	2.20	2.53	1.3225	4.8400
10	5	4	2.15	1.20	2.58	4.6225	1.4400
11	2	2	-0.85	-0.80	0.68	0.7225	0.6400
12	3	3	0.15	0.20	0.03	0.225	0.0400
13	2	2	-0.85	-0.80	0.68	0.7225	0.6400
14	2	2	-0.85	-0.80	0.68	0.7225	0.6400
15	3	4	0.15	1.20	0.18	0.225	1.4400
16	3	3	0.15	0.20	0.03	0.225	0.0400
17	2	2	-0.85	-0.80	0.68	0.7225	0.6400
18	4	3	1.15	0.20	0.23	1.3225	0.0400
19	3	3	0.15	0.20	0.03	0.2250	0.0400
20	2	2	-0.85	-0.80	0.68	0.7225	0.6400
Mean	2.80	2.75					
Total					11.4	14.55	15.2

$$r = \frac{\sum_{i=1}^{n}(X_i - \bar{X})(Y_i - \bar{Y})}{\sqrt{\sum_{i=1}^{n}(X_i - \bar{X})^2}\sqrt{\sum_{i=1}^{n}(Y_i - \bar{Y})^2}}$$

X - Pre-test attitudes developed scores

Y-Post- test attitudes developed scores

$\overline{X}$ - Pre-test mean attitudes developed score

$\overline{Y}$ - Post-test mean attitudes developed score

r- Pearson's Product –Moment Correlation Coefficient

r = 9.00/(√11.20 X √11.75)

r= 0.785

Appendix 14: Raw Data of the Pre-test and Post-Test Scores in Kinematics

Scores in %	Pre-test Frequencies		Post-test Frequencies	
	E(n=147)	C(n=123)	E(n=147)	C(n=123)
30	5	2	_	4
40	6	8	_	5
50	41	39	_	34
60	67	47	5	56
70	29	27	13	_
80	_	_	69	_
90	_	_	60	_

Appendix 15: t- Test Determination Formula

$$\bar{x}_A = \sum_{i=1}^{n_A} x_i \Big/ n_A \qquad \bar{x}_B = \sum_{i=1}^{n_B} x_i \Big/ n_B$$

$$s_A = \sqrt{\frac{\sum_{i=1}^{n_A} (\bar{x}_A - x_i)^2}{n_A - 1}} \qquad s_B = \sqrt{\frac{\sum_{i=1}^{n_A} (\bar{x}_B - x_i)^2}{n_B - 1}}$$

Where,

$\bar{X}_A$ –mean of sample A

$\bar{X}_{B}$- mean of sample B

S_A- standard deviation of sample A

S_B- standard deviation of sample B

Then, the pooled estimate of standard deviation s_{AB} is calculated:

$$s_{AB} = \sqrt{\frac{(n_A - 1)\, s_A{}^2 + (n_B - 1)\, s_B{}^2}{n_A + n_B - 2}}$$

Finally, the statistic t_{exp} (experimental t value) is calculated:

$$t_{exp} = \frac{|\, \bar{x}_A - \bar{x}_B \,|}{s_{AB}\sqrt{\frac{1}{n_A} + \frac{1}{n_B}}}$$

Appendix 16: Raw Data of Frequencies of Observation Scores on Development of BSPS.

Observations	Frequencies of Preliminary Observation Scores		Frequencies of Final Observation Scores	
	E(n=147)	C (n=123)	E (n=147	C(n=123)
1	48	34	12	40
2	52	59	35	50
3	24	28	45	20
4	14	8	54	5
5	9	4	1	8

Appendix 17: Raw Data on Demonstration of Scientific Attitudes

Observation	Frequencies of Preliminary Observation Scores		Frequencies of Final Observation Scores	
	E(n=147)	C(n=123)	E(n=147)	C(n=123)
1	9	7	3	7
2	22	21	4	21
3	51	47	46	47
4	50	25	64	25
5	15	23	30	23

Appendix 18: A Letter to the School Principal

Peter K. Sogoni,
P.O Box 181,
CHAVAKAL1

DATE:……………………………………………

THE PRINCIPAL

Dear Sir/ Madam,

RE: REQUEST TO CARRY OUT RESEARCH IN YOUR SCHOOL

I am a student at Masinde Muliro University pursuing a master's course in physics Education. As part of my course I am required to carry out a research on secondary school students' performance in kinematics using cooperative and conventional learning.

This letter is to seek your permission to collect relevant data from your school. If allowed, I promise to abide by your school rules and regulations.

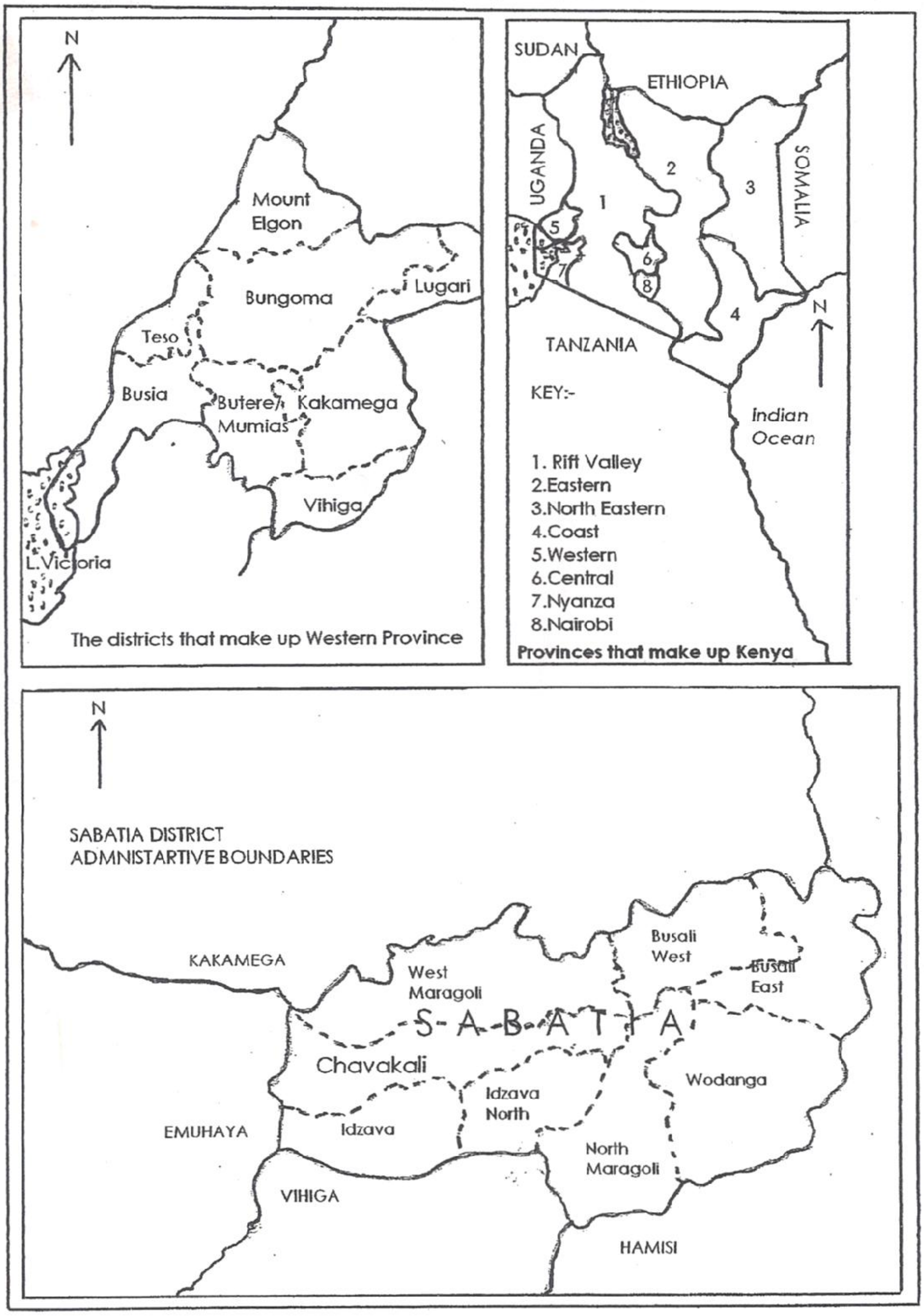
Enclosed please find my research abstract and a letter from the University.

Thanks you.

Yours sincerely,

PETER KELONYE SOGONI

Appendix 19: Map of Sabatia Sub-County



Appendix 19: Research Permit

THIS IS TO CERTIFY THAT:
MR. PETER KELONYE SOGONI
of MASINDE MULIRO UNIVERSITY OF SCIENCE AND TECHNOLOGY, 0-50317 CHAVAKALI,has been permitted to conduct research in *Vihiga County*

on the topic: *SECONDARY SCHOOL STUDENTS PERFORMANCE IN KINEMATICS USING COOPERATIVE AND CONVENTIONAL LEARNING STRATEGIES.*

for the period ending:
29th February,2016

Permit No : NACOSTI/P/15/8836/4760
Date Of Issue : 16th February,2015
Fee Recieved :Ksh 1,000

CONDITIONS

1. You must report to the County Commissioner and the County Education Officer of the area before embarking on your research. Failure to do that may lead to the cancellation of your permit
2. Government Officers will not be interviewed without prior appointment.
3. No questionnaire will be used unless it has been approved.
4. Excavation, filming and collection of biological specimens are subject to further permission from the relevant Government Ministries.
5. You are required to submit at least two(2) hard copies and one(1) soft copy of your final report.
6. The Government of Kenya reserves the right to modify the conditions of this permit including its cancellation without notice

REPUBLIC OF KENYA

National Commission for Science, Technology and Innovation

RESEARCH CLEARANCE PERMIT

Serial No. A 4248

CONDITIONS: see back page