CONSTRUCTIVISM INSTRUCTIONAL APPROACH ON STUDENTS' ACHIEVEMENT IN MATHEMATICS IN SECONDARY SCHOOLS IN MANDERA CENTRAL SUB COUNTY, KENYA

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DECLARATION AND APPROVAL

Declaration by Student

This research thesis is my original work and has not been presented for a degree in any other University or for any other award.

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DEDICATION

Dedicated to my wife Jackline Mwende, my children Joram Gweth, Everylne Hawi and Wesley Kido.

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I thank my family who were generous enough to provide patience and moral guidance during the study period.

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ABSTRACT

The performance of students in mathematics in the national examinations in Kenya had progressively been low. Despite the efforts made to change this trend, there is still low performance in mathematics. The condition is even worse and dire in Mandera Central Sub-County. This was the basis upon which the current study was designed. The study aimed to investigate the influence of the constructivism instructional method on student's achievement in Mathematics in Secondary Schools. The objectives of the study were: to evaluate the influence of engagement, exploration, explanation, and elaboration on students' achievement in mathematics in secondary schools in Mandera Central Sub-county, Kenya. The theories used in the study are individual constructivist theory, social constructivist theory, Jerome Bruner constructivist theory, and Moos theory of educational environments. A mixed research methodology was used. The experimental research design was adopted. The study population was 2573 respondents in total who comprised teachers (120) and students (2453) from 3 boys' schools, 3 girls' schools, and 3 mixed schools within Mandera Central Sub-county in Kenya. The random sampling approach was used in the selection of students. A sample of 22 respondents was selected. To determine the validity of the tool, a panel of experts in Mathematics was used. Quantitative data obtained analysis was by use of descriptive statistics, the SPSS-24 was used and it was presented using percentage, mean, standard deviation, and frequencies. The results were displayed by use of charts, bars and graphs. To communicate the study findings SPSS was applied. Data collected form open ended questions was analyzed using the content analysis method. The findings indicated that learners educated by use of constructivist method had higher mathematics achievement since they had a high score in mathematics in comparison to the students taught by use of the traditional method. Also, learners taught in a constructivist learning surrounding understanding had highly improved as well as their abilities compared to other abilities like skills and knowledge at 30 percent. The study conclusion was that constructivist teaching approach is appropriate in ensuring learner's achievement in mathematics and so ought to be included for practice in learning institutions to achieve enhanced performance in Mathematics.

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LIST OF ABBREVIATIONS AND ACRONYMS

ANOVA	**:**	Analysis of Variance
CA	**:**	Constructivist Approach
CAT	**:**	Chemistry Achievement Test
CLES	**:**	Constructivist Learning Environment Survey
CTA	**:**	Constructivist Teaching Approach
FTD	**:**	Field training detachment
KCSE	**:**	Kenya Certificate of Secondary Education
KICD	**:**	Kenya Institute of Curriculum Development
KNEC	**:**	Kenya National Examinations Council
MAT	**:**	Mathematics Achievement Test
NCF	**:**	National curriculum Frame work
SMASSE	**:**	Strengthening of Mathematics and Science in Secondary Education
TPQ	**:**	Teacher Perception Questionnaire

CHAPTER ONE

INTRODUCTION

1.0 Introduction

This chapter covers the background of the study, problem statement, research purpose, objectives; research questions, rationale/justification, significance, scope, limitations, delimitations, assumptions and operational definition of terms.

1.1 Background to the Study

The Constructivism theory is novel was recently developed and is now common and so vital in education (Taber, 2006). Bodner (1986) noted that focusing on constructivist model is building knowledge in learners mind. The experience of learning differs in students and it is therefore vital for educators to understand that knowledge construction is different in every learners. The existing knowledge that learners possess differs dependent on the experience in the past that is built in the learners mind (Taber, 2006). According to prior studies, the constructivist theory focuses on knowledge in the learning process particularly it being able to address other understanding for students. Krishnan and Howe (1994), indicates that learners challenges in comprehending science activities is as result of teaching not having prior student information on their understanding in the classroom.

A teacher's role in a constructivist classroom is shaping conditions that provide the student an opportunity of hypothesize, predict, manipulate, pose questions, research, investigate and come up meanings. Also, the center of a constructivism is the learners whereby a lot of importance is put on learner's other than the teacher meaning that the student is active. The one who relates prior attained knowledge with the novel knowledge is the learner (Driver, 1995); cited by (Kaya, Tufecki & Bilasa, 2010). Through this, the learner gets control over the learning (Brooks & Brooks, 1993; Akar & Yildirim, 2004).

Further, in a constructivist environment the student and teacher actively work together (Akar & Yildirim, 2004). The teacher is able to understand the learners and their procedure of learning by posing questions, observing and listening which helps in ensuring that the students acquire much and that knowledge is not just being dispensed to them by the teacher. This may also imply that the educator is like the researcher (Calkin, 1986). So, this learning method is not focused on singular answers and phenomenon explanation in a single manner. In generating sophisticated hypotheses, errors are usually mutual nonetheless they are essential. When learning, learners should not be punished for taking risks and making errors nonetheless they should be assisted and tolerated to get rid of the errors (Weaver, 1996). Before making a step to correct an error made by a learner, the teacher should put into consideration the effect it may have in student comprehension about the discussed idea. There is a great possibility of accomplishing effective instruction when learners participate more through conversations and meaning construction vital to them (Wells & Mejia - Arauz, 2006).

Recently, South Australia has insisted on constructivism and the theoretical basis of having improvements in education of government learning institutions. The new South Australian Curriculum Standards and Accountability (SACSA) Framework, will be in charge of governing developments in curriculum and also its execution in the learning institutions for the foreseeable future, presenting the 'central thesis of constructivism' as: in the procedure of acquiring information and developing knowledge and comprehension, the student is active; this means that they are the ones who are responsible for the construction of their individual learning. Learning refers to engaging in experience and utilizing it in thinking (DETE, 2011). From the year 1999, teachers have been supported by departmental funding for them to learn projects which will contribute to the policies of curriculum leading to future development 'pedagogy eliciting generative thought and

creativity required as knowledge for the future (Foster, Le Cornu, Peters & Shin, 2012). The main objective of the study is to generate new reasoning and comprehension of the process of acquiring knowledge and transiting the acquired knowledge to the system fully (Foster, Le Cornu & Peters, 2012). The theory that is drawn and promoted is 'constructivism' and is highly suitable for rethinking of the process of learning and also to the achievement of better meta-learning. The theoretical guide is relevant to learners, policy makers, administrators and teachers learning (Goldspink, 2013).

In Saudi Arabia, there was a national initiative of using new methods in teaching and learning of mathematics. Education administrators drafted a report indicating the approaches of instruction that are used in Saudi classrooms were the traditional ones and the major focus was to memorize and develop routine approaches which were unsuccessful in helping students develop a proper thinking and comprehension of the highest order. In Saudi, for the past 10 years, there have been high decline in studied done in the field of mathematics. Most of the research focused on the enhancement of teachers' pedagogies. This is due to the fact that mathematics teachers used teacher centered method other than learners and so the learners were not assisted to involve in high order reasoning (Bader, 2014; Alfarhod, 2009). Albalawi (2010) provided eight important areas of research in mathematics teaching and learning to help researchers to center their studies on vital parts that need research. The highest priority area given was professionally developing in service teachers in mathematics.

The Malaysian Education Blueprint (2013-2025), mentions a number of times that learners need to have the skill of higher thinking in this era of 21st century. Constructivism is therefore perfect as Lefoe (2008) indicated that through constructivism learning is regarded as an active process of constructing and not just the acquisition of knowledge. Once students have the ability of constructing their own knowledge and learning its

comprehension, they will be able to apply the use of higher thinking skill in solving problems, analyzing, synthesizing and many more. Mvududu and Thiel-Burgess (2012) also supports the use of constructivism in teaching language when they mentioned that despite the various teaching approaches, the approach of constructivist is seen as the approach that is compatible with various kinds of learners having various backgrounds in language. The approach of constructivist can be achieved in the case of Malaysian classrooms as Gilbert (2010) did an examination of the constructivist theory in social as well as cognitive forms using the context of 2nd language class. From his investigation, he established that the teachers are required to create an environment that allows the learners to experience meaningful situations and allow the construction of knowledge. To achieve this, more collaborative learning should be done more, the use of authentic materials, and effectively shift roles in class.

The role that mathematics play in the actual world is so vital and the traditional learning methods could not achieve the goals set by learning institutions. Mathematics experts and parties willing have made efforts in developing proposals and solutions approaches used in mathematics instructions and other curriculum challenges and numerous proposals were tested and applied at varied approaches and models on the basis of modern teaching and modern learning theories (Ellis & Berry, 2005). The constructivist classroom learning view may be attributed to numerous teaching practices. Mainly it means encouraging students to make use of active techniques (real world ways of solving problems, experiments) in knowledge creation and also making reflections and conversing about it and the manner it alters ones understanding. It is important for the instructor to understand the available student's idea and guide on ways of dealing and growing them (Cakici & Yvuz, 2010).

In regard to studies carried out in Botswana about learning centered method on learners and teacher centered ones have revealed that the most dominant method is the teacher centered one (Prophet, Rowell, 1993; Tabulawa, 1998). For instance, a study by Tabulawa (1998) on Pedagogical Classroom practices, which indicated that learners mainly receive passive knowledge meaning that they do not have a chance to create their own knowledge. In 1977, the education commission noted that it was main concern in the country's system of education. The adopted policy made the teacher dominant in the classroom since information was transmitted to the learner in an abstract way and so most of the learners memorized. The policy needed changes in the practice sin classroom to assist learners to progress through teaching and the course of learning to be student centered.

Tabulawa, (1998) indicated another concern that the teachers were the ones influencing the practices in their classrooms. Additionally, Tabulawa indicated that there are some factors that led to the teacher being the dominant one in classrooms an example is the assumption by the teacher regarding the nature of knowledge and how it should be passed to the earners and how the students perceive it. Such factors are areas of concern because they encouraged learning to be teacher centered and not centered on the learners. The focus of the study is to ascertain the level to which teachers use constructivist theory when they are teaching mathematics. The constructivist theory has proved that it boosts learner's independent learning.

Africa faces a problem of low mathematics and sciences performance and the tendency is causing alarm. The trend was among the schedules in a recently held meeting in Johannesburg SA. The warning provided by those delegated was that if mathematics instruction is not improved then the continent's economy would not be able to meet the MDGs (Kigotho, 2007). It was also noted that, though poor records in mathematics has

been there for a long time, the low level of students interest in learning mathematics is highly qualified to the manner in which it is conveyed.

Mathematics results in logic science because other sciences such as Biology, Geography, Chemistry and Physics are dependent on it. It is seen as a social life basis and the whole universe exploration. In the curricula in Kenya, one of the importance is mathematics. In spite its great significance, the subject performance in national examinations is very poor in comparison to the other sciences. The outcome is that affects the post-secondary student's placement since mathematics is highly stressed as a vital requirement. Reports by KNCE in the year 2017/2018 showed that many of the students were incapable of answering application question relation to major mathematics topic (KNEC, 2019).

From the report, circle geometry questions that form 38 percent of mathematics curricula was the most poorly performed. In 2019, a baseline survey by SMASSE agreed with the report by KNEC because they revealed that in the past decades, candidates for KCSE lacked competence in responding on questions associated with circles, vectors, chords and tangents. SMASSE INSET mathematics and science teacher's programmes were executed all over the country. The reports helped the government to be enlightened and so introduced programs to handle the problem. Ranani (2014) indicated that there has been poor performance in mathematics. Poor mathematics performance has been criticized by Njoroge (2014) in spite is being a very vital subject which the country depends on to make it industrialized by 2030.

Table 1: National Mean Standard Score of Mathematics at KCSE (2012-2016)

Year	Mean score
2012	4.066
2013	4.289
2014	4.275
2015	4.858
2016	4.821

Source: Ministry of Education (2018)

In 2010, in Mandera Central Sub-County, from a sum of 42 schools that took part in KCSE, just 18 had a score of 6.4 and above mean score in mathematics. Many of schools had a mean grade score of 4.5 or below (D+) in mathematics. This means that in 2010, mathematics mean grade for most of the schools was 4.5 and below. In 2013, the results had no much difference. The county education office report indicated that mathematics mean score in schools in the counties in the whole nation was 5.7 in 2013.

Table 2: National Mean Standard Score of Mathematics at KCSE (2012-2016) Mandera Central Sub County

Year	Mean score
2012	1.632
2013	2.011
2014	2.394
2015	2.502
2016	2.785

Source: ministry of education (2018)

The poor results in mathematics can be attributed from poor techniques of teaching mathematics. Other elements that can be associated with the poor results comprise; religion, culture, girls attitude and method of instruction used in teaching the subject. (Glover & Law, 2002). Dewey (1925) was in agreement with the learning outcome differences in cognition and lack of reinforcement of the behavior as suggested by

espoused that the outcomes on learning from cognitive dissonance other than reinforcement of behavior as suggested by behaviorist learning.

1.2 Statement of the Problem

The performance of students in Mathematics in the National Examination has progressively been low. In Central Sub-County in Mandera, the situation is even worse. For instance, in 2010 KCSE, schools in the Sub-County did not attain a 4.5 mean score (D+). Additionally, in 2013 KCSE, the mean score was 5.7. In Kenya, classroom practices are dominated by conventional instruction methods. The MoE has a lot of interventions to address poor performance in the subject. This comprises; SMASSE program pedagogy, resources provision, hiring qualified teachers for mathematics however the performance is still poor. If this situation is not addressed Mandera Central Sub-County schools would go on recording poor mathematics grades.

In Mandera, the challenges of using constructivism approach of instruction are the lack of dedication of teachers in executing the approach, shortage of chosen time to conduct active learning in high depth, deficiency of skills and understanding for teachers to use constructivist teaching methods and learning materials shortage more so in the mathematics department. There is no study that has been conducted on the influence of constructivism instructional approach on students in achievement of Mathematics in secondary schools in Mandera central sub county Kenya. This formed the current study basis.

1.3 Purpose of the Study

The purpose of the study was to establish the influence of constructivism instructional approach on students in achievement of mathematics in secondary schools in Mandera central sub county Kenya.

1.4 Objectives of the Study

The study was guided by the following objectives:

(i) To examine how engagement influence students' achievement in mathematics in secondary schools in Mandera central sub-county, Kenya.

(ii) To assess the influence of exploration on students' achievement in mathematics in secondary schools in Mandera central sub-county, Kenya.

(iii) To determine the influence of explanation on students' achievement in mathematics in secondary schools in Mandera central sub-county, Kenya.

(iv) To evaluate the influence of elaboration on students' achievement in mathematics in secondary schools in Mandera central sub-county, Kenya.

(v) To investigate the influence of evaluation on students' achievement in mathematics in secondary schools in Mandera central sub-county, Kenya.

1.5 Hypothesis

The study was guided by the following hypothesis:

(i) Engagement in the classroom has no significant influence students' achievement in mathematics in secondary schools in Mandera central sub-county, Kenya?

(ii) Exploration has no significant influence on students' achievement in mathematics in secondary schools in Mandera central sub-county, Kenya?

(iii) Explanation has no significant influence students' achievement in mathematics in secondary schools in Mandera central sub-county, Kenya?

(iv) Elaboration has no significant influence on students' achievement in mathematics in secondary schools in Mandera central sub-county, Kenya?

(v) Evaluation has no significant influence students' achievement in mathematics in secondary schools in Mandera central sub-county, Kenya?

1.6 Rationale/Justification of the Study

This study outlines of an experimental study on impact of constructivism instructional method on achievement of students. The study tried to demonstrate the difference in achievements of form 2 students that were being subjected to traditional and constructivist pedagogy respectively in 3 schools in Mandera Sub County. The research design for this study was pre-test post-test quasi experimental design that used both qualitative and quantitative methods. The learning strategy of 5E's (Engage-Explore-Explain- Elaborate-Evaluate) was applied on the experimental group while the control group, where 249 students took part, used the traditional methods.

1.7 Significance of the Study

This study created novel understanding on constructivism instruction technique influence on the accomplishment of students in mathematics in high schools. The MoE may use the findings to enhance their workability in the area of education. The stakeholders may be enlightened on appropriate methods to enhance mathematics performance. This study would identify challenges that are current and those to come that need to be solved.

This research would be helpful to the teachers to enhance the methods they use for instructions because a constructivist educator encourages the learners to progressively examine the manner an activity assists in developing an understanding. Using strategies and questioning, students in a constructivist class can be expert students. This way, they acquire tool that help them to grow and continue learning. In a well-planned classroom, learners can get new learning ways.

The teachers may acquire more insights since constructivism usually adjust their duties, the duty of the teacher is helping learners to develop their own understanding and without only providing them with facts. In constructivism a teacher transfers things like problem

solving and education guided on inquiry where learners create and execute ideas, make inferences, and pool and show their knowledge in the collaborative learning surrounding.

The study was also significant to students since it can help them in enhancing their knowledge and performance. Constructivism role is transforming students into active partakers in the learning procedure other than passive knowledge recipients. With the educator's guide, students grow their knowledge actively and not only acquiring knowledge from a book or teacher.

1.8 Scope of the Study

The study was conducted in Mandera Central Sub-County, Kenya. The study was conducted at pubic secondary schools in Mandera Central Sub-County. Questionnaires were used for data collection. The study was undertaken between April and November 2018.

1.9 Limitations of the Study

The limitations of the study were;

(i) Teacher's unwillingness to provide information to facilitate this study was one of the challenges. The study purpose was explained to them. In addition, they assured that the findings were purposely for the study and would not be used to assess their personal performance.

(ii) Some respondents were unwilling to participate in the study stating that they lacked time. To deal with the issue of lack of time, the researcher left them with the questionnaire for a few days and collected them later.

(iii) The study experienced language barrier during data collection. However, the services of a translator were employed to enhance data collection

1.10 Delimitations of the Study

The following was considered to be the study delimitations:

(i) The study was delimited to public secondary schools of Mandera Central Sub-County as the private secondary schools could be having different curriculum. In addition, private secondary schools were not included because their operational and supervisory structure depends on school managers.

(ii) The study was delimited to Form Two students only. Form 1's were considered to have covered little work in their syllabus while the Form 3 & 4 were preparing for national examinations and the principals were not willing to allow the students to be involved in the study.

(iii) The study was delimited to only nine schools because there are few schools in the Central Sub-county in Mandera.

1.11 Assumptions of the Study

The study considered the following as the assumptions;

(i) There was low performance in Mathematics in the Central Sub-County in Mandera, Kenya.

(ii) Constructivist Instructional Approach in teaching Mathematics had a positive impact on the students' performance in Mathematics.

(iii) Constructivist Instructional Approach involves engagement, explanation, exploration and elaboration (strategic components).

1.12 Operational Definition of Key Terms

In this section the key terms from the study are defined.

Constructivism: It is a situation whereby the learner has prior knowledge and experiences, which is often determined by their social and cultural environment. These include grouping of knowledge, student generated projects and flexible time frame

Conceptual understanding: Knowledge of why a mathematical idea is important and the kinds of contexts in which is it useful.

Representation: It is the description of something or someone in a particular way.

Constructivist teaching approaches: It is a process where the learner is actively involved in learning to create knowledge other than to only receive information. These include engagement, exploration, explanation and elaboration.

Traditional teaching methods: The teacher direct learners through memorization and recitation methods therefore the learner does not get critical thinking, problem solving and decision making skills

Engagement: It is the level of attention, curiosity and interest that learners show when they are learning or being taught. It involves prior knowledge, generation of interest and framing of ideas.

Exploration: It is where the teacher uses open-ended approach that gives the students an opportunity to identify and develop skills, concepts and processes. It involves situations in real life and probing and enquiring.

Explanation: It is the process of making something clear or easy to understand to learners. It involves ideas sharing and using primary resources.

Elaboration: It is the act of adding more information to existing information to improve a simple existing idea. It involves application of ideas and conceptual integration.

Use of open-ended approach: It involves understanding mathematical knowledge and applying mathematical knowledge.

Learning experience: it is any interaction, course, program, and any other experience that goes on when learning is taking place.

Self-evaluation: It the process where teachers look on the way they teach and the way the students learn and assist s teachers to better the results of learning.

School Ethos: they are the morals, values, and beliefs of a person or culture.

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

In this chapter, empirical literature, theoretical literature, theoretical framework, conceptual framework, research gaps and summary of literature are reviewed.

2.1 Empirical Literature

This section discusses studies that have been done about constructivism instructional approach impact on the achievement of students. The teacher's role in constructivism is helping students in building their own knowledge and controlling the existence of learners in the classroom learning process. Additionally, the teacher value learner reflection and cognitive conflict and also motivates the interaction among the peers (Association for Constructivist Teaching (ACT), 2007). Kompf (2017), indicated that a constructivist teacher give students a chance to be the ones driving the lessons, shifting strategies of teaching and altering content. This concept of limiting the teacher duty is to encourage the students to take part in collaborative learning.

In the contrary, teachers in a collaborative learning process act as the facilitators who provide a chance for solving problems and collaborative work. Ndon (2011) indicated that a teacher is responsible for the provision of a reach environment, experience as well as activities for learning through the incorporation of chances for collaborative work, solving of problems and authentic tasks. Lastly, it's the role of the teacher to concentrate on the learning of the student and not the performance of the teacher. In wiki classroom, a teacher is characterized by similar roles in constructivist Learning Theory and Collaborative Learning Environment, the role of the teacher is controller with students, and facilitator of transferring information to students. The process of learning is

facilitated by the teacher whereby he/she encourages the students to be responsible and self-governed (Gray, 2014).

Constructivism is viewed in 5Es; Engagement, Exploration, Explanation, Elaboration, and Evaluation. In engagement, the students first encounter and identify the instructional task. In exploration phase, students have the chance get involved directly with materials and phenomena. The explanation stage, is the pint whereby the learner starts to put the concep experience through which she/he has gone /into a communicable form. In stage four, elaboration, the students enlarge on their learnt concepts, making connections to related ideas, and use their knowledge to the world around them. Evaluation, the fifth "E", is a continuous process that gives the teacher an opportunity to determine if the learner has achieved concepts understanding and knowledge (Gray, 2014).

2.1.1 Engagement Approach in Constructivism on Student Performance in Mathematics

The start of this approach is the phase of engagement. This phase is one of the phases that assist the student to connect between their past learning experience and the present. Engagement is technique of constructivist where the students are involved in an active pedagogically process in class or outside class with the aim of achieving results that are computable (Kuh, 2007). Likewise, it is the involvement level of learners in different undertakings that are associated with the results of learning. The engagement process is meant to assist the learner to focus on being thoughtful and getting involved in process, concept and learning of skills. It is expected that the learner will relate to the posed problem and take part in getting the solution to the problem (Krause & Coates, 2008).

This phase is a vital part in the technique of constructivist in relation to the definition of constructivist instruction technique as being an active learning process whereby the learner constructs novel ideas based on past and current knowledge (Driver & Oldham,

1986). The learner relies on the cognitive structure when getting involved in processing as well as encountering information, coming up with hypotheses reaching a decision. Cognitive structures are mental procedures that are applied by people in making information sensible (Pratkanis, Breckler & Greenwald, 2014). Through this cognitive structure, (that is schema, mental models) Bruner (1960) postulated as involving providing meaning and organization of experiences that allow an individual to move past the information that has been applied. This instructional technique of constructivist has been regarded as successful pedagogical technique responsible for stimulating enthusiasm of the learners and assists them in deepening their comprehension through experience (Danielson 2011). Learning opportunities get a meaning through personal experiences (Brown, Collins, & Duguid, 1989).

The engagement of students differs depending on their background. There are several studies that have been conducted on the engagement of students in the US (Kuh, 2001, 2003; Kuh & Hu, 2001; Kuh *et al,* 2006; Kuh *et al,* 2010; Quaye & Harper, 2014). The area that has been greatly studied is the engagement of learners who have no background in traditions or have diverse traditional background and the main focus of these studies have been on demographics which include their gender, racial and ethnic identity, main fields, enrollment and first-generation status, age, and GPA (for instance Bridges, Carini, Hayek, &Harper, 2004; Carini, Kuh, & Klein, 2006; Denson, & Chang, 2009). An example being a study on engagement of 1st generation college learners by Pike and Kuh (2005) who did a survey of 3,000 US undergraduate students and compared engagement and development of intellects of the 1st and 2nd generation learner's in the college. The study established that comparing the students who had at least one of their parents having advanced from college, 1st generation learners were lowly involved in college life, lacked

sufficient integration into different capabilities in the college and their perception of the college environment was that it wasn't supportive (Pike & Kuh, 2005).

Patel, Franco and Lindsey (2013) noted that in the US learners in the 10th grade showed a higher cognitive engagement in comparison to their peers in other grades, and that STEM (science, technology, engineering, mathematics) students indicated that their schools provided them more with specific cognitive engagement behaviours compared to the learners in national sample at levels that were significant. Mauro (2014) indicated that educators who made lessons fun and allowed learners to be enthusiastic and energetic increases the likelihood of engaging them in class. Valle, Regueiro, Nunez, Rodriguez, Pineiro and Rosario (2016) established that homework approach and learning goals (control and competence), were statistically and significantly associated, variable related to homework engagement that is amount of done homework, time management in homework and achievement in academics.

Al-Alwan (2014) did a study in Jordan and established that cognitive engagement was statistically and significantly positively correlated with achievement in academics. Gunuc (2014) established that achievement score in academics and engagement of students were significantly associated and the sense of belonging and cognitive engagement sub-factors in Turkey. Furthermore, Kamla-Raj and Ugur (2015) established that performance in learners academics were positively related with cognitive engagement.

In their study, Francis, Tan and Che (2018) researched on student engagement and mathematics achievement. The study interrogated the link between the engagement of students and achievement in mathematics for 295,416 students who were 15 years of age from 11,767 secondary learning institutions in 34 nations took part in the International Student Assessment (PISA) program. Affective engagement measurement was by student's interest in mathematics (Interest Math) and schooling perceived usefulness

(Perception Sch), engagement in behavior by behaviors influencing learning mathematics (Behavior Math) and partaking in activities of learning mathematics (Activities Math), and openness in cognitive engagement (Openness) and problem solving perseverance (Perseverance). Findings indicated that students highly engaged had greater academic attainment levels, while cognitive engagement had the greatest link with achievement. Findings also indicated that student more engaged in the two domains has greater levels of achievement than those who were only engaged in one domain in comparisons of six pairwise (Interest Math-Behavior Math, Interest Math-Openness, Interest Math-Perseverance, Perception Sch-Behavior Math, Perception Sch-Openness, and Perception Sch-Perseverance).

Further, Skilling, Bobis, Martin, Anderson and Way (2014) researched on high and low attaining students and mathematics engagement in Australia. 37 high and low attaining 7^{th} year students 12 years old from 10 secondary school were interviewed exploring their engagement and achievement. It was revealed that students who were highly engaged were highly related in their attitudes in mathematics, the subject learning strategies, interest and behavioral engagement in mathematics irrespective of their achievement differences. Also, high and low achieving students who were disengaged from math's, shared few common characteristics. The findings help disentangle characteristics of engaged and disengaged learners from those attributed to mathematical achievement.

On another study, Sunawan, Halen, Kusnarto, Sri and Afriyadi (2017) researched on engagement and achievement in mathematics in junior and senior high school students in Indonesia. The study goal was to provide an understanding of engagement in classroom on achievement in mathematics. The study design was correlational comprising 368 student's sample (junior -134 and senior – 234). In obtaining data the engagement inventory in the classroom and students document on achievement in mathematics were

used and analysis was by use of moderator analysis approach. Results showed that disengagement predicted achievement in mathematics negatively, while affective, behavior and cognitive engagement failed to significantly predict achievement in mathematics. Further, senior schools with lower disengagement level had the great chance to achieve higher achievement in mathematics.

In Nigeria, Babatunde and Olanrewaju (2014), established that academic engagement and motivation of achievements were significantly related for post-graduate learners. Waweru and Nyagosia (2013), did a study in Kenya and established that KCSE mean and general score on task was significantly correlated at $p<0.05$. Hlalele (2018) evaluated the engagement of learners' in mathematics in South African Schools. The design was the case study method used to test student level of engagement. The sample was 80 learners in high school obtained from eight, ten, eleven and twelve grades. The SPSS was used to capture the responses and reliability was determined it was 0.8. The findings indicated that there is no engagement of learners in teaching and learning of mathematics. ANOVA results showed significant variations in the groups. A test on post hoc showed that all grades had equal mean apart from the tenth grade which established high variations with the eleventh grade. The conclusion was that all the participants showed disengagement in mathematics teaching and learning.

In Kenya, Mwanda, Odundo, Midigo, and Mwanda (2016) did an investigation on the use of constructivist learning technique in Kenyan secondary schools the main focus being achievement of learners in biology per class category. The focus of the study was linking instructional techniques and learning achievement in various categories in class. The design of the study was quasi-experimental. Data was collected from 4 boys and 4 girls in 4 mixed learning institutions with 477 students in total. Analysis of data was done using descriptive statistics such as mean and std. Dev. while analysis of variance and t-

test were applied in testing the significance in mean differences between groups at α = 0.05 level. Results showed that achievements of learner's in the control group had poor means in comparison to experimental groups, which implies that the approach of constructivist instruction has a positive influence on the achievements of students. While comparing the mean gain; girls improved. This suggests that student' achievements in girls' classes improve with the use of constructivist instruction technique. The students who were taught using the constructivist approach showed some level of improvement in their achievement.

From the empirical review on engagement most studies reviewed engagement and student performance using different methodologies. The main intention of this current study was to fill the research gap by examining how engagement affects students' achievement in mathematics.

2.1.2 Exploration Strategy in Constructivism on Student Performance in Mathematics

At the phase of exploration, it is expected that learners should have a common foundation of experiences. The approach that is adopted by the teachers is the open-ended one that gives the students the opportunity to identify and grow concepts, skills as well as processes (Hanke, 2009). This approach is advantageous in that the students get the chance to explore their environment and manipulate the material and they learn. When using this approach, the students acquire the ability of establishing the connections with the real world, by use of materials and manipulations for interaction and provide a common area of experience from where they can learn and grow. When a teacher acts as a facilitator of these instructions, they should pose a problem to the students and the students will explore it with the aim of understanding its truth (Hirst-Loucks & Loucks, 2013). In facilitating the phase of exploration, the constructivist teaching approach is

created in a way that it provides a reflection of situations in the real world (Bentley, 2012). Hofstein and Yager (1982) gave a proposition for social matters to be applied in organizing the curricula in order to contextualize the ideas that are being taught in various disciplines of study.

It is expected that teachers in their various disciplines should overcome the barriers in their subjects and should not stick to matters that are only distinctive to their subjects. It is expected that the teachers should incorporate language, understanding and application process to enable learners to create situations in the real world in the process of knowledge acquisition. It is also expected that teachers should encourage activities that are based on research during this phase. Programs that are based on research provide learners with the ability of retaining facts through critical thinking and working through problems in a logical way and create connections to the real life. Bruner (1960) supported this by advising that learners need to be given a chance to understand how it feels being completely involved in an issue and that the experience isn't usually faced in learning institutions where the traditional teaching ways are used in teaching.

Students need to be encouraged to find solutions to their own questions; this will encourage them to learn the art of solving problems (Boud, Keogh, & Walker, 2013). When exploring a concept, the students need to be provided with an opportunity of working with materials and manipulative in order to have experiences that are primary and real. The role that is played by the hands-on learning is very vital in constructivist method of instruction, since it involves utilizing learning experience in this exploration stage. During the instructional cycle, the use of hand-on learning is enabled and the student's gets to experience a lot of captivating content and it has proven to be effective since in today's world, technology is very affordable.

Fink (2013) asserts that with the aim of comprehending an idea better, teachers are encouraged to engage students in learning solutions that are effectively integrated in their real life and in tools that are familiar. For instant a learner who is passionate in hunting birds can be provided with an opportunity of exploring the concept in population estimation technique and more specifically to capture organisms with the aim of estimating their population. They can also use sweep nets in capturing the insects. Using this approach, the student gets the opportunity of exploring meaningful science in the context that they love doing (Hirst-Loucks & Loucks, 2013).

In their study, Semerci and Batdi (2015) did a constructivist learning approach (CLA) meta-analysis on students' academic achievements, retention and attitudes. The focus of the study was answering the query on whether CLA affects the achievements of students, retention and attitude scores. From systematic examination of experimental researcher that were conducted from 2002 to 2015 in national and international area, 324 (218 articles, 106 theses) researches were obtained. Pre-test-post-test and group link procedures were used on 28 of the experiments and the researches were added in the research of meta-analysis. Thalheimer and Cook (2002) classifications were considered in the statistical analyses. While considering the size of the effect, the effect of Constructivist approach on achievement in academics, retentions and attitudes (were calculated. From the findings, it was evident that the size of the effect on achievement in academics and retention were at a higher level while for attitude was at a medium level. The conclusion reached was that the learning approach of constructivist positively affects the success of the student academically, there attitude scores and retention.

Laz (2014) studied the effectiveness of exploration model of constructivist learning in mathematics instructions. The study used student's samples that were on their year of preparatory in Tabuk University and divided into two randomly to have a control and

experiment group. It was established that there was great variations among learners mean scores in the control and experimental groups after application to determine the statistical beneficial concepts for students who were in the experimental group.

Kim (2015) researched on exploration constructivism teaching method effects on academic achievements, self-concepts and learning methods of students. The investigation was about constructivist method effects on achievement in academics, self-concepts and learning methods. Two groups were formed from a population of 76 grade six learners. The constructivist method was used in teaching the experimental group and the traditional method was used for the control group. The experiment was executed for nine weeks for over 40 hours. The process was as follows; teacher administered mathematics tests, self-concept and learning method inventories and survey in the classroom environment. It was found that teaching using constructivism is highly effective than the traditional methods in relation to achievement in academics, however, constructivist learning is ineffective in regard to self-concepts and learning method, but affected motivation, learning anxiety and individual monitoring. Constructivism was preferable.

Aydisheh and Gharibi (2015) researched on exploration constructivist learning technique effectiveness on achievement of students in mathematics. The goal was to evaluate the impact of exploration constructivist learning on achievement of students in mathematics. This was an applied study, the design being quasi-experimental and control groups were used. The population comprised grade three girls' learners forming a total of 364 from Iranian high schools. The study employed cluster random sampling from where six schools were selected with 14 classes in total. A multistage approach was used to select one school. Afterwards a random method was used to select two classes in each school.

A questionnaire was used. Findings showed that exploration constructivist learning impacts on evaluation, application, knowledge, understanding, analysis and combination.

Charles-Ogan and Wonu (2019) researched on progressing learner geometry attainment by exploration constructivist teaching model in Nigeria. The study was an investigation of suitability of exploration constructivism learning model in enhancing the attainment of solid geometry by senior students in high schools by use of quasi-experimental method. The models for constructivism were Metacognitive Instructional (MCI) and Teaching for Understanding (TfU). The study location was River State in Emohua Local Government Area (LGA). The population comprised 86 senior students in secondary schools. To determine solid geometry achievement by students, a structured achievement test was approved and used and it had fifty multiple choices questions. Reliability was ascertained by use of KR-21 a value of 0.84 was obtained. Analysis was by use of ANOVA, means and standard deviations. Results indicated that constructivism teaching model highly enhances the solid geometry learning among students in SSC1. The effectiveness of MCI model was low than TFU in enhancing students learning. Gender did not impact on achievement in solid geometry of students in spite of the model used. It was recommended that solid geometry should be taught by arithmetic teachers by use of instructional constructivism models.

Mrayyan (2014) researched on the influence of constructivism learning of mathematics on success in academics and mathematical reasoning for learners in a college course of algebra among 1st year students in vocational education. Constructivism principle is very influential in classroom organization and curricula of school and it appeals to the modern ideas of knowledge and learning but it conflicts with traditional practices. There is need to reflect on our practices for the purpose of applying those ideas in our work. The focus was to establish the effect of applying the constructivism learning model in instructions

based on constructivism theory on achievements academically and the results of mathematical thinking. Basically, the theory on Constructivism whose basis is observation and scientific study regarding the way individuals acquire knowledge/learn. It states that individuals develop their own knowledge and understanding by facing situations and reflection on the experiences. When encountering a novel thing, we should relate it with past ideas and experiences, perhaps changing our believes or doing away with the novel information considering it to be irrelevant. Whichever the case, we are the active knowledge creators. In order to achieve this, we should pose questions, explore, and examine our knowledge.

Semerci and Batdi (2015) researched on constructivist learning approach (CLA) meta-analysis on academic achievements of leaners, their attitude and retention. Laz (2014) studied the effectiveness of exploration constructivist model for learning in mathematics learning. Charles-Ogan and Wonu (2019) researched on growing the learner achievement in solid geometry by use of exploration constructivist model of instruction in Nigeria. Mrayyan (2014) researched on the effects of constructivism learning of mathematics on achievement in achievement and mathematical reasoning for learners in a college course of algebra among 1st year students in vocational education. From the empirical review there no study which has been done to find out the influence of exploration on learner's outcomes in mathematics. The aim of this study was to fill the study gap by establishing the influence of exploration on student performance in mathematics.

2.1.3 Explanation Strategy in Constructivism on Student Performance in Mathematics

The explanation stage helps students to reveal ideas surrounding their exploration. Learners should have a chance to verbalize their abstract understanding, of facing novel material content of showing novel abilities (Loughran, Berry & Mulhall, 2012). In this

phase, the instructor is given the chance of presenting the main component materials like formal tem, definition and content data. While the learner is given the chance of skills and behavior identification with a goal of facing and knowing information that can be applied in that precise area (Ergin, 2012). When the students get the opportunity to participate and discover a topic, having conceptual understanding rooted in it that strat to have experience anchors through which they can fasten knowledge on particular content.

In terms of constructivist, delivery of content needs to focus on primary sources as well as materials that content knowledge are applied and integrated. There are a number of sources and they comprise publications, textbooks, lectures, mentors or films. There is need for the learners to be guided to use the data they acquire in methods that motivate them to synthesize and also analyse. Such behavior, and content interactions, encourages higher order understanding in a human construction associating with social situations and so defining meaning to oneself. The teacher should consider the students point of view as something that is vital to them. Based on the students experience in the past, their understanding of concepts and content will be different (Knowles, Holton III & Swanson, 2014). The learner requires opportunities to address the knowledge they acquired in the past with the aim of addressing misconceptions and developing ideas in a correct manner. A classroom that is effective, there is more to learning than putting together novel material to old thinking ways; it rather needs learners to get to a novel method of comprehension. Students have numerous ideas about numerous topics they come through while in school, some may be correct while others incorrect (Rutherford & Ahlgren, 1990).

At this phase, students are being allowed to develop skills as well as behaviors that would assist them triumph in learning. Learners further require experience that assists in developing novel opinions and ensuring and improved understanding of the world (Boud,

2012). Learning being the student's duty, it is important that the educator guides the procedure of learning using content material and experiences in the classroom. For learning to be successful it is of importance and vital to have perspective and communication from and between multiple peoples (Bentley, 2012). A master of particular knowledge is a person who can successfully explain particular knowledge to another person. While explaining a particular idea to others, the learner synthesizes the material in a manner requiring thinking of higher order (Brookfield, 2015). While explaining, the teacher needs to encourage the learners to describe ideas, asking for proof and interpretation for their description and listen carefullt to the explanations by others and that of the educator. Learners need to use observations as well as recordings while making their explanations (Hannafin, Hill, Land & Lee, 2014). In this stage, the educator ought to provide some descriptions and clarifications using the prior experiences of students as the foundation for their discussion.

Cofer (2015) researched on strategies of mathematics explanation used in Australia's secondary schools. The study proposed a way of reviewing methods in which potential educators incorporate their knowledge on mathematics gotten from topics that are advanced into explanatory understanding for providing instructions in schools. Respondents, who recently had finished the abstract algebra coursework, were requested to provide explanations on concepts associated to curriculum on mathematics, like even numbers and division by zero. Findings indicated that three different explanatory methods were used by students: Analogy, Abstract Mathematical Argument and rules. There was competition experienced by students within and among approaches. However, varied conclusions were provided by use of varied strategies by the students. When they experienced such a conflict, they were obliged to select a strategy and come up with conclusions gotten from the usage of the strategy, in spite of making sense. The ability of

students to incorporate explanatory techniques was dependent on them having coherent meanings on mathematics, meaning that the integration of strategy indicates that students possess vital development knowledge of the fundamental ideas on mathematics.

Zain, Rasidi and Abidin (2012) researched on student-centered learning in mathematics –constructivism in the classroom in Malaysia. This was an exploration on student-centred learning (SCL) method effects in mathematics on the skills of learning between students and teachers in pre-university; and their views on SCL method. Using the qualitative method and interviewing samples selected, analysis was done and discussed along the theory of constructivism. Findings indicated that skills on learning were shown in SCL by high student's cooperation and interaction, in and out of the class, improved lesson planning and learning, with numerous analytical skills elements being shown. The learners are less receivers of passive knowledge, highly responsive and have the ability of relating their experiences. The gap was also highlighted in the study that was there in regard to students learning expectation and what has been taught by the teachers; in relation to the design of the curricula and examination.

Onwuka (2014) studied the effects of explanation in constructivist instruction method on students learning outcomes in mathematics. This examined the impact of constructivist instruction approach on mathematical achievement of learners. The design used was quasi-experimental and the study area being Delta State in Nigeria. One research query and hypotheses was generated and analyzed using t-test, means and standard deviations. A 215 sample was obtained. MAT was the study instrument. Reliability results were 0.81. The experiment group had a better performance.

Dixon, Watkins and Montalvo (2014) studied the impact of explanation in constructivist learning of mathematics on rural schools achievements. The study was a comparison of achievement of students in grade six mathematics outcomes from Illinois SAT. A

comparison was done between student's results in three varied rural schools, who were being taught in three varied curricula for mathematics. Students got 7 years of K-6 each day in one district in mathematics curricula in comparison to students who got 7 years traditional instruction method in district two and scores form district three were equated with students taught with traditional methods. It was revealed that the mathematics curricula on constructivist K-6 failed to result to improve performance in achievement in mathematics in comparison with traditional techniques.

Origa (2000) did an investigation on the effects of constructivism in learning geometry in Kenyan high schools. This was an investigation on constructivism effects in three dimensional geometry learning in girls' schools in Kenya. The study used the behaviorist and constructivist methods to test the teaching experiment, the adopted concepts are greater in facilitating geometry concepts acquisition. The study participants were students in form three from 62 secondary high schools.

The study goal was to determine the effects of constructive method on geometry ideas mastery, find out how manipulative materials affects geometry achievement, how manipulative materials helps in transferring skills on geometry, assessing errors and misconceptions of students in three dimensional geometry (three-D) learning, findings out the difficulties in mathematics learning faced in learning three-D and find out the elements that result to poor results in geometry. Questionnaires were used and quantitative and qualitative methods used for analysis (Origa, 2000).

Students using constructivist method achieved higher scores and were better ranked in comparison with those that adopted the behaviorist method in spite of the used instruction materials. Analysis results showed performance that was unsatisfactory in three-D concepts in girls' schools in Kenya is a result of numerous elements either collectively or singly. The elements were inclusive of: negative attitudes of the learner, lack of

prerequisite concept, inability to apply prerequisite concept, lack of the ability to use precondition concepts, conceptual challenges, 3-D abstract nature, inadequate resources for instruction, resources underutilization, problem solving skills and language deficiency, high students enrolment and poor methods of presentation of concepts.

The reviewed studies were conducted in different contexts and covered different concepts. The aim of this current study was to fill the study gap by exploring the influence of explanation on student performance in mathematics.

2.1.4 Elaboration Strategy in Constructivism on Student Performance in Mathematics

The elaboration phase is developed to spread the learner's abstract understanding in skills and behavior. In constructivism model, the teacher's duty is to give students a chance to practice and improve their skills and behaviors (Gregory & Chapman, 2012). Students are given numerous chances to broaden and deepen their acquaintance base and incorporate the knowledge to concepts comprehension and activities in class and out. The techniques give the learner a chance to use their time to discover and describe the procedure and mirror on the numerous experiences for information synthesis (Quinn, Amer, Lonie, Blackmore, Thompson, & Pettigrove, 2012).

Fink (2013), indicated that learners need to be engaged in and out of class since it is very important in learning and in constructing purpose as well as meaning. The educator plays the role of actively promoting and encouraging positive interaction in groups and cooperative behavior which boosts thinking interactions enhancing learning process (Prince & Felder, 2006). In this phase, learning is expected to move to action from vision to act, from content to idea and from a still state to a changing chance. So, it needs intensified solving of problems, critical thinking and cooperative learning. At this stage

the student should be able to make use of skills and concepts in novel circumstances and make use of formal marks and descriptions. The teacher should remind learners on other descriptions and consider the existing data available in exploring novel ideas (Baybee, Tayler, Gadner, Scotter, & Powell, West brook, & Lardes, 2006).

Salwah and Ashari (2015) did a study on the elaboration strategy effectiveness in enhancing achievement of students in Indonesia. The goals of this research was to evaluate the disparities in achievement in learning for students using elaboration method in learning and those in use of conventional methods, find out the elaboration methods effectiveness in enhancing learning success of students in the fifth grade in high schools and determine if learning attainment for learners taught math's by the elaboration method are highly effective than those learning using the conventional methods. The participants comprise of grade X students in senior schools and a random method was used on selecting two classes, X3, X4 years were experiment groups.

The analysis of data methods were descriptive and inferential methods. Findings revealed that: student's mean on learning achievement in mathematics prior being instructed with conventional method was extremely low, however after learning using the conventional method the outcomes were average, similarly in the control group, students mean before learning by use of the elaboration method on 3-D topic was low, however after learning using elaboration it was average. The conclusion was that there exist differences in achievement in mathematics for learners being instructed by use of elaboration and conventional strategies.

Elsayed (2015) studied the effectiveness elaboration theory adoption in mathematics teaching to cultivate achievement in academics and critical thinking in Oman primary schools. The goal was to formulate mathematics curricula content in primary school children in relation to the elaboration model and determine the mathematics content

effeteness in the development of skills in critical thinking and achievement in academics. A sample of 119 learners in grade 5 was selected and two groups were formed. Sixty learners were in experimenting group while 59 were the control group. Data was obtained through achievement tests and critical reasoning for samples in measurement and geometric areas. The research was done 25 times in 5 weeks. Analysis was by use of t-tests, means and standard deviations. It was concludes that there exists significance variances between the experiment and control group academic achievements, the experiment group was favored and there were also great differences in the two groups in regard to critical thinking skills in experiment group favor.

Nayak (2014) did research on constructivist pedagogy impact on achievement of students in mathematics at the elementary schools. This study was an outline of an experimental research on learners in a constructivism environment and the impact on achievement of leaner's in mathematics in elementary schools. This study wanted to determine the achievement differences in two grade five groups who were taught using the constructivist pedagogy and traditional method in Odisha urban schools. This was a quasi-experimental method on pre and posttest integrating quantitative and qualitative methods. In the experiment group the 5Es for learning were used and control traditional learning was used a sample of 249 learners. To test for achievement in the group MAT was adopted. ANCOVA was employed to test for the hypothesis. In the experimental results two things were discovered. The use of constructivism in learning highly enhances the achievement of students in mathematics in comparison to traditional methods. Also, the student's ability to understand and reflect improved. It was noted that learning using constructivist methods can assist students to understand, incorporate and clarify concepts in mathematics and improve their interest to partake in constructivist class group.

Amoonga (2008) studied the adoption of constructivism on learning mathematics for knowledge: research on difficulties that hamper effectiveness of teaching math's for knowledge in Omusati secondary schools, South Africa. Eight high schools formed the sample. The random method was employed in selecting the schools. The response on the interviews was by 32 mathematics teachers and an observation was made for two lessons per respondent. Further, 20 mathematic teachers responded to interviews and observations. Analysis was by use of bar graphs, tables and pie charts. Findings showed that majority of the teachers had no enough knowledge in regard to teaching for understanding. Results also showed that in mathematics classrooms there was little observation about teaching for understanding. Some challenges that were identified include, classrooms were overcrowded, unavailability of resources for learning and teaching and absence of support. Teachers in the mathematics discipline require programmes on induction, opportunities for in-service training and advise among other so that to effectively teach mathematics.

Otewa (2015) did a study on teacher constructivism in preparation in Kenya. The paper provided a summary of traditional technique of educator preparation, whereby the teacher is trained so that they can be able to transfer information effectively to the students. Tella *et al* (2010) stated that techniques that are centered on the teacher make the learning experience for the students boring and therefore they miss the advantages of intellectual discovery. The proposition that was provided was some of the Constructivist principles educator preparation processes that needed to be included so as the teachers can encourage students to have a reflection of what they have experienced in the past and integrate the experience with novel information in knowledge construction process. Learning that is centered on the student has been noted by Chika (2012) as being great in improving learning achievements in comparison to the ones that are centered in the

teacher. Incorporating constructivist teacher preparation in the education system of Kenya would reflect the current global curriculum trends whereby different international countries, inclusive of Africa's like Ghana, Nigeria, Namibia, Zimbabwe and South Africa are all trying the system to improve education quality. The above studies focus on effects of elaboration on student achievement in violin training and Biology. The current study aims to fill the research gap through the evaluation of the influence of elaboration on student performance in mathematics.

2.1.5 Evaluation Strategy in Constructivism on Student Performance in Mathematics

In this phase it requires individual students to assess their personal comprehension and capabilities and allow educators evaluate the understanding of learners on key areas and on development of skills. Therefore, learners learn on ways of assessing their abilities, identifying areas that they are experts in and strengthen their development of understanding (Plotnik, & Kouyoumdjian, 2011). It provides the educator with an opportunity of evaluating the performance of the learners regarding integration of new knowledge either by presentation or demonstration. Evaluation has been explained to be a technique that is used in clarifying and understanding the level of knowledge that has been obtained by the learner (Slavin, 2009). The wide definition imply that the technique of assessment can range from simple to complicated, from the observation of the educator on the learner in classroom to whole day standardized tests (Tomlinson, 2014). Knowledge level suggests that whatever a learner understands changes constantly as time passes and the teacher judges what students have achieved (Earl, 2012).

Olina and Sullivan (2013) studied the impacts of class evaluation strategy on achievements of learners and their attitude in Latvian. The focus of the study was investigating the impact of evaluation of educators and combination of self-evaluation of

learners and teacher evaluation on the performance of learners and their attitude. The study sample was 189 students from Latvian high school and 6 teachers. Each teacher was allocated one of the three conditions of treatment: no assessment, teacher assessment, and self-assessment and teacher assessment. The groups went through complete instructional program of 12-lesson on the way experiments are carried out and provided reports from the research. The group of teacher evaluation students got teacher assessment on their study reports initially. Learners that were in the self-plus-teacher assessment group did a self-evaluation of their reports and also got the assessment of their teachers. The group of no-evaluation did not receive a formal instruction on evaluation. Learners in the groups of teacher-assessment and the self-plus-teacher assessment did receive a significant high rating on their final project compare to the ones of no-evaluation group. However, the attitude of the students in the no-evaluation group was more favorable regarding the program compared to the ones in the other groups. In addition, the students in the self-and-teacher assessment group were more significantly confident of their capability to carry out future research.

Chowdhury (2016) investigated the impact of the approach of constructivist mathematics achievements of standard six students. Constructivism is a pedagogy that is emerging among community of teachers all over the world and National curriculum Frame work (NCF 2005) agrees with the direction to it in the situation in Indian classes. The emphasis of Constructivism is on the way students build their knowledge through experience which to every single individual it is unique. The study design was a pre-test post-test quasi experimental that applied the use of qualitative and quantitative methods. 5E's learning approach was used in the experiment group and control group the traditional technique on 60 learners. MAT was employed in the estimation of achievement of students in the groups. Results revealed that constructivist method of learning highly enhances

achievement of students in mathematics in comparison to the use of the traditional methods. The same method was also suitable for girls and boys in enhancing their accomplishments in mathematics. Further, teaching using the constructivist method highly improves students understanding and their ability of application.

Kivuti (2015) studied the impact of formative evaluations on learner performance in mathematics in high schools in Embu County, Kenya. The research made use of descriptive survey research design. The populace comprised 173 Secondary schools while simple random method was employed in sampling 130 respondents composing of 70 students and 60 teachers from five school one from each Sub-County. Questionnaires and tests were used in primary data collection. Quantitative and qualitative information was generated. Descriptive methods were used. The data was displayed using tables and figures while description was done in prose. The study found that Mathematics teachers employ assignments test as a formative evaluation approach to way of measuring students' progress in mathematics performance which form an integral part of education system and that frequent assessment of students' performance has demonstrated to improve student outcomes. The study also found that assessment is a tool of importance for enhancing classroom practices and learner's' performance, and that it can enhance teaching and learning by providing a more focused application for learners.

Ross, Hogaboam-Gray, and Rolheiser (2002) researched on self-evaluation of students in grade 5-6 mathematics effects on achievement of resolving problems. When Grade 5-6 learner's self-assessed for 12 weeks treatment learners outperformed control group (ES = .40). The results indicated that subject moderates the self-evaluation effects on achievement. Students self-evaluation enables them to understand their abilities, determine their area of strength and weakness and make use of their strengthens and abilities data to learn, However, teachers access learning accomplishments of students to

understand the degree of integration of knowledge leading to presentation, demonstration and exploration (Quinn, Amer, Lonie, Blackmore, Thompson & Pettigrove, 2012).

From the empirical studies, the focus of the studies had been on effects of strategies of classroom evaluation on achievements of students and attitudes in Latvian, estimating the impact of instructional practices on achievements of learners in science and the impact of the approach of constructivist on the accomplishment in mathematics of standard six students. The current study aim was to fill the research gap by analyzing the influence of evaluation on student performance in mathematics.

2.2 Theoretical Literature

Learning is a process of acquiring knowledge that is guided and needs appropriate techniques that are aimed to increase retention of knowledge and its application (Laurillard, 2013). Because it is the responsibility of teachers to drive the process of learning, most of the time they embrace techniques that they think they are appropriate. The foundation of the current study is the idea of individual constructivist theory of Piaget (1972) and social constructivist theory of Vygotsky (1978). Through the Individual constructivist theory of Piaget (1967) it provides a two approach that is prolonged to the construction of knowledge.

2.2.1 Constructivism Theory

Kirschner, Sweller and Clark, 2006) notes that this theory basis is on the notion that learning ought to be based on creation of knowledge by a learner. The theory notes that a person constructs their environment knowledge and understanding, through their experience with things and reflection on their experiences (Van Manen, 2015). So, this implies that when students come through some novel information, they make a comparison with prior ideas and practices and afterwards agree or disagree with the novel

evidence and so receive novel knowledge. From the theory, human are seen as active creators of knowledge. To be able to create knowledge, students must be able pose queries, take part in environmental exploration, and also conduct an evaluation on their individual activities for learning (Boud, 2013).

Also significant in the constructivism theory application in learning is that students ought to be motivated to adopt active learning technique like conducting experiments, involvement in discussions and solving problems. These learning methods assist students to have a reflection on their undertaking and so leading to the creation of knowledge. The educator duty is to make sure that they have an understanding on the learners' pre-learning ideas, align activities in the classroom and construct on the idea of learner's as a mode of learning facilitation (Kolb, 2014). Educators in constructivism ought to motivate students to partake in individual evaluation of individual undertaking to facilitate improved understanding. Expectations are that the students who evaluate ideas, techniques they adopt and their work outcomes eventually become expert-learners encouraged to continue learning. A classroom is a better learning environment if planned well with numerous tasks for students to perform however improperly planning; it obstructs the process of learning (Nelson, 2013).

Mertens (2014) indicated that the roots of constructivism are manifold in philosophy and psychology. Numerous scholars have been accredited for constructivism theory development. They include, Bruner, Piaget and Vygotsky, Kuhun, Gibson, Goodman, Dewey and Fouccult (O'Connor, 1998). The focus of Piaget was mathematical and logic concepts development. The theory of reasoning was developed by Piaget on cognitive structures concepts formed by individuals involved in thinking. Piaget explains that individuals use the cognitive structures for thinking. He further describes the structures as methods of mental or physical reasoning linked with particular doings or intellect and

relates to child development stages (Beard, 2013). Due to his researches, Piaget developed four major learning principles; children mostly provide varied explanations of their reality at varied cognitive development stages; the development of learner's cognitive may be facilitated by ensuring the environment for learning is challenging with numerous task for students to partake in and need adaptation (accommodation and assimilation) of learner's acquired novel information; the materials for learning organization should be in a manner that is appropriate with the degree of mental and motor activities for certain age children; learners ought not to provide assignments afar from their cognitive abilities and finally learning ought to involve instruction techniques that present learner's with challenges in their ideas and ensuring they are active (Derry, 1996).

Vygotsky focus was on the children learning language context (Lantolf, Thorne & Poehner, 2015). Vygotsky created themes on the manner social interactions give a vital duty in developing reasoning and devised the learning principle that the level of children reasoning development is limited to certain age range though cognitive development fully may be achieved if learners are given opportunities for interactions socially (Butterworth, 2014). Vygotsky (1980), notes that the meaning of learning and development is similar and they cannot be divided in learners and also described education and socialization process that they assist in encouraging children learning and development. He also noted that culture afford essential cognitive items that change the children's perceptions, attentions and memory. The cultural cognitive tools comprise history, religion, social contexts, language and traditions.

In line with the assumptions learning takes place when students full use the social surrounding by mingling with others which gives them an opportunity to internalize their understandings. It involves previous children notions and novel experience that come due

to their interaction with children in their surroundings that results to development of novel ideas. An example provided by Vygotsky is pointing a finger, describing that an individual pointing a finger explains the manner in which behavior that began as something simple results to more clear movement as other children respond to gestures. Due to the idea inclusion and propagation that culture and social setting have a duty in cognitive procedure, the contribution of Vygotsky in constructivism was eventually stated as social constructivism (Kim, 2001).

As cited by Takaya (2013) Bruner focused on development of children. His contribution to constructivism was about the idea that students create novel concepts or ideas built on the knowledge that they have. Bruner notes that learning is an active procedure comprising the educator's presentation to students and what students get from the process of learning. He also recommended the numerous scopes in the learning process including selection and change of data, coming up with novel decisions in relation to gathered data, novel hypothesis generation from obtained data and making the acquired information meaningful and encountered experiences.

Bruner (1966) theory stresses on the importance of learning categorization. He noted that perception can only be achieved through categorization. So, concluding that to categorize is to make decision (Bruner & Austin, 1986). Other Bruner important concepts are that the interpretation of experiences and data is on the basis of similarities and variations of student's previous understandings (Jonassen & Hernandez-Serrano, 2002). The center of Bruner research was on the learning concept is seen as an active procedure whereby students firm novel concepts and thinking ways by consideration the present and previous understanding (Duffy & Jonassen, 1992). The learner is responsible of selecting and changing novel information and making decision in read to their cognitive structure. As a result, Bruner formed three main principles for learning: the student's previous

knowledge should be taken care of in the instruction and the environment for learning to ensure learner's ability and willingness to learn. The method of instruction should be in a systematic manner for learners to understand easily. The design of instruction should enable the student to fill the gaps in learning through creation of extrapolation room (Sivan, 1986).

This theory is important in this study since it explains the effect of constructivism instructional method on students learning. According to the theory to improve learning, instruction should involve practical activities like conducting experiments, discussions and solving problems. This improves learning since the reflections from the practical learning activities are reflected in the mind at all times.

2.2.2 Production Function Theory

The study adopted the Education Production Function Theory by Schulz (1960). The education production function sourced from economic theory of production and described as all inputs combinations whose outcome is any provided set of school outputs. The common inputs are things like school resources and teacher quality, and the outcome is student achievement. Certain scholars make use of the education production function, whereby the outcomes in education are described by inputs, comprising the resources in school, family upbringings and initial student's ability (Glewwe & Lambert, 2010; Hanushek, 2010; Harris, 2010).

This education production function basis is on the principle that increase in input improves achievement. Moreover, this simple function basis is on unrealistic assumptions on efficient use of inputs (Harris, 2010); so the equation use, Hanushek (2010) established a weak negative relationship. These results means that inputs in education are ineffectively adopted by systems of education.

The production function was used in this study to find out the maximum product from a combination of different inputs as a way of explaining the residual factor in the American rate of economic growth in the 1950s.

Educational production function is defined as follows:

Where;

A = f(X1 … Xn)

A … Output

17

X1 … Xn …… Input

In this case the dependent variable being "A" the output and independent variables being X1, X2, X3 and X4. The output, A, students' performance in mathematics is a function of X1, X2, X3 and X4, which are qualification of teachers', resource material, perception of students' and students' background in mathematics are the inputs that influence the output, students' performance.

This theory was used in the study to explain how the use of constructivism instructional approaches that is engagement, exploration, explanation, elaboration and evaluation influence students achievement in mathematics.

2.2.3 Bruner's Theory on Constructivism

This theory of on constructivism entails the concept of learning as a process that is active whereby the individuals learning have the ability of forming new ideas based on the knowledge they currently possess and also on their past knowledge. A structure that is cognitive is explained to be the mental process that provides the student with the ability of organizing experiences and deriving meaning out of them. Through these structures, the student is allowed to push beyond the information that is provided in developing their new concept. The students, most of the time a child, takes part of their past knowledge

and experience and organize them in a sensible way, then basing further ideas and solving additional issues depending on a combination what is already possessed and what they are thinking needs to be processed next (Bruner, 1966)

The resource that is used by a teacher should focus on encouragement, aiding and allowing the learner to uncover key principles without anyone help. The key concept is communication between the teacher and the learner. The technique that is suggested to be best in communication is the one of Socratic learning, because it gives the educator the opportunity to actively note any study skill that is verbalized by the student, how they have progressed, their frustrations, and form a rubric the current state of their learning depending on the dialogue. This theory uses the already known information and expounds it, plans of teachers on lessons, educators worksheet, or resources need to be building the knowledge of the learner constantly ad in a spiral manner (Bruner, 1973).

The 4 key principles in this theory are: a predilection toward learning; the way grouping of knowledge has the ability of being constructed in a way that the student can easily understand it; effective way in which the educator can present a particular material to the students and final aspect is progression of rewards and also punishments (Bruner, 1983). Concerning language, Bruner is a poignant and the way it affects cognition in this theory regarding learning as well as development. For any child to triumph, this is important because it helps the child to identify between the languages that adult's use and the one that is used by children. A child being young requires time to advance their conceptual learning and also their language. Therefore, parents and educators are motivated to envelop the "scaffolding" technique while communicating which is a strategy that aims to simplify tasks in learning through making small steps, and all leading to the same result. This assists in maintain frustrations and keep the mind focused on what is important in the entire process of learning (Bruner, 1990).

When making an evaluation of the skills of a child, the theory of Bruner suggest that the educator should be explicit in regard to the organization, assist the student to be focused on larger task at hand and also the objective and not get caught in between minor details. It is recommended that they should praise the effort that the students put while reminding them, assist them to remain focused on items that are relevant, and encourage them to practice and rehearse what they have learned. Social and also cultural contingencies of learning were embraced into Bruner's later work, theorizing the way they impacted the process of learning (Bruner, 1996).

This theory is important in the study since it suggests that active learning improves student creativity. Therefore, using activities learning an instruction approach can help in improving student's ideas on the subject hence achievement in mathematics.

2.3 Theoretical Framework

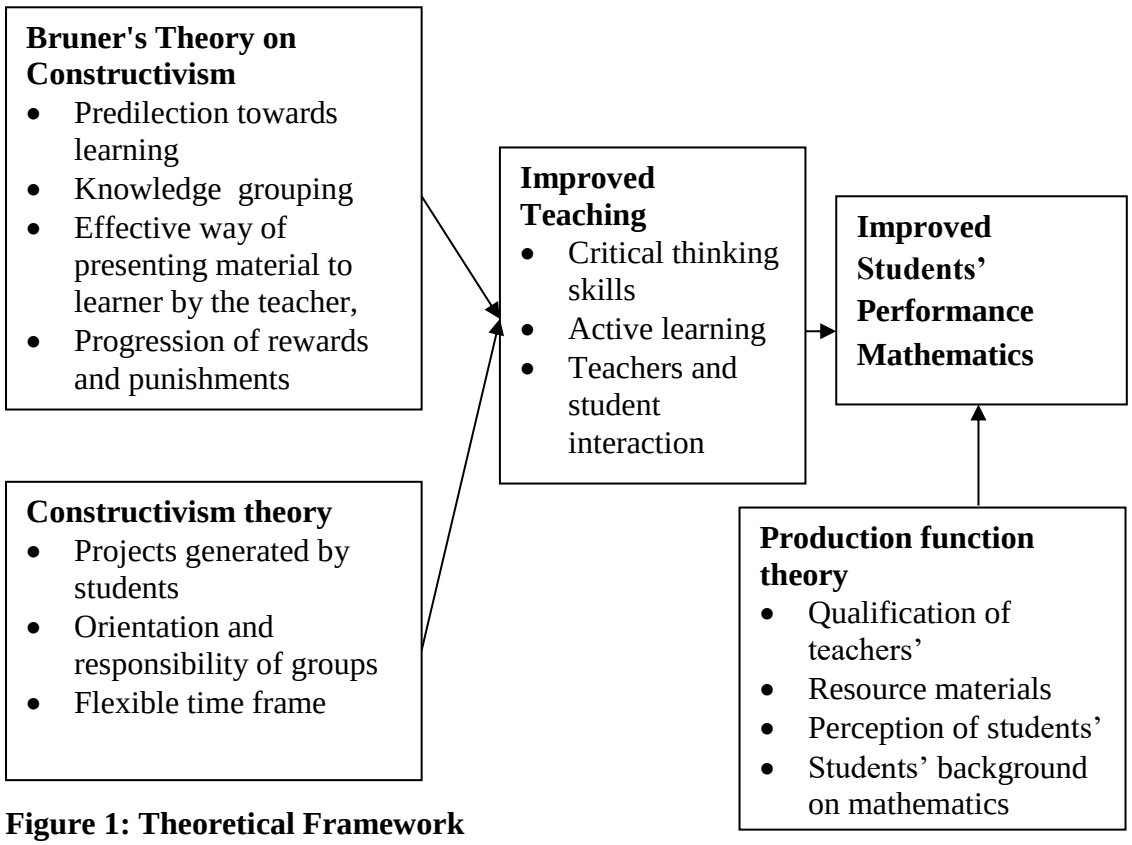

Figure 1: Theoretical Framework
Source: Bruner (1966)

The Constructivist learning theory was the basis of this study developed by Bruner (1990) and Piaget (1972). The Constructivist learning is developed on the basis that the learning procedure is achieved when students are directly involved in knowledge construction process and meaning differently from acquiring passive information. The theory recommends that learners make their own understanding and sense. The significance of constructivism in instruction is its importance in enhancing thinking and assists in developing learners who are motivated and autonomous. From the framework, learning development is from the ideas learners have and the previously acquired ideas are described as schema. Because the learning procedure is clarified by knowledge that is already available, the recommendation given by constructivists is that learning procedure is highly effective when students are involved actively in learning and not acquisition of passive knowledge. Several methods claim to be based on constructivist learning theory. Figure two shows an effective process of learning described in constructivist learning theory. The theory shows that construction of knowledge is built on schema. Children are not like blank slate and so knowledge may not be conveyed to them with no sense made from it on the basis of their conception currently. This means that children can best learn when given a chance to develop their own understanding dependent on experience and experience reflections. The main goal of using constructivist in education is that it assists the student to learn by training on the manner to take initiatives for individual learning procedures.

2.4 Conceptual Framework

The conceptualization approach of this study the 5Es constructivist teaching approach as the key independent variable and the achievements of the learners in mathematics is the dependent variable. Figure 1 shows the conceptual Framework.

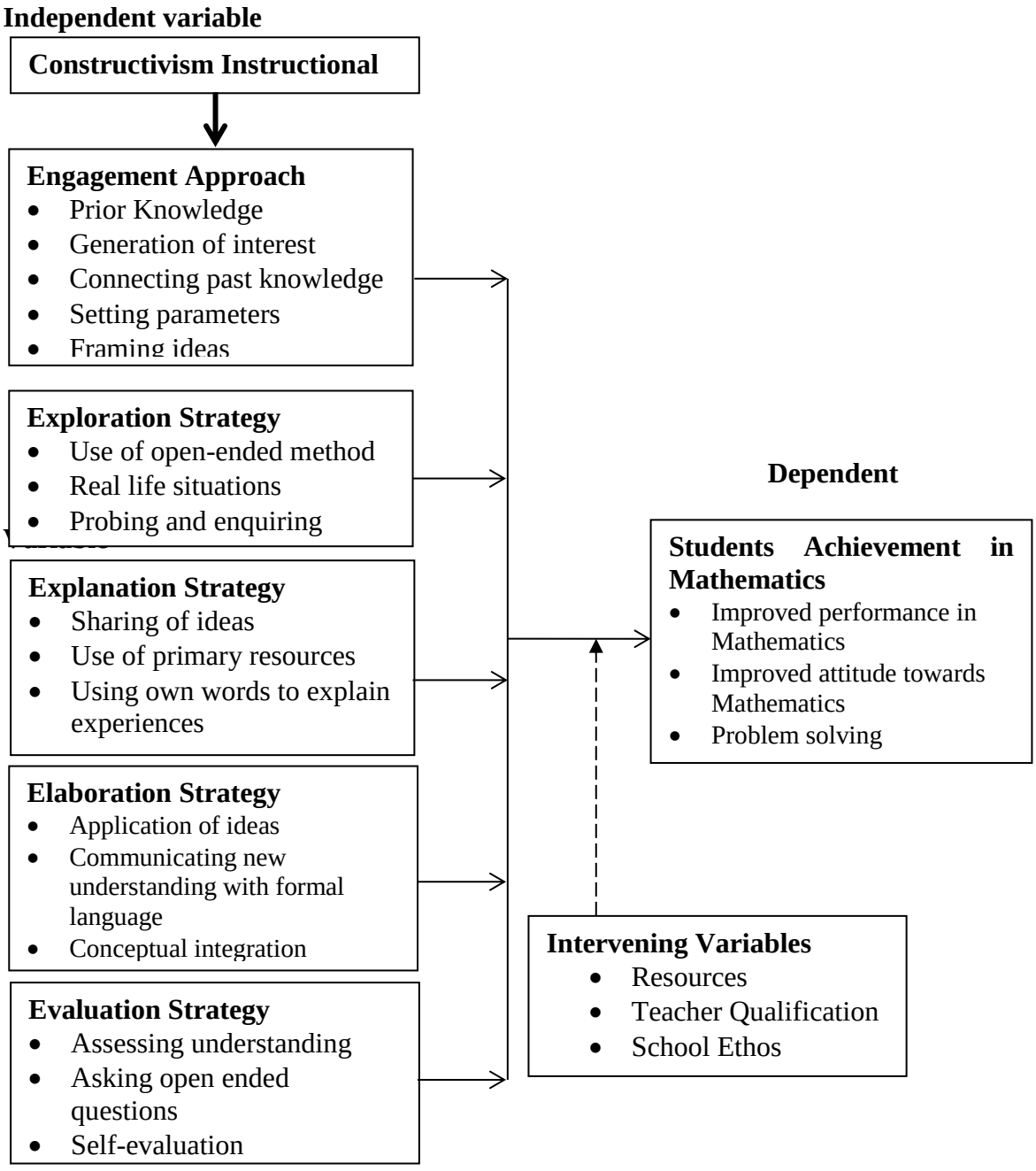

Figure 2: Conceptual Framework Adapted from Theoretical Review
Source: Researcher (2018)

The conceptual framework shows that constructivism has five techniques. They comprise engagement method needed through previous knowledge, interest generation, former knowledge connection, parameters setting and ideas setting. Exploration approach could be accomplished using the open-ended technique, accepting situations in real life and searching and questioning. Explanation approach may be attained by idea sharing, primary resources usage and the use of own words by instructors to describe experiences. Elaboration method could be achieved by idea application, communication of novel knowledge with official language and abstract incorporation. Evaluation approach could be accomplished by examining learners' understanding, posing open-ended queries and self-evaluations. Using constructivism instructions enhanced mathematics performance, enhanced attitude in mathematics and solving problems. Moreover, to make sure learners achievement in Mathematics, schools need to make sure that they give the required resources, hire qualified educators and developing school ethos.

2.5 Research Gaps

Kibos, Wachanga and Changeiywo (2015) did a research study on the impacts of the approach of constructivist in teaching on achievements of students in secondary schools in Chemistry in Baringo North Sub-County, Kenya. The study aimed to determine the effects of CTA on the performance of learners in Chemistry. The research design that was adopted was the Quasi-experimental design. The study targeted high schools that were located in Baringo North. The findings if the study revealed that CTA led to high achievements of students in Chemistry.

Mwanda, Odundo, Midigo, and Mwanda (2016) did an investigation on the constructivist learning technique adoption in Kenyan secondary schools the main focus being student achievement in biology. The focus of the study was linking instructional techniques and learning achievement in various categories in class. The design of the study was quasi-

experimental. Data was collected from 4 boys and 4 girls in 4 mixed schools with 477 students. Analysis of data was by use of descriptive statistics like mean and std. Dev. while analysis of variance and t-test were applied in testing the significance in mean differences between groups. The findings revealed that achievements of students in the control group were based by poor means in comparison to experimental groups, which implies that the approach of constructivist instructional positively influences the achievements of students. While comparing the mean gain; girls enhanced. This suggests that student' achievements in girls' classes improve with the use of constructivist instruction technique. The students who were taught using the constructivist approach showed some level of improvement in their achievement.

Mwanda, Odundo and Midigo (2017) investigated the constructivist teaching approach adoption in learning of biology in Kenyan secondary schools; while focusing on the attitude of the learner. The study focus was on the attitude of the learner towards the teaching approach of constructivist. Study design adopted for the study was cross-sectional survey. The results indicated that the attitude of the learner's was positive towards the teaching approach of constructivist.

Origa (2000) did an investigation on the effects of constructivism in learning geography in Kenyan secondary schools. This was an investigation on constructivism effects in three dimensional geometry learning in girls' schools in Kenya. The study used the behaviorist and constructivist methods to test the teaching experiment, the adopted concepts are greater in facilitating geometry concepts acquisition. The study participants were students in form three from 62 secondary high schools. Students using constructivist method achieved higher scores and were better ranked in comparison with those that adopted the behaviorist method in spite of the used instruction materials.

Ongowo (2013) studied the perception biology teachers of secondary school regarding constructivist learning environment in Gem Sub-County, Kenya. The focus of the study was investigating the perception of educators of actual and preferred environment of learning of constructivist biology. The research design that was adopted was survey design. The study used 41 biology teachers as a sample from Gem Sub-County, Kenya and applied the use of 20-item TPQ a modification of CLES, but the version of educators. The findings revealed that the scores of the teachers on the preferred scale (Personal relevance, uncertainty and student negotiation) had significant differences from the real form. Also, the scores for the educators for scale on critical voice and scales on shared control of real and preferred ways of TPQ weren't significant.

Chowdhury (2016) investigated the impact of the approach of constructivist mathematics achievements of standard six students. Constructivism is a pedagogy that is emerging among community of teachers all over the world and National curriculum Frame work (NCF 2005) agrees with the direction to it in the situation in Indian classes. The emphasis of Constructivism is on the way students build their knowledge through experience which to every single individual it is unique. The study design was a pre-test post-test quasi experimental that applied the use of qualitative and quantitative methods. 5E's learning approach was used in the experiment group and control group the traditional technique on 60 learners. MAT was employed in the estimation of achievement of students in the groups. Results revealed that constructivist method of learning highly enhances achievement of students in mathematics in comparison to the use of the traditional methods. The same method was also suitable for girls and boys in enhancing their accomplishments in mathematics. Further, teaching using the constructivist method highly improves students understanding and their ability of application.

Most of the studies conducted focused on constructivist teaching method on students' achievements in biology and chemistry. The current study sought to fill the research gap by investigation the constructivism instructional method influence on learner's in achievement of mathematics in secondary schools in Mandera central sub county Kenya.

2.6 Summary of Literature Reviewed

This chapter has reviewed other studies related to constructivism approach in education. The theories of the study which include individual constructivist theory of Piaget (1991) social constructivist theory of Vygotsky (1978) and Moos theory of educational environments and the research gap which has arose from the empirical literature.

CHAPTER THREE

RESEARCH METHODOLOGY AND DESIGN

3.0 Introduction

In this chapter, the methodology that was applied in exploring the research objective was discussed. The chapter specifically covered the research methodology, the design used in the study, location of the study, targeted population, procedures of sampling, sample size, instruments used in the research, pilot test, procedures of gathering data, and analyzing them and finally ethical considerations.

3.1 Research Methodology

The design used in the study was the experimental method. The design is about examining the impact of predictor variable on the response variable, where there is manipulation of the predictor variable by treatment or intermediation and the impact of the intervention is perceived on the response variables (Kothari, 2014).

3.2 Research Design

In experimental research design, the researcher manipulates the predictor variable, and controls others variables that are potentially influential. Empirical observation from experiments affords the strongest foundations for making conclusions on casual links. Whenever this design is adopted, the study aimed at finding out the cause and effect. The predictor variable is the casual variable and the dependent variable is the outcome or effect. The major research method that can help in testing hypotheses about cause and effect associations is the experimental approach. It is the most suitable method to education difficulties solutions, practically and theoretically and the improvement of science education.

3.3 Location of the study

The study was carried in Mandera Central Sub-County in Kenya. The county location is Kenya's and the County had five sub-counties, Mandera central sub-county is among them. According to the 2009 census, there are roughly 17,162 households and the population is estimated to be 275, 8041. The region covers an area of 6148 Km. The predominant ethnic group in the region is the Garre (who speak Borana) clan, they are nomads and their settlement is influenced by pasture and water. Some areas of the region are covered with some low lying hills that start with Wargadud and stretch to Gari hills which is located on the northern side of the Sub-County. The other low lying plains are 400m above sea level. Their main activity is pastoralism and agro-pastoralist and because of their livelihood of being nomads, their access to education is limited. The bordering regions are Ethiopia to the North, Mandera East to the North East and Eastern side, Somalia to South East, Wajir East Sub-County to the South, and Mandera West Sub-County to the West.

The study sought focus was on secondary schools in Mandera central sub-county. The sub-county has 9 secondary schools. They include El –Hacho mixed secondary school, Rhama mixed secondary school, Chief Mohamed Jari secondary school, Elwak Girls Secondary School, Rhamu Girls secondary school, Takaba Girls' Secondary School, Ashabito boy's secondary school, Sheikh Ali High school, and Elwak secondary school. Mandera central sub-county was chosen for the study because: 1) there is very little classroom research especially concerning the issue of problem-solving in mathematics conducted in the region. 2) Their performance in mathematics has been poor since they recorded a mean grade of D (plain) in the past three years KNEC (2009). 3) The nature of the research study that was conducted regarding live classroom teaching was characterized by long visits with limited time and finance, therefore the researcher found

it appropriate to research in the region. The issue that is currently alarming that faces mathematics teaching and learning is the need to better the performance of learners in mathematics. The dominating instruction mode is the conventional (didactic) method; therefore there is a need for employing problem-solving and other methods that are centered on the learner.

3.4 Target Population

Ngechu (2004) indicated that population refers to a distinct and definite set of services people, events, elements, or groups of items or households under an investigation that is based on research. The population targeted was each student and teacher in secondary schools selected in Mandera Central Sub-County. From the education office in the Sub-county, the number of schools there are 9, 3 for boys, 3 for girls and 3 mixed. So, the targeted population was 2573 encompassing 120 teachers and 2453 students.

Table 3: Target Population

Category	f	No. of Students	No. of teachers
Boys' Schools	3	726	30
Girls' School	3	779	28
Mixed Schools	3	948	62
Total	**9**	**2453**	**120**

Source: Mandera Central Sub-County Education Office (2018)

3.5 Sampling procedures and sample Size

The study was done in secondary schools selected from the sub-county. Random sampling approaches were used to choose the students since their number was big. Random sampling assisted in student's selection in the schools. The group chosen represented the whole population and probability sampling was carried out. The sampling method was predicted to produce the required outcomes. By use of random sampling, students were grouped as required in explaining on their participation in classroom

attendance and overall performance. The study participants were 222 encompassing 15 teachers and 207 students.

Table 4: Sampling Grid

Category		f	No. of Students	No. of teachers
Boys' Schools	E	1	36	3
	C	1	28	2
Girls' School	E	1	40	2
	C	1	32	4
Mixed Schools	E	1	41	2
	C	1	30	2
Total		**6**	**207**	**15**

Key: E – Experiment group **C –** Control group

Source: Researcher (2018)

3.6 Research Instruments

The study used questionnaires to collect data. The study also used pre-test and post-test achievement tests. Pre-/post-tests were used to evaluate learner's outcomes of constructivism instructions. This process provided feedback to the educator by measuring the level of the initial knowledge of the student and the kind of knowledge the student acquired from the constructivism instructions method.

3.6.1 Mathematics Pre-test Achievement Test

The study made use of pre-test achievement test to obtain information. The Pretest–posttest design involved obtaining a pretest result measure interested prior the treatments administrations, then the posttest followed on a similar measure after the treatment occurrence. The pretest was used in the study to determine if the student groups where the application took place are equal or not.

3.6.2 Mathematics Post-Test Achievement Test

The post-test assessments were also used in collection of data. Similar respondents were measured on the study variables at different particular times. Posttest was adopted so that to show the effectiveness of the techniques adopted in pretests.

3.6.3 Questionnaires for Teachers of Mathematics

Questionnaires were used to get data from the teachers. The questionnaire had 6-sections. In the first section, demographic information was addressed; the sections 2,3,4,5 and 6 addressed all the dependent variable for this research. Here, the researcher sought to establish the associations that are there between the dependent and independent variable though the various questions in the questionnaire.

3.7 Piloting

Before conducting an actual study, a pilot test is a technique that is used to test design, technique or research instrument. The process involves carrying out an initial test of collecting data and the process with the aim of establishing and correcting the errors. The aim of conducting a pilot test is to establish how accurate and appropriate the research design and the instruments are (Saunders, Lewis & Thornhill, 2009). Cooper and Schindler (2008) indicated that pilot test aims to detest weakness in research design and its implementation and provide proxy in collection of data for probability sample. Sekaran (2008) asserts that pilot test is important in order to test for instrument's reliability and validity before conducting the actual research study. The researcher sought to make research questionnaire consistent, clear and understandable by all. Piloting was done so that to determine the validity and reliability of the research tool in collection of data needed in the research. Questionnaire was used in data collection; hence it was tested to ensure that it was effective and relevant. Eight questionnaires were piloted to a sample population that was not part of the real study.

3.8 Testing for Validity and Reliability

This section reviewed the techniques that were applied in testing for validity and reliability

3.8.1 Validity of Research Instruments

Validity is the level to which the research tool provides measures for the item that is being investigated (Mugenda & Mugenda, 2003). The study used content validity because it provides the measures of the level to which the sampled items represent content that the test has been designed to measure. Questionnaires that were designed were in line with the research questions. The validity of the instrument was ascertained with mathematics experts from Educational Psychology and Technology department, School of Education, MKU. The discussion with the panel of experts enabled the researcher to identify those questions that needed some editing and the ones that were ambiguous. Finally, the questionnaire was printed and distributed to the field for data collection. Data was collected by the researcher with the help of research assistants.

3.8.2 Reliability of Research Instruments

The study ascertained reliability by pre-testing the questionnaire using a small sample from the secondary schools in Mandera. The researcher used the pre-test results to evaluate how compatible and consistent the instrument was with the requirements of the study, and those areas that were determined to need improvements were edited to attain a reliable instrument (Nunnally, 2008). Reliability involved the pretest for questionnaires KRO for pre and post-test and attitude questionnaires. The participants that were selected to take part in the pre-test were drawn from a different school but one that had similar characteristics with the ones that were selected for the actual study, and the sample used in the pilot test were different from the actual participants this was to make sure that the actual participants did not take part in the pilot study because it can interfere with the outcome of the findings of the study. Cronbach alpha adopted to assess the reliability of the research tool. A reliability of more than 0.6 means more reliable while a correlation of point 0.7 and above means a strong correlation

3.9 Data Collection Procedures

Prior the researcher goes to collect date from the field, a particular procedure was done. First, the researcher requested the Mandera central sub-county director of education for permission to obtain data from schools that were being investigated. On a written acceptance of the request of the researcher visiting the schools, principals introduced themselves and were given a go ahead by the principal to obtain data from students. The questionnaires and pretest/posttest assessments were used in collected the needed data. This technique was suitable since it offers qualitative and quantitative data requirement. It also helps in achieving a high response rate giving information which can be easily organized, tabulated and statistically analyzed, which is the study main goals. Trained and experienced instructors and mathematics expert instructors administered structured questionnaires.

3.10 Data Analysis Procedures

The scores obtained from tests were analyzed using SPSS-24. To test samples unrelated a t-test was used in measurement of the scores against one another by use of ANOVA and ANCOVA. Due to the t-test superior power in noticing differences in two means, it was used in analysis of the means. ANOVA was employed in analyzing the difference in the scores of post-test means of the four groups. It helped in findings out whether there is a significant difference or not. To establish whether the control and initial groups had initial difference the ANCOVA was employed. The error on experiments is statistically reduced and by use of experimental processes (Borg & Gall, 1989; Coolican, 1994).

The descriptive statistics were used in the analysis of quantitative data obtained and presented using percentage, mean, standard deviation and frequency. Bars, graphs and charts were used to display the findings. To accomplish this, tallying was done on the responses, computation of percentages of difference responses, description and data

interpretation was carried out on the basis of the study objectives and assumptions. Study results communication was by use of SPSS (Version 24).

3.11 Ethical Considerations

Throughout the research process, code of conduct was observed. It included granting the respondents confidentiality, anonymity and free content of joining and withdrawing from the study. In order to protect the respondents, their real names were not used when reporting. The study sought the consent of the respondents. The study avoided plagiarism by acknowledging work done by authors on the topic that was being investigated (Sanjari, 2014).

Material that was cited was cited following the citation procedures of Mount Kenya University. Tylor and Bogdan (2008) indicated that it is important for the researcher to guarantee privacy as well as confidentiality of the respondents. The researcher was informed on the ethical concerns that have been enshrined in the constitution of Kenya and thus the researcher applied them in convincing the respondents to provide information. The procedures that were followed are outlined below.

The study sought permission to conduct the study from NACOSTI, County Commissioner, County Director of Education in Kenya. Bodgan and Bilken (2013) indicated that indicated that asking for permission to carry out a study involves more than just getting official go ahead but includes also laying ground work with the participants that the researcher was interacting with.

The researcher allowed the participants to voluntarily provide information without coercing them. Before the respondents participated in the study, they signed consent form. The respondents were guaranteed by the researcher that the data they provide was treated as classified information. This motivated the respondents to provide information that was legit and consistent. To ensure this, the names of the respondents were not included in the

research tool apart from a code that was only seen by the analyst. Taylor and Bogdan (2008) suggested that analysts should make sure that the members are classified and protected.

The respondents were asked to provide information without indicated their names on the research instrument. Codes were used by the researcher in identifying the respondents. There is no single information regarding the respondents that was revealed in written or in any other form of communication. This assisted the researcher to avoid participants who would provide biased responses.

During the entire procedure of examination, the researcher maintained a charming look and satisfactory quirks. The specialist maintained extreme respect, attributes in line with the traditions of the society enabling him to fit the principles not a surprise in research (Orodho, 2009)

The data that were obtained from the field was stored for future reference. Analyzed data was filed as hard copies and also stored in flash disks and VDs in soft copies.

CHAPTER FOUR

RESEARCH FINDINGS AND DISCUSSION

4.0 Introduction

This chapter discusses the analysis of data, interpretation, presentation, and discussed the findings of the data obtained from the field. The chapter also covers the background information of the respondents, findings of the analysis in line with the objectives of the study. The findings of the study were discussed using inferential and descriptive statistics.

4.1 Response Rate

The study sample was 15 respondents from where 14 questionnaires were filled which translated to a 93% rate of response. A response rate of 50% is adequate; 60% is good and above 70% is excellent (Mugenda & Mugenda, 2008). So, the rate of response in this case is appropriate for analysis.

4.2 Demographic Characteristics

In this section the demographics of the respondents have been discussed.

4.2.1 Distribution of the Teachers Demographic Characteristics

The study sought to determine the gender, age and period of service of the respondents. The findings are presented in Table 5

Table 5: Distribution of the Teachers by Gender, Age and Period of Service

Gender	**f**	**%**
Male	10	71
Female	4	29
Total	14	100
Age	**f**	**%**
19-29 years	2	14%
30-39 years	7	50%
Above 40 years	5	40%
Total	14	100%
Period	**f**	**%**
Less than 2 years	2	14%
3 to 5 years	4	29%
6 to 10 years	5	36%
Above 10 years	3	21%
Total	14	100%

Source: Mandera Central Sub – County Education Office (2018)

From the results in table 4, most of the teachers were male as shown by 71% while the female teachers were represented by 29%. This is an indication that majority of teachers in Mandera Central Sub County are male. However, both gender participated in the study. Table 4 shows that 50% of the respondents were aged between 19-29 years, 36% were above 40 years, and 14%were aged between 19-29 years. This implies that the teachers employed are of different ages.

Table 4 shows that 36% of the respondents had worked in the institution for between 6 to 10 years, 29% for a between 3 to 5 years, 21% for above 10 years, and 14% for less than 2 years. This suggested that the respondents had worked in the firm long enough to provide the information needed for the study.

4.3 Research of Findings

This section is a presentation of the descriptive information of the study in line with the study objectives.

4.3.1 Influence of Engagement Approach on Students' Achievement in Mathematics

The first study objective was to find out engagement strategy influence on students' achievement in mathematics.

Table 6: Influence of Engagement on Students' Achievement in Mathematics

Statements		SD	D	M	A	SA	Mean	SD
1. Students with prior knowledge are more likely to perform well on standardized tests	f	0	1	1	8	4	4.1	1.0
	%	0	7	7	57	29		
2. Through generation of interest, the excitement of students about attending class and participating as well as how frequently they apply what they have learnt in class in their daily lives can be measured.	f	1	1	2	6	4	3.8	0.8
	%	7	7	14	43	29		
3. There is a close relationship between setting parameters, motivation and satisfaction	f	0	0	2	5	7	4.4	1.0
	%	0	0	14	36	50		
4. The perception of learners regarding their general emotional state is class can be measured by connecting past knowledge	f	1	2	2	6	3	3.6	0.7
	%	7	14	14	43	21		
5. The strengths and growth areas in various interest of learners in different subjects is determined by framing ideas	f	0	0	3	7	3	4.0	0.95
	%	0	0	21	57	21		

Source: researcher (2018)

Table 6 indicates that most of the respondents (7, 50%) agreed that there is a close relationship between setting parameters, motivation and satisfaction (Mean= 4.4 SD=1.0) and there is a high likelihood that students with prior knowledge performed well on standardized tests (8, 57%; Mean= 4.1 SD=1.0). In addition, majority of the respondents (7, 50%) agreed that strengths and growth areas in various interest of learners in different

subjects is determined by framing ideas (Mean=4.0, SD= 0.95). Through generation of interest, the excitement of students about attending class and participating as well as how frequently they apply what they have learnt in class in their daily lives can be measured (Mean=3.8 SD= 0.8). Further, the perception of learners regarding their general emotional state is class can be measured by framing (Mean 3.6 SD= 0.7). This implies that engagement strategy facilitates achievements of students in mathematics. These concur with those of Mauro (2014) who stated that educators who make lessons fun and allowed learners to be enthusiastic and energetic increases the likelihood of engaging them in class.

4.3.2 Influence of Exploration Strategy on Students' Achievement in Mathematics

The second study objective was to assess exploration strategy influence on learners' achievement in mathematics. Results as shown in Table 7

Table 7: Influence of Exploration on Students' Achievement in Mathematics

Statements		SD	D	M	A	SA	Mean	SD
1. Use of open-ended method gives learners the opportunity to work with material resources in numerous ways comprising materials manipulation to assist then have a real world experience.	f	1	1	2	5	5	3.9	0.8
	%	7	7	14	36	36		
2. Real life situations allow students to face the real world.	f	1	1	1	5	6	4.0	0.94
	%	7	7	7	36	43		
3. Probing and enquiring facilitates the use of numerous equipment and tools, thus, students get highly interested in the study topic and improve learning	f	0	1	3	6	4	3.9	0.8
	%	0	7	21	43	29		
4. Use of open-ended method enables learners to effectively incorporate their individual experiences with accustomed material resources	f	0	2	2	7	3	3.8	0.8
	%	0	14	14	50	21		
5. Real life situations give students chances to form a large comprehension in learning since they can observe and imitate what is done by others	f	1	1	1	7	4	3.9	0.9
	%	7	7	7	50	29		

Source: Researcher (2018)

From Table 7, most of the respondents (6, 43%) agreed that real life situations allow students to face the real world (Mean= 4.0 SD= 0.94); majority (7,50%) stated that real life situations give students chances to form a large comprehension in learning since they can observe and imitate what is done by others and match resemblances and variances in their context understanding of the work of others (Mean= 3.9 SD= 0.9). In addition, majority (7, 50%) indicated that use of open ended method gives learners the opportunity to use material resources in numerous means comprising materials manipulation to assist then have a real world experience (Mean=3.9 SD=0.8); probing and enquiring facilitates the use of numerous equipment and tools, thus, students get highly interested in the study topic and improve learning (Mean=3.9 SD= 0.8) and use of open ended method enables learners to effectively incorporate their individual experiences with accustomed material resources (Mean=3.8 SD=0.8). This means that exploration approach influences students'

achievement in mathematics. The results relate to those of Fink (2013) who asserts that with the aim of comprehending an idea better, teachers are encouraged to involve learners in learning solutions that are well integrated in their real life and in materials that are familiar. For instant a learner who is passionate in hunting birds can be provided with an opportunity of exploring the concept in population estimation technique and more specifically to capture organisms with the aim of estimating their population.

4.3.3 Influence of Explanation Strategy on Students' Achievement in Mathematics

The third study objective was to find out the explanation influence on students' achievement in mathematics. Table 8 shows the findings

Table 8: Influence of Explanation on Students' Achievement in Mathematics

Statements		SD	D	M	A	SA	Mean	SD
1. Sharing of ideas describes relevant occurrences, build learner's logical reasoning and guide them over inductive judgment	f	1	1	1	7	2	3.7	1.1
	%	7	7	7	64	14		
2. Use of primary resources leads to clarifying interrelations, demonstrating and justifying	f	1	2	2	7	2	3.5	0.78
	%	7	14	14	50	14		
3. The use of own wording in explaining experiences improves communication and reasoning	f	0	1	3	7	3	3.9	0.8
	%	0	7	21	50	21		
4. Using own words to explain derives meaning of a tool much clearly	f	0	0	3	8	3	4.0	0.95
	%	0	0	21	57	21		

Source: Researcher (2018)

From Table 8 majority of the respondents (8, 57%) agreed that using own words to explain derives meaning of a tool much clearly (Mean=4.0 SD= 0.95); majority (7,50%) stated that using own words to explain improves communication and reasoning (Mean=3.9 SD= 0.8); while also majority (7, 64%) indicated that sharing of ideas helps to describe appropriate occurrence, develop the learner's logical thinking and guides them over inductive judgment (Mean= 3.7 SD= 1.1). Further, use of primary sources leads to clarifications on interrelation, demonstration and justifications (Mean=3.5 SD=0.78).

This this explanation phase, students get the opportunity to develop abilities and behavior that help them to become effective learners. It means that description enhances the achievement of students in mathematics. Results agree with Boud (2012) that students also need proficiencies that help in novel views development and improving their understanding of the real world. This could be attained through explanation.

4.3.4 Influence of Elaboration Strategy on Students' Achievement in Mathematics

The fourth study objective was to find out the elaboration strategy influence on learners' achievement in mathematics. Table 9 shows the results.

Table 9: Influence of Elaboration on Students' Achievement in Mathematics

Statements		SD	D	M	A	SA	Mean	SD
1. Application of ideas assist learners to comprehend new information and show how its associated with their previously acquired information	f	0	1	2	10	1	3.8	1.2
	%	0	7	14	71	7		
2. Organization of mathematics content through application of ideas makes it compatible with knowledge arrangement in learner's mind, which leads to development of accomplishments in academics and critical reasoning.	f	1	1	1	6	5	3.9	0.9
	%	7	7	7	43	36		
3. Through communication of new understanding with formal language, students are given familiar analogies with lesson content which makes the process of learning easy and less errors in knowledge understanding	f	0	0	5	5	4	3.9	0.7
	%	0	0	36	36	29		
4. Communicating new understanding with formal language help to relate information helping students to understand the link between information and critical reasoning such as: interpretation, classification, discrimination, deduction and conclusions.	f	0	2	2	6	4	3.9	0.8
	%	0	14	14	43	29		
5. Learners are encouraged through conceptual integration to be the center duty in generation of novel material course with structure of the already present knowledge.	f	1	2	1	7	3	3.6	0.8
	%	7	14	7	50	21		

Source: Researcher (2018)

Table 9 shows most of respondents (6, 43%) agreed that arrangement of mathematics information through application of ideas ensures its compatibility with knowledge arrangement in learner's mind, leading to development of accomplishments in academics and critical reasoning (Mean= 3.9 SD= 0.9); Most of the respondents (6, 43%) stated that through communication of new understanding with formal language, students are given familiar analogies with lesson content which makes the process of learning easy and less errors in knowledge understanding (Mean=3.9 SD= 0.8); communicating new

understanding with formal language help to relate information helping learners to know the link between data and critical reasoning including: interpretation, classification, discrimination, deduction and conclusions (Mean= 3.9 SD= 0.8); application of ideas assist learners to comprehend new information and show how its associated with their previously acquired information (Mean= 3.9 SD= 0.7); learners are encouraged through conceptual integration to be the center duty in generation of novel material course with structure of the already present knowledge (Mean=3.6 SD=0.8)

This implies that elaboration method influences the accomplishment in mathematics. The results agree with Baybee *et al.* (2006) that students need to be able to make use of abstract and abilities in novel but similar circumstances and usage of formal label and descriptions. The instructor is required to prompt learners of other descriptions and contemplate available data and evidence when examining novel situations.

4.3.5 Influence of Evaluation Strategy on Students' Achievement in Mathematics

The fifth study objective was to evaluate evaluation strategy influence on learners' achievement in mathematics. As shown in Table 10

Table 10: Influence of Evaluation on Students' Achievement in Mathematics

Statements		SD	D	M	A	SA	Mean	SD
1. Assessing understanding guide's, directs and monitor's students' learning and progress towards attainment of course objectives	f	1	1	4	6	2	3.5	0.7
	%	7	7	29	43	14		
2. Through assessment of understanding, learners get the opportunity to examine their progress and analyze what their strength and shortcomings are	f	1	1	2	9	1	3.6	1.0
	%	7	7	14	64	7		
3. Assessment of understanding provides accurate information of learners' outcomes which educators may use to make vital decisions in regard to the learners	f	0	1	3	8	2	3.8	0.9
	%	0	7	21	57	14		
4. Students are more likely to remember what they have learned when they explore the implications of their learning through self-evaluation	f	1	2	1	6	4	3.7	0.8
	%	7	14	7	43	29		
5. Asking open ended questions helps teachers and students to reflect on methods of learning and make suitable changes when needed	f	1	2	2	7	2	3.5	0.8
	%	7	14	14	50	14		

Source: Researcher (2018)

From Table 10, majority of the respondents (8,57%) agreed that assessment of understanding provides precise data of learners' outcomes which educators may use to come up with vital decisions in regard to the learners (Mean= 3.8 SD=0.9). In addition, most of them (6,43%) agreed that there is a high likelihood that learners will remember what they are taught when they try to find out their learning implications through self-evaluation(Mean=3.7 SD= 0.8); majority (9, 64%) agreed that through assessment of understanding, learners get the opportunity to examine their progress and analyze what their strength and shortcomings are (Mean= 3.6 SD= 1.0); Most (6, 43%) agreed that assessment of understanding guide's, directs and monitor's students' learning and progress towards attainment of course objectives (Mean=3.5 SD= 0.8) and asking open ended questions helps educators and learners to check on their method of learning and suggest suitable changes (Mean=3.5 SD=0.7).

This indicates that evaluation approach betters the achievement in mathematics. The results concur with those of Quinn, Amer, Lonie, Blackmore, Thompson & Pettigrove, (2012) who noted that student's self-evaluation assists them to experience their abilities, determine their strength and weakness and make use of data about their learning strength and capabilities. However, teachers access the learner's attainment to see the degree of integration of knowledge leading from presentation, demonstration and exploration.

4.4 Pre- test and Post-test

With the goal of determining the constructivist method effect, data was analyzed putting in consideration the overall learners achievement score on mathematics achievement test (MAT). The post MAT score was undertaken to assist in analyzing the varied students' Mathematics performance.

Table 11: Pre-test result on MAT Scores

Test	Groups	Mean	SD	df	t-value	p-value
Mathematics Achievement Test (MAT)	Experimental group (N=117)	16.13	6.04			
	Control group (N=90)	14.24	6.26	206	1.18	0.001

Source: Researcher (2018)

Table 11 implies that there was no statistically significant different in the mean performance between the experimental group (M=16.13, SD= 6.04) and control group (Mean=14.24, SD= 6.26) in the pre-MAT, t (206) = 1.18, ═ , α = .05. This showed the two groups were homogenous at the start of the study.

In establishing the constructivist strategy effects on achievement of learners in mathematics, an examination was done on post-test results on MAT scores. This is as shown in Table 13.

Table 12: Post-Test Result on MAT Scores

Test	Groups	Mean	SD	df	t-value	p
Mathematics Achievement Test(MAT)	Experimental group (N=117)	28.14	7.21			
	Control group (N=90)	19.36	8.05	206	7.68	0.001

Source: Researcher (2018)

Table 12 shows that there was a statistically significant different in the mean performance between the experimental group (Mean=28.14, SD= 7.21) and control group (Mean=19.26, SD= 8.05) in the Post-MAT test, t (206) = 7.68, $\rho = .001$ at $\alpha = .05$. Thus, the Ho: there was no statistically significant mean variation in the learners' performance in mathematics between the group taught through constructivism instructional approach and those taught through the traditional methods was rejected and H_A was accepted.

The study concluded that there was a statistically significant mean variation in the students' achievement in mathematics for the taught through constructivism instructional approach and those taught through the traditional methods

The learner's achievement which was examined using same MAT at posttest may have been impacted to certain degree with exposure of pre-test to MAT. The application of ANCOVA controlled it. Taking of the pretest scores was as covariate and post-test was the response variable. Table 13 shows the results.

Table 13: Analysis of Co-Variance for Students' Achievement in Mathematics

Score	Sum of squares	df	Mean square	F-value	p
Correlated model	15162.65	2	7581.32	128.76	
Intercept	5731.53	1	5731.53	144.11	
Co-variate (pre-test score)	5867.36	1	5867.36	186.72	0.002
Main effect (Treatment)	4940.48	1	4940.48	122.63**	
Total correlated	214611	116			

Source: Researcher (2018)

Table 13 shows that the mean student performance in the Post Test MAT for the experimental group was statistically higher the control group (F (1,116) =122.63, $\rho = .002, \alpha = .005$). The study concluded that there was a statistically significant mean difference in the students' performance in mathematics among those taught through constructivism instructional approach and those taught through the traditional methods.

Further Cohen-d was computed to establish the effect size using the formula:

Cohen's d = $\frac{M1-M2}{\sigma}$

Where, M_1: Mean Performance of experimental group;

M_2: Mean Performance of Control group and;

σ: pooled standard deviation, $SD_{pooled} = \sqrt{((SD_1^2 + SD_2^2)/2)}$

Cohen's d = $\frac{28.14-19.36}{\sqrt{\frac{(7.21^2+8.05^2)}{2}}}$

= 1.148981.

The above value denotes a large effect size. These findings imply that there was a statistically significant mean difference in the students' mathematics achievement among those taught through constructivism instructional approach and those taught through the traditional methods. The findings concur with those of Laz (2014) who found that there

existed statistically significant different in the students mean scores of experiment and control groups in the post application for testing the statistical concepts for the significance of the experimental group students. Kim (2015) found that teaching using constructivism is highly effective than the traditional methods in relation to achievement in academics, however, constructivist learning is ineffective in regard to self-concepts and learning method, but affected motivation, learning anxiety and individual monitoring. Constructivism was preferable.

The learner requires opportunities to address the knowledge they acquired in the past with the aim of addressing misconceptions and developing ideas in a correct manner. A classroom that is effective, there is more to learning than putting together novel material to old thinking ways; it rather needs learners to get to a novel method of comprehension. Students have numerous ideas about numerous topics they come through while in school, some may be correct while others incorrect (Rutherford, & Ahlgren, 1990).

The study also found that there was no significant variation in the mathematic achievement test outcomes between gender and school type. The findings concurs with Charles-Ogan and Wonu (2019) who indicated that gender did not impact on achievement in solid geometry of students in spite of the model used.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.0 Introduction

In this chapter, the key findings are presented, conclusion drawn based on the findings and recommendations made there-to. The objectives of the study were addressed by the conclusions and recommendations.

5.1 Summary of Findings

5.1.1 Engagement Influence on Students' Achievement in Mathematics

Determining the influence of engagement on students' achievement in mathematics was the first objective of the study. The findings revealed that there is a close relationship between happiness in class, motivation and satisfaction, there is a high likelihood that students with prior knowledge will perform well on standardized tests, the strengths and growth areas in various interest of learners in different subjects is determined by framing of ideas, through generation of interest, the excitement of students about attending class and participating as well as how frequently they apply what they have learnt in class in their daily lives can be measured and the perception of learners regarding their general emotional state is class can be measured by framing ideas. Mauro (2014) stated that educators who make lessons fun and allowed learners to be enthusiastic and energetic increases the likelihood of engaging them in class.

5.1.2 Exploration Influence on Students' Achievement in Mathematics

The study established that real life situations give students a chance to experience the real world, real life situations provide learners with chances to get a high understanding in learning since they can observe and imitate what is done by others and ascertain the differences and similarities in their understandings in relation to others, use of open ended method gives learners the opportunity to use material resources in varied ways

comprising material manipulation to help them create a real world experience, probing and enquiring facilitates the use of numerous equipment and tools, so learners are highly interested in the study topic and thus improve learning and open ended method enables learners to effectively incorporate their individual experiences with known material resources. The findings relate with the findings of Fink (2013) who asserts that with the aim of comprehending an idea better, teachers are encouraged to engage learners in learning solutions that are effectively integrated in their real life and in materials that are familiar. For instant a learners who is passionate in hunting birds can be provided with an opportunity of exploring the concept in population estimation technique and more specifically to capture organisms with the aim of estimating their population. The findings agree with Boud (2012) noted that students also need proficiencies that help in novel views development and improving their understanding of the real world. This could be attained through explanation.

5.1.3 Explanation Influence on Students' Achievement in Mathematics

The study found that explaining using own words provides an object's clearer meaning, using own words to explain improves communication and reasoning, sharing of ideas helps to describes relevant occurrences, develop the learner's logical reasoning and guiding them through inductive judgments and use of primary sources helps in clarifying interrelation, demonstration and justification. The findings agree with Boud (2012) noted that students also need proficiencies that help in novel views development and improving their understanding of the real world. This could be attained through explanation.

5.1.4 Elaboration Influence on Students' Achievement in Mathematics

The study revealed that organization of mathematics content through application of ideas ensures that it is compatible with arrangement of knowledge in the learners mind, resulting to development of academic accomplishments and critical reasoning, through

communication of new understanding with formal language, analogies are provided to students that relate to the lesson content which makes the process of learning easy and errors reduction in knowledge understanding, the elaboration focus is linking information and helping students understand the link between data and critical reasoning such as interpretation, classification, discrimination, dedication and conclusion, application of ideas assists learners understand novel information and find out how it related to prior acquired data, students are motivated through conceptual integration to be the center duty in generation of novel course tools with structure of a preexisting knowledge. These findings agree with those of Baybee *et al.* (2006) that this stage students are required to be able to make use of abstract and abilities in novel but related circumstances and usage of formal label and descriptions. The instructor is required to recap learners of other descriptions and consider avaialable data and evidence when examining novel situations.

5.1.5 Evaluation Influence on Students' Achievement in Mathematics

The study found that assessment of understanding shows an accurate data of the performance of learners which educators may use in making vital decisions in regard to learners, there is a high likelihood that learners will recall what they are taught when they find out their learning implications through self-evaluation, through assessment of understanding, learners get the opportunity to examine their progress and analyze what their strength and shortcomings are, assessment of understanding guide's, directs and monitor's students' learning and progress towards attainment of course objectives and asking open ended questions helps teachers and students to revise their methods of learning and make suitable improvements.

The study also found that constructivism approach motivates learners to take part in reflecting individually with the aim of organizing and understanding the world, solving of problems teaches learners to put into consideration various perspective on a particular

situation or occurrence, this approach of constructivism assist learners to learn synthesizing various sources of information and reference with the aim of drawing conclusion and evaluating the conclusions. Another advantage of this approach is that it helps learners to question ideas and knowledge using comparison process and contrasting other ideas and context and also assist learners in making connections and associations that relate their real-life experience and lastly the approach of constructivist develops flexibility in thoughts and skills of thinking and learners compare and contrast different possibilities with the aim of making conclusions.

Further learners should partake in mathematical tasks confidentially and with enthusiasm, a proper math's instruction evident in a class when learners engage actively in a lesson facilitates students achievements in mathematics, the teacher allowing the students perform cognitive lifting and application of what is learned in their lives facilitates students achievements in mathematics, in mathematics instructions, teachers think that the suitable practices facilitate the engagement of learners in critical reasoning, which shows students mathematics concepts mastery and the use of examination methods focused on understanding other than on correct answers facilitates students achievements in mathematics. The findings concur with the findings of Quinn, Amer, Lonie, Blackmore, Thompson & Pettigrove, (2012) who noted that student's self-evaluation assists them to experience their abilities, determine their strengths and weakness and make use of material about their learning strength and capabilities. However, instructors access the learner's achievement to see the degree of integration of knowledge leading from presentation, demonstration and exploration.

5.2 Conclusion

5.2.1 Engagement Influence on Students' Achievement in Mathematics

From the finding's engagement helps students to be active in class by asking and answering questions. It helps to gauge a student's understanding on a particular topic and also improves their confidence. Engagement also measures the emotional well-being in class. The study concluded that engagement is essential in enhancing learning in the classroom and improves students' achievement in mathematics.

5.2.2 Influence of Exploration on Students' Achievement in Mathematics

From the finding's exploration helps students to deal with the real world activities far from the normal class work activities. This helps students to apply their classroom work to the real world. Hence, improving their understanding on different topics. The study concluded that exploration is important in enhancing students' performance in mathematics.

5.2.3 Explanation Influence on Students' Achievement in Mathematics

The results show that explanation makes learning more clear therefore, enhancing the logical thinking of students. In explanation issues in students minds are clarified qualifying how a certain addition is tackled in a certain manner. The study concluded that explanation is important in giving comprehensive information therefore significant in mathematics achievement of students.

5.2.4 Elaboration Influence on Students' Achievement in Mathematics

The results indicated that elaboration promotes the arrangement of knowledge in the learners mind which leads in the improvement in academic accomplishments and critical thinking. It also helps students to be the center in the procedure of generating their own material course by use of preexisting knowledge. The study concluded that elaboration is important in enhancing achievement of students' in mathematics.

5.2.5 Evaluation Influence on Students' Achievement in Mathematics

From the finding's evaluation helps to measure the students understanding of what they are taught in classroom. It helps to identify students' strengths and weaknesses in different topics hence devising ways to improve on the weaknesses to enhance their performance. The study concluded that evaluation is essential in enhancing students' achievement in mathematics.

5.3 Recommendations

In line with the study findings, the following recommendations were made;

i. It was recommended that policy makers in the education ministry ought to consider motivating mathematics educators to make use of constructivist method that use the 5Es (engagement, exploration, explanation, elaboration and evaluation), since this method is highly appropriate in mathematics learning in comparison to other conventional methods that are presently used by most of the educators.

ii. So that to improve mathematics performance, teachers are required to put into consideration the application of use of constructivist learning techniques and this ought to be executed in all secondary schools if they are to realize achievement in mathematics. Because the participation of a learner is essential and has performance implications, educators ought to enable use the constructivist approaches of instruction because it removes some class activities that do not motivate learners to take part when learning mathematics.

iii. Finally, the managers in schools ought to be encouraged to enhance academic programmes through the provision of the necessary facilities needed for purposes of instructions majorly numerous text-books to encourage constructivist learning techniques. These suggestions can be successfully executed at the start of

mathematics syllabus so that to enhance student's involvement in their first encounter with secondary school mathematics.

5.4 Area for further Research

In the current research constructivist approach of instruction was conveyed using the 5Es constructivist theory using pretest and posttest techniques of examination to measure achievement in learning. Moreover, the study suggests further studies into constructivist learning using other approaches of assessment like reciprocal teaching/learning, inquiry-based learning (IBL), problem-based learning (PBL) and cooperative learning apart from the 5Es.

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APPENDICES

Appendix I: Pre-test Achievement Test

Instructions: You will be required to answer all questions on the question paper provided. Do and leave all workings or rough work on the paper.

1. When a spherical balloon is filled with air, it has a radius of 3 inches. Which of these gives the **best** estimate for the volume of air in the balloon, in cubic inches?

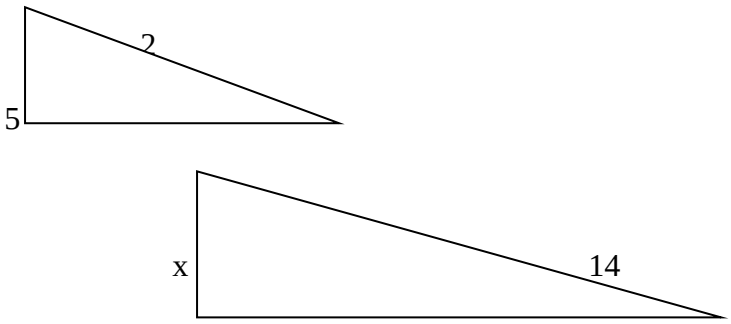
   A. 63.6

   B. 108.0

   C. 113.1

   D. 150.8

2. Two triangles are similar, and the dimensions shown are in centimeters. What is the measure of *x*, in centimeters?



   A. 4.0

   B. 5.6

   C. 8.4

   D. 11.0

3. What is the solution to the equation $2(x - 10) + 4 = -6x + 2$?

   A. $-9/2$

   B. 1

   C. 9/4

   D. 5/2

4. Tom has two cubes with one of each number, 1–6, on each of the six faces. He rolls the cubes at the same time and finds the sum of the numbers that show on the top. The sample space of all the possible outcomes is {2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12}. Which subset describes the possible outcomes for a roll in which one of the cubes shows a number less than or equal to 3 and the other cube shows the number 4?

   A. {5, 6}

   B. {4, 5, 6}

   C. {5, 6, 7}

   D. {4, 5, 6, 7}

5. The price of a certain sofa, *S*, is \$900 more than the price of a chair, *C*. The total price for the sofa and chair is \$1200. Which system of equations can be used to find the price of each piece of furniture?

   A. $S = C + 900$

      $S + C = 1200$

   B. $S = C - 900$

      $S - C = 1200$

   C. $S = C - 900$

      $S + C = 1200$

   D. $S = C - 1200$

$S - C = 900$

6. Consider this polynomial expression.

   $(x^2 - x + 1) + (2x^2 + x - 9)$

   What is the sum of the polynomials?

   A. $x^2 - 8$

   B. $3x^2 - 8$

   C. $3x^2 - 2x - 8$

   D. $3x^2 + 2x - 8$

7. Line l and line k are perpendicular. Line l has a slope of 3. Line k contains the points (5, 8) and (2, y). What is the value of y?

   A. –1

   B. 7

   C. 9

   D. 17

THANK YOU

Appendix II: Post -test Achievement Test

Instructions: You will be required to answer all questions on the question paper provided. Do and leave all workings or rough work on the paper.

1. Evaluate and provide a reason for your response to the mathematics question: 14+26/2
2. It takes Mamuna and Kojovi one-third of an hour and half an hour respectively to walk round the school field. When will be their first time of meeting if they should all start at 6.30 am from a starting point?
3. The vertices of △ABC are A (0, 0), B (6, 0), and C (3, 7). What type of triangle △ is ABC?

   A. acute isosceles triangle

   B. acute scalene triangle

   C. right isosceles triangle

   D. right scalene triangle
4. Which statement is true for a line that passes through points (–2, 4) and (3, 4)?

   A. The line has a negative slope.

   B. The line has a positive slope.

   C. The line has an undefined slope.

   D. The line has a zero slope.
5. An item sells for $20 per kilogram. What is the cost in cents per gram for this item?

   A. 0.02 cents per gram

   B. 0.2 cents per gram

   C. 2 cents per gram

   D. 20 cents per gram

6. John found the length of one side of a square to be $\sqrt{40}$ inches. Which is closest to the length of the side of the square?

   A. approximately 6 inches

   B. approximately 7 inches

   C. approximately 10 inches

   D. approximately 20 inches

THANK YOU

Appendix III: Questionnaire for Teachers

Kindly tick or write in the spaces provided as appropriate

Section A: General Information

1. Gender

   Male ( )

   Female ( )

2. Age

   Below 18 years ( )

   19-29 years ( )

   30-39 years ( )

   Above 40 years ( )

3. Period worked in the Organization

   Less than 2 years ( )

   3 to 5 years ( )

   6 to 10 years ( )

   Above 10 years ( )

Section B: Influence of engagement approach on students' achievement

To what extent do you agree with the following about influence of engagement approach on students' achievement in mathematics? Using the scale 1- strongly disagree, 2-disagree, 3-moderate, 4-agree, 5-strongly agree

Statements	**1**	**2**	**3**	**4**	**5**
Engaged students are more likely to perform well on standardized tests					
Through engagement, the excitement of students about attending class and participating as well as					

how frequently they apply what they have learnt in class in their daily lives can be measured.					
There is a close assoiciation between happiness in class, motivation and satisfaction					
The perception of learners regarding their general emotional state is class can be measured using engagement					
The strengths and growth areas in various interest of learners in different subjects is determined using engagement.					

Section C: Influence of exploration strategy on students' achievement

To what extent do you agree with the following about influence of exploration strategy on students' achievement in mathematics? Using the scale 1- strongly disagree, 2-disagree, 3-moderate, 4-agree, 5-strongly agree

Statements	**1**	**2**	**3**	**4**	**5**
Use of open-ended method gives learners the opportunity to use material tools in numerous means comprising materials manipulation to assist then have a real world experience.					
Real life situations allow students to face the real world.					
Probing and enquiring facilitates the use of numerous equipment and tools, thus, students get highly interested in the study topic and improve learning					
Use of open-ended method enables learners to effectively incorporate their individual experiences with accustomed material resources					
Real life situations give students chances to form a large comprehension in learning since they can observe and imitate what is done by others and match					

matches and variations in their context knowledge of the work of others.					

Section D: Influence of explanation strategy on students' achievement

To what extent do you agree with the following about influence of explanation strategy on students' achievement in mathematics? Using the scale 1- strongly disagree, 2-disagree, 3-moderate, 4-agree, 5-strongly agree

Statements	**1**	**2**	**3**	**4**	**5**
Sharing of ideas describes appropriate occurrences, develops the learner's logical reasoning and directs them over inductive decision					
Explanation leads to clarifying interrelations, demonstrating and justifying					
Explanation improves communication and reasoning					
Using own words to explain derives meaning of a tool much clearly					

Section E: Influence of elaboration on students' achievement

To what extent do you agree with the following about influence of elaboration on students' achievement in mathematics? Using the scale 1- strongly disagree, 2-disagree, 3-moderate, 4-agree, 5-strongly agree

Statements	**1**	**2**	**3**	**4**	**5**
Application of ideas assist learners to comprehend new information and show how its associated with their previously acquired information					
Organization of mathematics content through application of ideas makes it harmonious with knowledge arrangement in learner's mind, leading					

to development of accomplishments in academics and critical reasoning.					
Through communication of new knowledge with formal language, learners are given familiar analogies with lesson content which makes the process of learning easy and less errors in knowledge understanding					
Communicating new understanding with formal language help to relate information helping learners to know the link between data and critical reasoning					
Learners are encouraged through conceptual integration to be the center duty in generation of novel material course with structure of the already present knowledge					

Section E: Influence of evaluation strategy on students' achievement

To what extent do you agree with the following about influence of evaluation strategy on students' achievement in mathematics? Using the scale 1- strongly disagree, 2-disagree, 3-moderate, 4-agree, 5-strongly agree

Statements	**1**	**2**	**3**	**4**	**5**
Evaluation guide's, directs and monitor's students' learning and progress towards attainment of course objectives					
Through evaluation, learners get the opportunity to examine their progress and analyze what their strength and shortcomings are					
Assessment of understanding affords reliable information of students outcomes which educators may use in making vital decisions in regard to the learners					

It is highly likely to recall what is learnt through exploration of implications of learning through self-evaluation					
Asking open ended questions helps educators and learners to reflect on methods of learning and make suitable changes when needed					

THANK YOU

Appendix IV: Procedure of Activities

Activity	**Target**	**Resources**	**Timelines**
Pre-test Achievement Tests	Students	Tests	1 week
Treatment for the experiment group	Students	Tests	10 weeks
Post-test Achievement Tests	Students	Tests	1 week
Administration of questionnaires to teachers	Teachers	Questionnaires	2 weeks
Data analysis and presentation			2 weeks

Appendix V: Letter of Introduction

Mount Kenya University

P.O Box 342-00100

Thika, Kenya

Dear Respondent,

I am carrying out a research study on "**Influence of Constructivism Instructional Approach on Students in Achievement of Mathematics in Secondary Schools in Mandera Central Sub County Kenya"** this is a requirement for the award of degree of Master of Education in Educational, Instructional, Technology in Mount Kenya University.

A questionnaire has been attached which you are requested to respond to all the questions providing your level of agreement to them. The information you provide will be treated confidentially and applied for academic reasons only.

Thank you for your time and the response you've provided

Yours sincerely,

Charles Majiwa.

Appendix VI: Participants Consent Form

CHARLES MAJIWA

Mount Kenya University

Dear Respondent,

RE: DATA COLLECTION

Hello, my name is **Charles Majiwa and** I am the **Master of Education Degree in Instructional Technology of Mount Kenya University**. I am currently working on my project and would greatly appreciate your assistance. You asked to participate in the study that aims at assessing the **INFLUENCE OF CONSTRUCTIVISM INSTRUCTIONAL APPROACH ON STUDENTS' ACHIEVEMENT IN MATHEMATICS IN SECONDARY SCHOOLS IN MANDERA CENTRAL SUB COUNTY, KENYA**.

There are no foreseeable risks for you participating in the study or payment for you. If you may have questions while taking part, please stop and ask. You will be required to read and respond to the questions in the questionnaire that you will be provided with. Please answer the questions with honesty. The information given by you will be treated with anonymity and confidentiality. Participation in this study is voluntary, and you will not be victimized if you refuse to participate or decide to stop. You have a right to withdrawal from this research at any time without any risk

In case of any question feel free to contact

Chairman MKU ERC

P.O BOX 342...01000

Participant's Name……..

Signature……..Date……..

Researchers Name……

Signature……Date…….....

Appendix VII: Introductory letter

Mount Kenya University

SCHOOL OF POSTGRADUATE STUDIES

MED/39344/2015

24th August, 2018

The Director, Research Coordination Division
National Commission for Science, Technology & Innovation
Utalii House, 8th & 9th Floor
P.O Box 30623- 00100
NAIROBI

Dear Sir/Madam,

RE: CHARLES MAJIWA – REGISTRATION NO. MED/39344/2015

The purpose of this letter is to introduce the above named student who is pursuing **Master of Education in Educational Instructional Technology** in the Department of **Psychology and Instructional Technology** in the School of **Education.**

The title of his research is *"Effects of Constructivism Instructional Approach on Students' Achievement in Mathematics in Secondary Schools in Mandera Central Sub County, Kenya."*

He has been cleared by the University's Ethics Review Committee (Certificate attached) and now has to proceed to the field to collect data for his research between **August and October, 2018.**

Any assistance accorded to him will be highly appreciated.

Thank you.

Registrar
School of Prograduate Studies
Mount Kenya University
Box 342 - 01000, Thika

Mr. Daniel Gatungu
Registrar, School of Postgraduate Studies
Enc.

Appendix VIII: Ethical Clearance

Mount Kenya University

AUGUST 24, 2018

Ref. No. MKU/ERC/0907

CERTIFICATE OF ETHICAL CLEARANCE

This is to certify that the proposal titled **"EFFECTS OF CONSTRUCTIVISM INSTRUCTIONAL APPROACH ON STUDENTS' ACHIEVEMENT IN MATHEMATICS IN SECONDARY SCHOOLS IN MANDERA CENTRAL SUB COUNTY, KENYA"** Whose Principal Investigator is Mr Charles Majiwa (MED/39344/2015) has been reviewed by Mount Kenya University Ethics Review Committee (ERC), and found to adequately address all ethical concerns.

Dr. Francis W. Makokha
Secretary, Mount Kenya University ERC

Sign: _____ **Date:** 24/8/2018

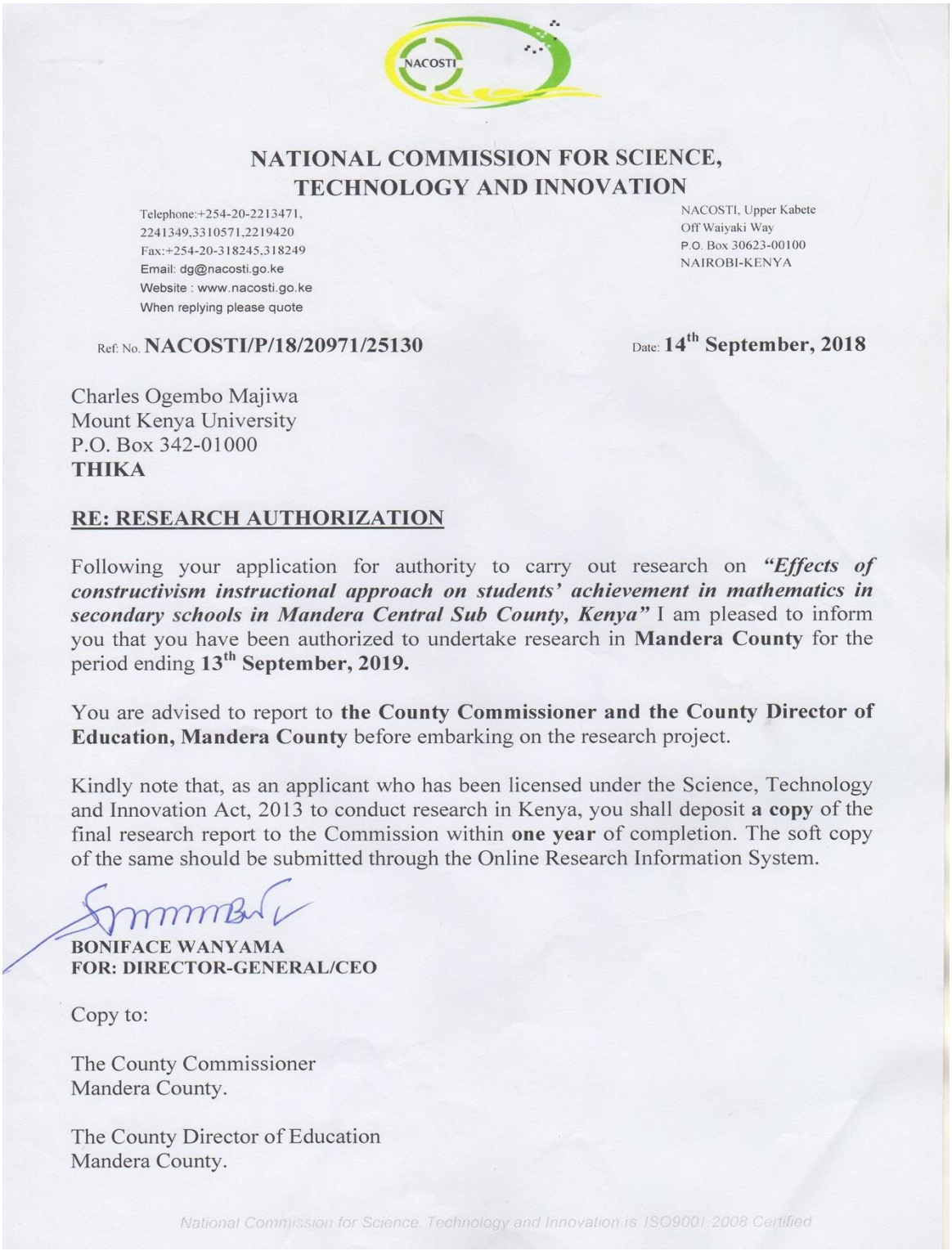
Prof. Francis W. Muregi
Chairman, Mount Kenya University ERC

Sign: _____ **Date:** 24.08.2018

The Chairman
Mount Kenya University
Ethics Review Committee
P. O. Box 342 - 0100, Thika

Main Campus, General Kago Road, P.O. Box 342-01000 Thika. Tel: +254 67 2820 000,
Cell: +254 720 790 796, 0709 153 000
Email:info@mku.ac.ke, Web: www.mku.ac.ke
Chartered and ISO 9001 : 2008 Certified Institution.
Unlocking Infinite Possibilities

Appendix IX: Research Permit



NACOSTI

NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY AND INNOVATION

Telephone:+254-20-2213471, 2241349,3310571,2219420
Fax:+254-20-318245,318249
Email: dg@nacosti.go.ke
Website : www.nacosti.go.ke
When replying please quote

NACOSTI, Upper Kabete
Off Waiyaki Way
P.O. Box 30623-00100
NAIROBI-KENYA

Ref: No. **NACOSTI/P/18/20971/25130**

Date: **14th September, 2018**

Charles Ogembo Majiwa
Mount Kenya University
P.O. Box 342-01000
THIKA

RE: RESEARCH AUTHORIZATION

Following your application for authority to carry out research on ***"Effects of constructivism instructional approach on students' achievement in mathematics in secondary schools in Mandera Central Sub County, Kenya"*** I am pleased to inform you that you have been authorized to undertake research in **Mandera County** for the period ending **13th September, 2019.**

You are advised to report to **the County Commissioner and the County Director of Education, Mandera County** before embarking on the research project.

Kindly note that, as an applicant who has been licensed under the Science, Technology and Innovation Act, 2013 to conduct research in Kenya, you shall deposit **a copy** of the final research report to the Commission within **one year** of completion. The soft copy of the same should be submitted through the Online Research Information System.

BONIFACE WANYAMA
FOR: DIRECTOR-GENERAL/CEO

Copy to:

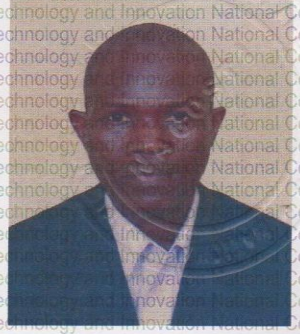
The County Commissioner
Mandera County.

The County Director of Education
Mandera County.

National Commission for Science, Technology and Innovation is ISO9001:2008 Certified

THIS IS TO CERTIFY THAT:
MR. CHARLES OGEMBO MAJIWA
of MT. KENYA UNIVERSITY, 0-300 NAIROBI,has been permitted to conduct research in *Mandera County*
on the topic: *EFFECTS OF CONSTRUCTIVISM INSTRUCTIONAL APPROACH ON STUDENTS' ACHIEVEMENT IN MATHEMATICS IN SECONDARY SCHOOLS IN MANDERA CENTRAL SUB COUNTY, KENYA.*
for the period ending:
13th September,2019

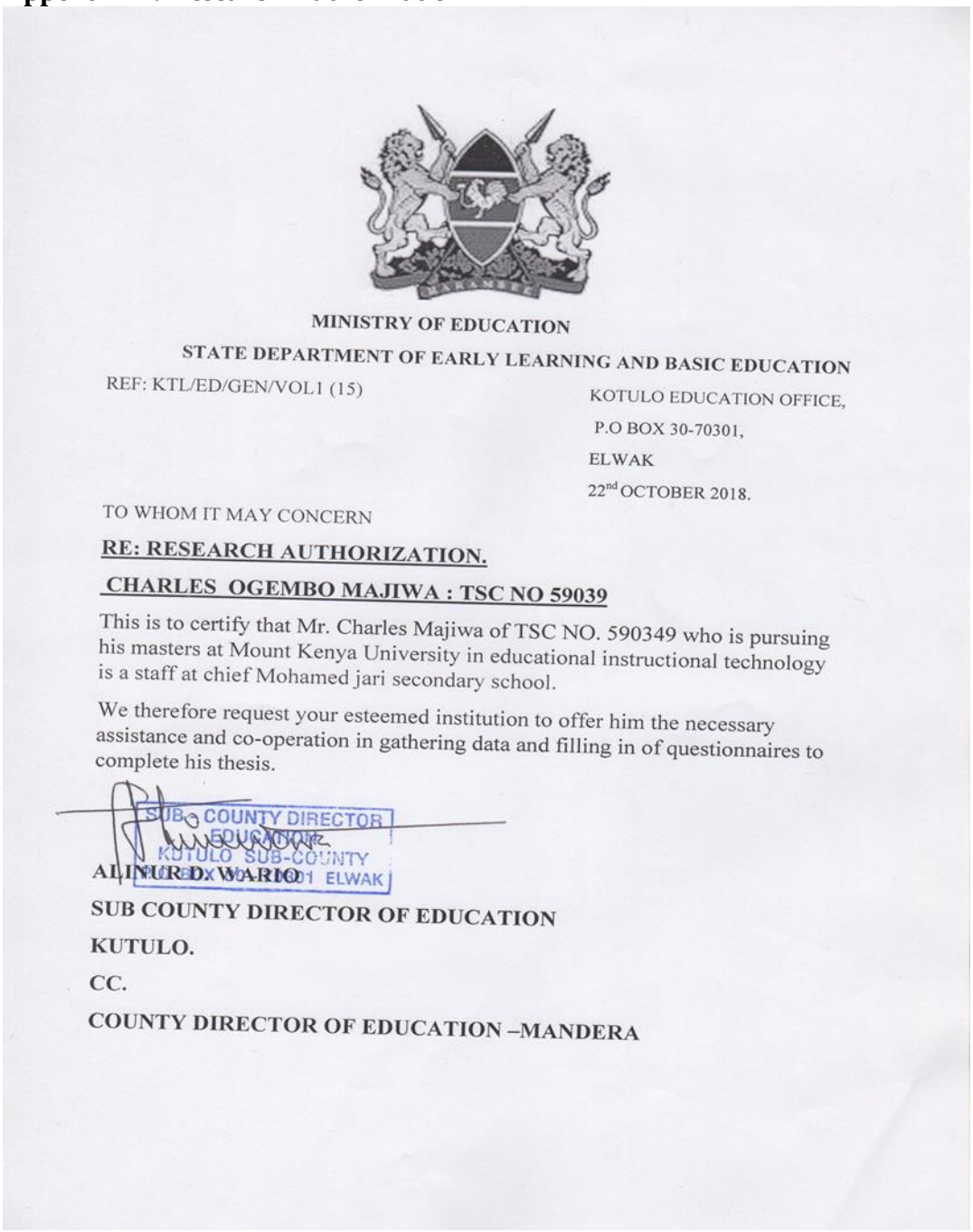
Permit No : NACOSTI/P/18/20971/25130
Date Of Issue : 14th September,2018
Fee Recieved :Ksh 1000



.....
Applicant's Signature

.....
Director General
National Commission for Science, Technology & Innovation

Appendix X: Research Authorization



MINISTRY OF EDUCATION

STATE DEPARTMENT OF EARLY LEARNING AND BASIC EDUCATION

REF: KTL/ED/GEN/VOL1 (15)

KOTULO EDUCATION OFFICE,
P.O BOX 30-70301,
ELWAK
22nd OCTOBER 2018.

TO WHOM IT MAY CONCERN

RE: RESEARCH AUTHORIZATION.

CHARLES OGEMBO MAJIWA : TSC NO 59039

This is to certify that Mr. Charles Majiwa of TSC NO. 590349 who is pursuing his masters at Mount Kenya University in educational instructional technology is a staff at chief Mohamed jari secondary school.

We therefore request your esteemed institution to offer him the necessary assistance and co-operation in gathering data and filling in of questionnaires to complete his thesis.

SUB COUNTY DIRECTOR EDUCATION KUTULO SUB-COUNTY P.O Box 30701 ELWAK

ALINUR DXWARIO

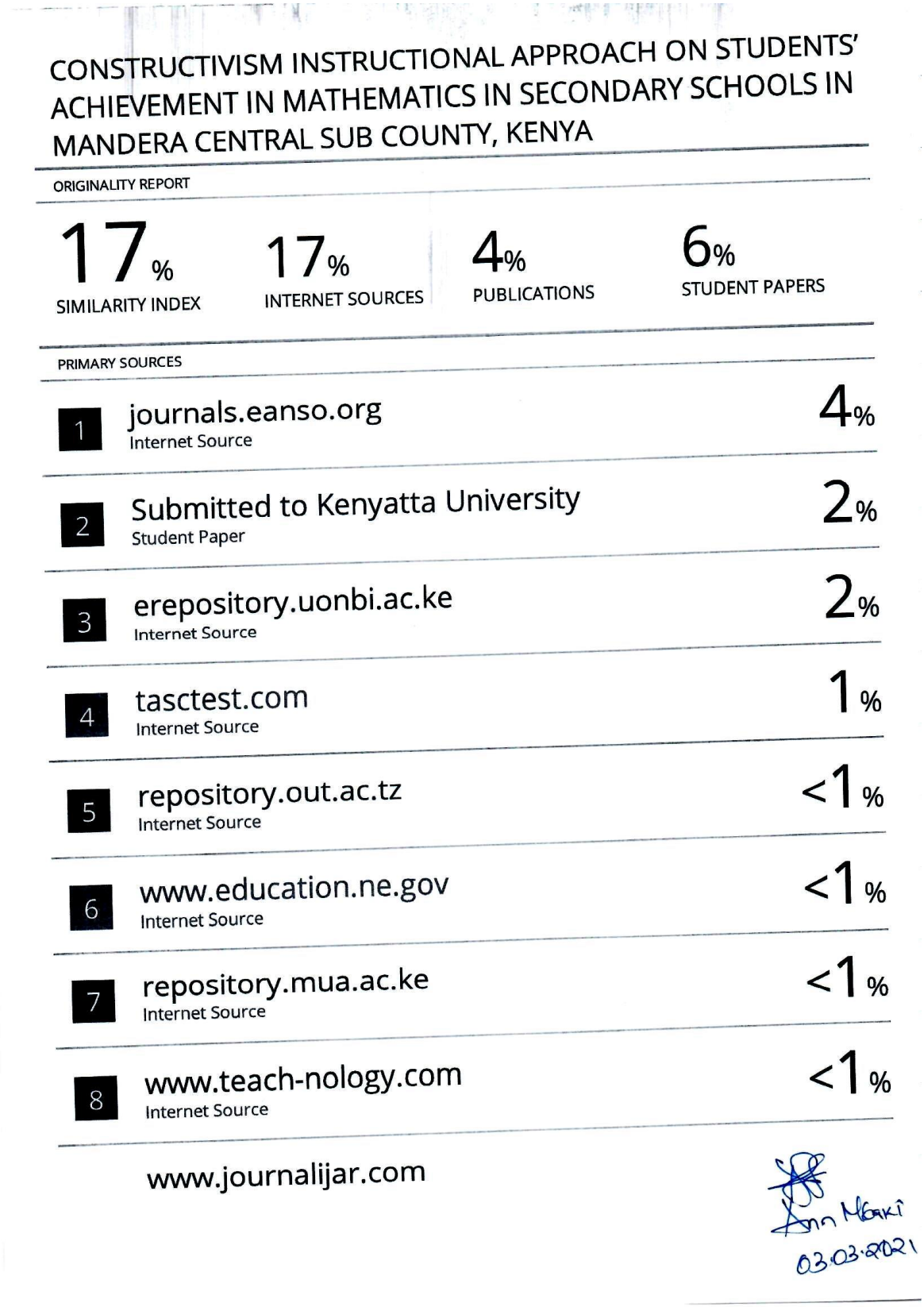
SUB COUNTY DIRECTOR OF EDUCATION

KUTULO.

CC.

COUNTY DIRECTOR OF EDUCATION –MANDERA

Appendix XI: Similarity Index



CONSTRUCTIVISM INSTRUCTIONAL APPROACH ON STUDENTS' ACHIEVEMENT IN MATHEMATICS IN SECONDARY SCHOOLS IN MANDERA CENTRAL SUB COUNTY, KENYA

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Appendix XII: Map of Locale