ACHIEVEMENT MOTIVATION AND METACOGNITION AS PREDICTORS OF MATHEMATICS ACHIEVEMENT AMONG FORM THREE STUDENTS IN BUSIA COUNTY, KENYA

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DECLARATION

I confirm that this research project is my original work and has not been presented in any other university or institution for consideration. This project has been complemented by referenced sources duly acknowledged. Where text, data (including spoken words), graphics, pictures, or tables have been borrowed from other sources, including the internet, these are specifically accredited and references cited in accordance and in line with anti-plagiarism regulations.

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This research project has been submitted for appraisal with my approval as University Supervisor

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DEDICATION

This research project is dedicated to my parents; Geoffrey and Jane for taking me to school and my wife Rachael and our lovely son Owen for their support and patience.

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ABBREVIATIONS AND ACRONYMS

KCSE	Kenya Certificate of Secondary Education
SMASE	Strengthening Mathematics and Science Education
STEM	Science, Technology, Engineering and Mathematics

ABSTRACT

A significant number of KCSE candidates in Busia County have been performing below average in mathematics. Studies have been conducted in different counties in Kenya on the factors that may be associated with poor performance in mathematics in national examinations. However, despite the efforts that have been made, this is yet to be satisfactorily addressed. In Busia County, achievement motivation, metacognition as predictors of mathematics achievement have received little attention. This study sought to examine achievement motivation and metacognition as predictors of mathematics achievement in order to come up with a model that can be used to predict mathematics achievement. The specific objectives were; to examine the relationship between achievement motivation and mathematics achievement, to find out the relationship between metacognition in mathematics and mathematics achievement, to examine if there were gender differences between achievement motivation and metacognition on mathematics achievement, and to determine the predictive weight of achievement motivation and metacognition on mathematics achievement among form three students. This study was based on two theories namely; achievement theory of motivation by McClelland (1985) and model of cognitive monitoring by Flavell (1976). Quantitative research methodology was adopted with a correlational research design. The target population for this study was 5395 Form three students in 28 public secondary schools in Samia Sub-County. Purposive sampling, proportionate sampling, and simple random sampling techniques were used to select the participants. A sample size of 361 students was selected from a target population of 5395. Academic motivation scale, metacognition scale, and mathematics achievement score sheet were used to collect data. Pilot study was conducted among 30 students in one public secondary school in Samia Sub-County to establish the validity and reliability of achievement motivation and metacognition scales. The researcher conducted a number of descriptive statistics such as mean, percentage, and standard deviation to describe the study variables. Inferential statistics was used to test the research hypotheses. Results revealed that achievement motivation score had a strong, positive and significant relationship with mathematics achievement, r (346) = .76, $p < .05$. Metacognition also had a positive and significant relationship with mathematics achievement, r (346) = .52, $p < .05$. The results on metacognition revealed that the mean differences between male and female students were statistically significant, t (2, 344), $p < .05$. On achievement motivation score, the results revealed that the mean differences between male and female students were statistically significant, t (2, 344), $p < .05$. R square value was .70 which indicates that 70% of the variance in mathematics achievement among form three students in Busia County is jointly influenced by achievement motivation and metacognition. The study recommends that teachers and curriculum developers should include and improve ways of enhancing achievement motivation and metacognition like enquiry based learning in their teaching methodologies and in the school curriculum to ensure that it works for the benefit of the students in learning mathematics and better achievement in the subject.

CHAPTER ONE

INTRODUCTION AND BACKGROUND TO THE STUDY

1.1 Introduction

This chapter presents the background to the study, statement of the problem, purpose of the study, research objectives and research hypotheses. It also highlights the significance of the study, limitations and delimitations of the study, assumptions of the study, theoretical and conceptual framework as well as the operational definition of terms.

1.2 Background to the Study

In most countries around the world, mathematics is the foundation of scientific thinking, innovation, and technological development. Owing to the importance of mathematics in skills development, the subject has been made obligatory in both primary and secondary schools in most education systems of the world. Students who perform well in secondary school mathematics are considered to possess adequate problem solving skills that can be tapped in Science, Technology, Engineering and Mathematics (STEM) fields to steer social and economic development (Aydemir & Karali, 2019). The importance of mathematics in schooling and the benefits it brings to society cannot be overemphasized. For instance, by engaging with mathematical concepts in school, children can increase their attention in class, memory, and thinking ability. As a result, learning and achievement in mathematics has continued to be an area of scholarly interest.

According to Malik and Abbas (2018), mathematics significantly contributes to scientific and technological development of a nation. Valero (2018) also confirms this assertion by agreeing that the knowledge and skills acquired through mathematics play a key role in looking for solutions to the challenges that face humanity. Some of the key sectors in the world economy that rely heavily on mathematical skills include; manufacturing, health, and agriculture. According to Barwell (2018), mathematics education is also important for environmental sustainability. Despite the importance of mathematics, many countries around the globe are still contending with low quality achievement in mathematics.

In developed countries, cases of poor quality learning outcomes in mathematics are mostly common among students from disadvantaged backgrounds. Wen et al. (2020) indicated that a significant number of students with disabilities in Japan perform below standard in mathematics. The researchers observed that a majority of the students scored below average marks in mathematics. Dowker et al. (2019) revealed that poor performance in mathematics in China among some students was an issue of concern. This challenge was attributed to the negative attitude of the students towards the subject.

The quality of achievement in mathematics is also a major issue of concern in most African countries. Studies conducted in different countries show that a significant number of students perform poorly in mathematics. According to Mosoge and Challens (2018), the prevalence of low achievement in mathematics in South Africa is high. This has been attributed to negative attitude of students towards the subject and the high student-teacher ratio. Mbazima (2018) also confirmed the high prevalence of low performance in mathematics amongst South African students. In Ghana, there is also a high prevalence of low grades in mathematics (Butakor et al., 2018). The same trend has been reported in Nigeria in a research by Olanrewaju (2019) which revealed that there is low quality achievement in mathematics among students in national examinations.

East African countries have also experienced a considerable number of students who have posted low grades in mathematics. In Uganda, Malibiran and Izon (2019) pointed out that a significant number of students from public schools score low grades in mathematics. The researchers indicated that students' negative attitude towards mathematics and high teaching loads of the teachers affected the achievement of the learners in mathematics. The low grades in mathematics denied the students an opportunity for further education in STEM careers. Similarly, Mazana et al. (2020) revealed that there is a high prevalence of low achievement in mathematics in secondary schools in Tanzania. The study revealed that a majority of the candidates who sat national examinations performed below average in mathematics which was largely associated with negative attitude of the students towards the subject.

In Kenya, a similar trend of skewed performance in mathematics is also experienced in KCSE. A study by Chepkirui (2020) reported that majority of secondary school students scored below D in mathematics in teacher-made tests. The researcher observed that there was limited usage of calculators, and there were relatively few mathematics course books in the classrooms. It was observed that the performance in mathematics in most secondary schools was a matter of great concern that requires to be urgently addressed. Muema et al. (2018) also reported that a significant number of the candidates performed below average in mathematics in KCSE examinations. It was established that nearly 85% of the candidates scored grade D and below. Mathematics was among the poorly performed subjects in KCSE. Kelechi (2018) also confirmed that the performance of secondary school students in mathematics was below standard compared to other subjects. The study concluded that poor performance in mathematics was as a result of negative attitude of the learners towards the subject and also absenteeism due to lack of school fees.

Busia County and Samia Sub-County to be specific has also experienced a similar challenge of low grades in mathematics in most public secondary schools. Makokha (2020) revealed that there is a high prevalence of low achievement in mathematics in Busia County. The study established that despite the implementation of SMASE program, most secondary schools are yet to significantly improve in mathematics performance. Molenje (2020) also confirmed that there is a high prevalence of low performance in mathematics in KCSE in the county. The study revealed that poor performance in mathematics was as a result of poor communication skills exhibited by the teacher and also use of teacher centered approach as opposed to learner centered approach. Data obtained from education office indicate that most of the candidates in Samia Sub-County scored grade D and below in mathematics in KCSE. This is evidenced in Table 1.1.

Table 1. 1

Samia Sub-County KCSE Analysis Mathematics from 2016 to 2020

Year	Grades								
	A	A-	B+	B	B-	C+	C	C-	D+ and below
2016	14	23	71	99	153	200	178	184	2450
2017	17	34	88	101	164	216	100	187	2622
2018	20	25	70	87	177	234	155	190	2365
2019	16	29	85	90	198	216	245	180	2446
2020	25	20	69	134	123	201	143	178	2268

Source. Busia County Education Office (2021)

Table 1.1 indicates that the performance of most of the students is below average. The majority of the students have been scoring grades D+ and below in KCSE examinations. Research efforts have been made to address this issue and results indicate that performance in mathematics is influenced by several factors. Gamboa et al. (2019) indicated that achievement in mathematics is determined by student’s ability and interest in mathematics. Huda (2018) found out that attitude, skills as well as beliefs influence mathematics achievement.

In the same vein, Mazana and Montero (2019) in their study found out that students' attitude contributes to their achievement in the subject. In Kenya, studies have been conducted in different counties on mathematics achievement. For instance, Chepkieng (2020) studied the effect of metacognitive knowledge on academic achievement while Kipngetich (2021) examined the role of motivation in academic achievement. However, in Busia County and Samia Sub-County to be specific little has been done particularly on achievement motivation and metacognition variables. This study investigated achievement motivation and metacognition as predictors of mathematics achievement.

Achievement motivation refers to the drive or force behind the desire to accomplish goals (Schunk et al., 2008). It is reflected in approach, persistence, and level of interest to accomplish academic tasks. It entails actions or behavior that are directed towards academic success through self-regulation and self-efficacy. Achievement motivation plays a key role in learning and it helps students to realize their goals (Marumo et al., 2019). Chon and Shin (2019) opined that motivation plays an important role in learning and is categorized into three domains namely; extrinsic, intrinsic, and amotivation.

Extrinsic motivation is a reward-driven behavior where a person is motivated to perform an activity and exhibit certain behaviour because they want to be rewarded or avoid punishment (Schunk et al., 2008). In this type of motivation, external forces drive an individual to act or behave in a certain way. According to Onyekere and Okoro (2018) external factors such as the desire to pass a test to avoid punishment and get a reward influence student's achievement in mathematics. Karina and Sullivan (2018) also confirmed in their study that there was a notable influence of teacher support, rewards, and environmental factors on academic achievement of students.

Intrinsic motivation is an internal drive or desire to achieve success in academics (Schunk et al., 2008). This type of achievement motivation is subjective but it is believed that it occurs as a result of the pleasure derived from performing a certain task. Intrinsic motivation has been reported to have a profound influence on academic achievement in mathematics among students. According to Alkharusi and Adel (2020), intrinsic motivation is correlated to mathematics achievement among students. Heydeir and Steinmayr (2020) indicated in their study that many students perceive mathematics as a difficult subject but those who are intrinsically motivated do well no matter how hard the task is. Therefore, intrinsic motivation is an important psychological construct in mathematics achievement.

Amotivation refers to a reduction in the desire to initiate or persist in goal-directed behaviors (Schunk et al., 2008). It arises from lack of competence to carry out an activity and low expectation to achieve success. Amotivation affects subjective and behavioral aspects of goal-oriented behavior. Tran and Nguyen (2021) in their study established that there existed a negative correlation between amotivation and mathematics achievement. Similarly, Ilter (2021) revealed that amotivation which is characterized by lack of effort belief, less value on the tasks and perception about the characteristic of the task negatively affect achievement in mathematics.

The other variable that this study focused on is metacognition which refers to the ability to use prior knowledge to strategically plan for success in academics (Meichenbaum et al., 1985). According to Meichenbaum et al. metacognition is divided into three domains namely, metacognitive knowledge, metacognitive experiences, and metacognitive strategies. Metacognitive knowledge refers to what individuals know about themselves regarding their thinking processes which entails belief in personal attributes, task features and strategies.

Abdelrahman (2020) indicated that metacognitive knowledge is key for academic success. Metacognitive experience is a process in which information, memories and earlier experiences are recalled by an individual and used to come up with a solution to the current problem. Asik and Erktin (2019) revealed that metacognitive experiences have a significant impact on problem solving. Metacognitive strategies refer to the thinking strategies that students use to achieve success in academics. Muhid et al. (2020) indicated that metacognitive strategies are important in improving reading and help in organizing, monitoring, self-assessment, self-evaluation and self-reflection towards academic tasks.

The intervening variable of the study was student's gender. Gender has been found to be an important construct in academic achievement more so mathematics achievement. Mwihia (2020) found that there is a high prevalence of poor achievement in mathematics among girls compared to boys. Another study by Lee and Kung (2018) also indicated that male students excel more in mathematics than female students. In the same vein, Innabi and Dodeen (2018) revealed that male students tend to answer more challenging and application questions in mathematics than female students. The studies demonstrated that gender was a crucial factor that should be considered in the study of mathematics achievement among students.

As demonstrated in the background to the study, achievement motivation and metacognition beliefs are important constructs in mathematics achievement. Studies have shown that the two variables independently predict the mathematics achievement of students. However, in Busia County and Samia Sub-County in particular little is known regarding these psychological variables. Furthermore, there is a gap concerning how the two variables jointly predict mathematics achievement among secondary school students hence the need for the current study.

1.3 Statement of the Problem

Mathematics achievement in a majority of secondary schools in Samia Sub-County has been below average. For a period of five years, 2016 to 2021 the sub county has been registering below average achievement in KCSE examinations with a majority of the students scoring grade D and below. For instance, in the year 2016, 2017, 2018, 2019 and 2021 the mathematics mean scores in KCSE were 2.246(D-), 2.201(D-), 2.015 (D-), 2.435(D-) and 2.342 (D-) respectively. Mathematics skills and achievement play a significant role in daily endeavors, job placement and career development of the students. Therefore, the below average achievement in mathematics indicates that the affected students are not equipped with adequate skills to realize their full potential in life. Furthermore, they will have limited opportunities in job placement and career development. This hampers social and economic development in the county and the country at large hence the need for the current study to address the problem.

Based on the background to the study, the variables associated with mathematics achievement have identified factors like motivation, attitude, resilience, self-concept, self-efficacy among others. Despite the abundance of empirical evidence on the variables that can be addressed to improve mathematics achievement among secondary school students, this problem has continued to persist in the country and in Samia Sub-

County in particular. Most of the variables that influence achievement in mathematics are influenced by contextual factors that vary from one place to another. In Kenya, there are a number of studies that have been conducted on the predictors of achievement in mathematics. The studies have identified a number of variables such as home factors, school factors and psychological factors. It is worth to note that the results obtained may be used to address the problem in Samia Sub-County but the studies differ in terms of practical knowledge and application to address the problem. Furthermore, there is limited research in Samia Sub-County on how achievement motivation, metacognition predict mathematics achievement.

1.4 Purpose of the Study

The aim of this research was to examine achievement motivation and metacognition as predictors of mathematics achievement in order to come up with a model that can be used to predict mathematics achievement. The study also sought to examine how gender moderates the relationship between achievement motivation, metacognition and mathematics achievement. This will help to address mathematics achievement disparities between boys and girls.

1.5 Research Objectives

This study was guided by the following objectives:

i. To examine the relationship between achievement motivation and mathematics achievement among form three students.

ii. To find out the relationship between metacognition in mathematics and mathematics achievement among form three students.

iii. To establish gender differences in achievement motivation and metacognition among form three students.

iv. To determine the relative predictive weight of achievement motivation and metacognition on mathematics achievement.

1.6 Research Hypotheses

The following were the alternative research hypotheses;

Ha_1 There is a relationship between achievement motivation and mathematics achievement among form three students.

Ha_2 There is a relationship between metacognition in mathematics and mathematics achievement among form three students.

Ha_3 There are gender differences in achievement motivation and metacognition among form three students.

Ha_4 There is a predictive equation of mathematics achievement from achievement motivation and metacognition among form three students.

1.7 Significance of the Study

The study aimed to address the poor achievement in mathematics in most of the secondary schools in Samia Sub-County. The findings may be useful to education stakeholders in helping the students adopt new learning strategies to improve achievement in the subject. The teachers may use the findings to address students' mindsets and motivation issues toward mathematics. In addition, parents and guardians may use the findings to guide them in providing required resources and support to enhance mathematics achievement. Furthermore, the findings may help the guidance and counseling teachers with empirical evidence on learner characteristics that may be manipulated to enhance achievement in mathematics. Similarly, the findings may assist education policy makers to improve policies that may guide curriculum and initiate interventions aimed at enhancing achievement in mathematics. The research findings may also help researchers in the future as they seek to enhance knowledge in this area of study.

1.8 Limitations and Delimitations of the Study

1.8.1 Limitations of the Study

The study concentrated on secondary schools in Samia Sub-County which have been recording below average achievement in mathematics. Even though other sub-counties in Kenya may be facing the same trend of poor achievement in mathematics, the results of this study may not be generalizable to the whole population of secondary schools in Kenya. Student characteristics may differ with those of students from other schools outside Samia Sub-County. However, the study used a representative sample to enhance the generalization of the results. The other limitation of the study was that the study relied on respondent's self-reports which may be subjective. To enhance the reliability of the responses, the researcher explained in detailed the purpose of the study. The study used a correlational research design and therefore the results may not be used to imply causal relationship among the study variables. Consequently, generalization of the results will only be based on the extent of the relationship between the research variables.

1.8.2 Delimitations of the Study

The research was conducted among form three students in public secondary schools in Samia Sub-County in Busia County. Even though mathematics achievement is affected by several factors; the study was delimited to achievement motivation and metacognition as predictors of mathematics achievement. This is because achievement motivation and metacognition have received little attention compared to other factors in the local context.

1.9 Assumptions of the Study

The study was conducted with the assumption that achievement motivation and metacognition are related to mathematics achievement. It was also assumed that the sampled respondents reliably reported their achievement motivation and metacognition. In addition, the study was carried out with the assumption that mathematics achievement of the students is affected by cognitive variables. Furthermore, the study also assumed that the respondents were honest in their responses.

1.10 Theoretical and Conceptual Framework

1.10.1 Theoretical Framework

This research was based on two theories namely; achievement theory of motivation by McClelland (1985) and model of cognitive monitoring by Flavell (1976).

a) McClelland's Achievement Theory of Motivation (1985)

McClelland's achievement theory of motivation explains human behavior and achievement based on a person's need for achievement. The theorist defined achievement motivation as the extent of an individuals' desire to succeed for various reasons such personal satisfaction, to get praise from others and get feelings of personal mastery (McClelland, 1985). The theory categorized achievement motivation into; intrinsic motivation, extrinsic motivation, and amotivation. McClelland defined intrinsic motivation as the inner desire to excel in a competitive environment for personal satisfaction. It presupposes that students are intrinsically motivated to achieve their set academic goals amid the competitive learning environment. The spirit of excellence is driven by the student's desire to achieve set academic targets.

Regarding extrinsic motivation, McClelland argued that the need for achievement is more important when students are in competition with others to achieve high standard of excellence in academics. The concern can be how well one can perform a task, regardless of how others are doing or to outperform others, meeting some standard of excellence, or doing something unique. This means that an individual's desire for achievement is driven by fear of failure or to enhance competence.

McClelland stated that extrinsic motivation may be due to the desire to please others, control or influence others by having authority over them. Those with extrinsic motivation work to perform well in order to be recognized and direct others. They have to organize their efforts based on extrinsic motivation to achieve their set goals. Such students are inclined to impact and control others on matters academic achievement. They are ambitious and motivated to achieve excellence in academics in order to lead others.

Amotivation is another type of motivation which refers to a reduction in desire to succeed in academics in order to establish, maintain, or restore positive relationships with others. These relationships can be considered as academic friendships that are centered on the way the students are performing in academics. Students have the tendency to build friendships based on academic feedback they get from the teachers which in turn affects the way the students are performing academically. Students are motivated by the desire to align themselves with like-minded friends. It is driven by social recognition and affiliation with others who impel them to achieve success in academics.

The propositions of this theory provides an appropriate underpinning to explain the concept of achievement motivation of the students to achieve success in mathematics. The desire or need for achievement will drive the students to excel in mathematics. The need for personal satisfaction will motivate the students to excel in mathematics. Finally, the students can be motivated to excel in mathematics to align themselves with those who perform well in the subject in what is referred to us extrinsic motivation. The theory has been successfully used in the study of student's academic achievement in Kenya. Mutweleli (2014) used this theory in the study of students' motivation and academic achievement. The study found that the two variables were significantly related. Therefore, this theory was found appropriate for this research as it explains motivation strategies that can be used to enhance the student's achievement in mathematics.

b) Model of Cognitive Monitoring by Flavell (1976)

Metacognition refers to a persons' knowledge of their thinking processes (Flavell, 1976). It is the ability to think about thinking and it explains the differences in learning strategies exhibited by students. The theory deals with the regulation of personal cognitive processes in terms of planning, problem solving and monitoring of learning progress. According to this theory, the learning strategies are controlled by an individuals' consciousness of their thinking processes.

Flavell suggested that students acquire the ability to store and retrieve information gradually. They learn situations that are intentional and store information that is useful in the future. According to this theory, students learn by keeping the information they learn now which will help them solve their problems. He further stated that learning occurs through the search for information that helps the students to solve their academic problems.

Flavell's theory is based on three concepts namely; metacognitive knowledge, metacognitive experience, and metacognitive strategies. Metacognitive knowledge is defined as the awareness of the factors that affect cognitive activities. The theorist stated that this can lead an individual to engage in or restrain from a particular cognitive initiative based on its relationship with interests, abilities, and goals. This was grouped into three categories namely; student characteristics, task, and strategy. The students' characteristics involves the student's beliefs about themselves and their perception of how other people think about them. The task category entails knowledge about the tasks that need to be completed to achieve academic success. This knowledge helps students to manage their learning tasks to achieve academic goals. The strategy category involves setting goals and taking appropriate action to realize those goals.

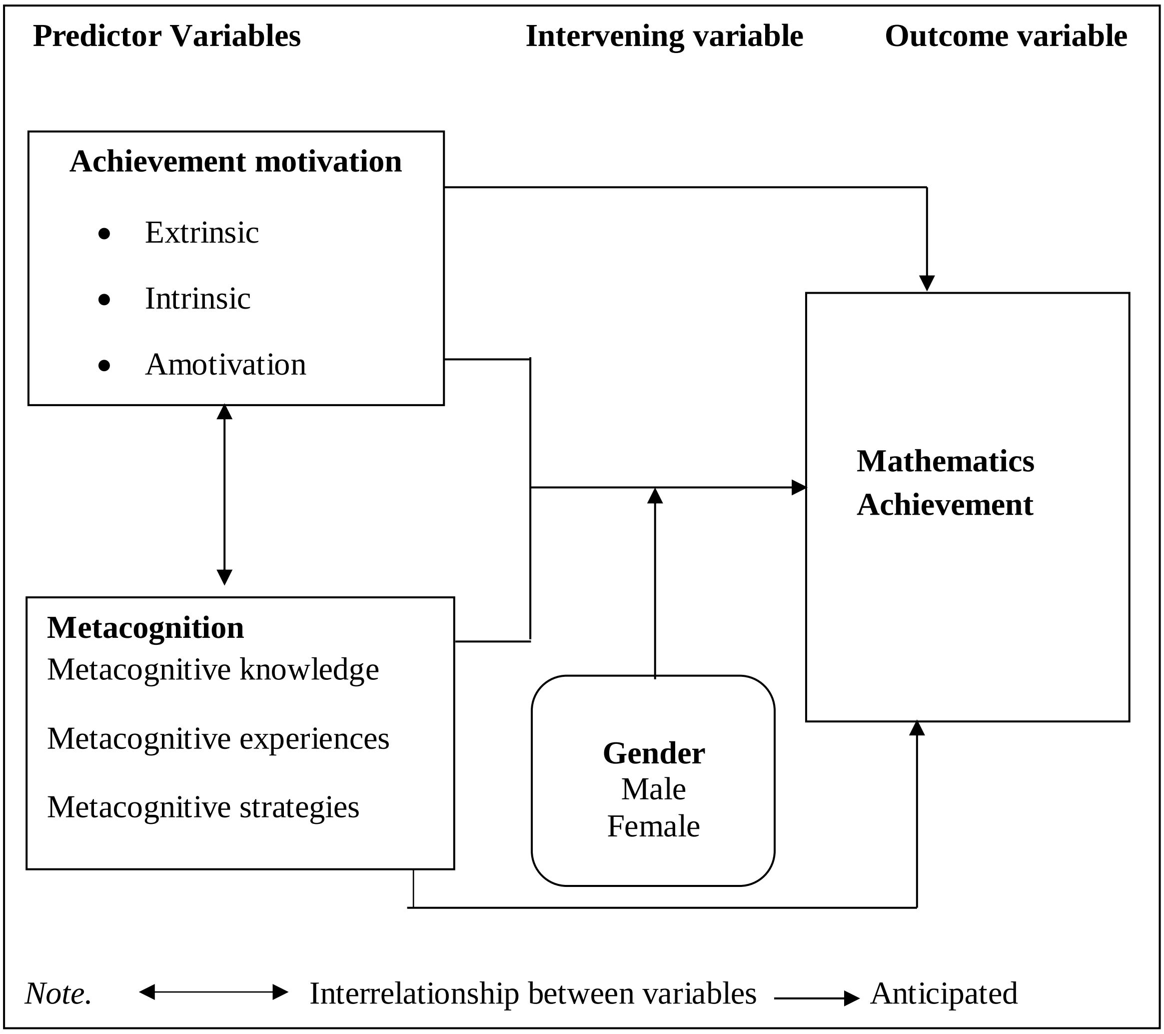
Metacognitive experience is a process in which information, memories and earlier experiences are recalled and used to come up with a solution to the current problem. Metacognitive strategies are ordered steps that are used to monitor one's cognitive activities to achieve set targets. Equipping students with these metacognitive skills helps them to monitor their learning process, plan and engage in activities that lead to academic success. Mwaniki (2015) used this theory to study metacognition and reading comprehension achievement among pupils and found that the two variables were significantly correlated. This theory is appropriate to the study since it helps explain mental strategies that can be used by students in learning to influence their mathematics achievement. Achievement motivation theory will help to explain what motivates students in the strategies they employ to achieve success in mathematics.

1.10.2 Conceptual Framework

Figure 1.1 presents the conceptual framework.

Figure 1.1

Model for the Relationship Among Study Variables



Researcher's Conceptualization, 2023

Figure 1.1 shows the relationship between predictor variables, intervening variable, and outcome variable. The predictor variables were achievement motivation and metacognition while the outcome variable was mathematics achievement. The intervening variable of the study was gender. The student's achievement motivation comprised of extrinsic, intrinsic and amotivation. On the other hand, metacognition comprised of metacognitive knowledge, metacognitive experiences and metacognitive strategies. The study hypothesized that achievement motivation and metacognition predict mathematics achievement.

1.11 Operational Definition of Terms

Achievement Motivation	It refers the students’ score on achievement motivation questionnaire concerning the cause of actions or behavior that provoke academic success
Amotivation	This is the students’ score on achievement motivation questionnaire regarding reduction of motivation to initiate or persist in goal-directed behavior
Extrinsic Motivation	This is the students’ score on achievement motivation questionnaire concerning motivation to engage in an activity to earn a reward or avoid punishment
Intrinsic Motivation	This is the students’ score on achievement motivation questionnaire concerning internal drive for success
Mathematics Achievement	This is the students' score in mathematics in end of term examination. It will be transformed into T score.
Metacognition	This is the students’ score on metacognition questionnaire on the level of awareness and understanding of his/her thought process.
Metacognitive Experience	It refers to the students’ score on metacognition questionnaire on awareness and feelings elicited in problem solving
Metacognitive Knowledge	This is the students’ score on metacognition questionnaire on what they know about themselves and others

Metacognitive Strategy It refers the students' score on metacognition questionnaire on methods used to help them understand what they learn

CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.1 Introduction

This chapter presents the literature from previous studies that are related to the current study. It examines the link between achievement motivation and mathematics achievement. It also looks at the link between metacognition and mathematical achievement. It also presents related literature on gender differences in achievement motivation and metacognition and prediction of mathematics achievement. Finally, the summary of the reviewed literature and research gaps are highlighted.

2.2 Relationship between Achievement Motivation and Mathematical Achievement

The link between achievement motivation and mathematics achievement has been studied extensively. Eunhye and Sunghwan (2019) did a study to explore changes in achievement motivation and mathematics scores among multi-ethnic pupils in South Korea. The researchers used a three-year longitudinal case study. The study involved a group of grade six pupils. Interviews were conducted in two ways: formal and semi-structured. For data analysis, a code book was used to identify the major themes. The study's findings revealed that pupils' motivation to succeed in mathematics influenced the scores the pupils obtained. This study can be used to improve mathematics achievement by enhancing achievement motivation but achievement motivation of learners may vary based on level of learning and context. Therefore, this may not be the case among students in Kenya hence the need for this study to address the population gap.

In another research, Amanda et al. (2020) investigated the predictive weight of cognitive, motivational, and affective characteristics on mathematics achievement among students in Spain. A total of 2365 students took part in the research and the researchers used descriptive and regression analyses. The results showed that the extent of the relationship between intellectual ability and mathematics accomplishment was less than the extent of the relationship between motivational and emotional elements and mathematics achievement. It was also found that children who had superior intellectual ability, more perceived competence in mathematics, and higher intrinsic drive performed well in mathematics assignments. This research is vital to address the issue of the current study but it did not address the different types of achievement motivation as postulated in the achievement theory. The current research was conducted to address the theoretical gap.

The association between achievement motivation and achievement in mathematics has also been studied in Nigeria. Okotie and Adeyemi (2019) investigated achievement motivation as a predictor of academic accomplishment among students in Edo State, Nigeria. A total of 698 students took part in the research. The sample was selected using multi-stage sampling procedure. Pearson correlation coefficient and multiple regression were used in data analysis. The study's outcomes showed that students' achievement motivation impacted on their academic achievement in mathematics. Achievement motivation of students vary from one context to another and therefore a similar study in Kenya is necessary for more conclusive results.

Furthermore, Ifelunni and Clara (2019) conducted a research in the South-East of Nigeria to explore motivation as a driver of academic achievement of primary school kids in mathematics. The research employed a correlational research design. The study involved 400 students as a study sample. Data were collected using intrinsic and extrinsic motivation scale and mathematics achievement test. Data were analyzed using the Pearson coefficient and regression analysis. The study's findings revealed a link between intrinsic motivation and academic achievement in mathematics among elementary school students. The study was conducted among young children and therefore the results may not be generalized to adolescent secondary school students in Busia County hence the need for the current study.

In Kenya, research has been conducted to determine the link between achievement motivation and mathematical achievement. Kariuki and Mbugua (2018) did a research to explore teacher-related motivating factors influencing students' academic achievement in Nyeri and Kirinyaga counties. The descriptive survey study involved a total of 370 students. Data were gathered through questionnaires and the study's findings revealed that teacher motivation had a positive impact on students' academic achievement. The study focused on teacher motivation while the current study focused on achievement motivation among secondary school students to address the population gap.

Studies have also been done on motivation and academic achievement in Kenya but little is known on the link between achievement motivation and achievement in mathematics in Busia County. A related study by Kipngetich (2021) conducted in Kitui County to find out if motivation influence academic achievement. Data were gathered using questionnaires. A total of 193 students took part in the study. Multiple regression and the Pearson correlation coefficient were utilized in data analysis. It was established that academic motivation, self-efficacy, and academic achievement were significantly related. However, the research focused on general academic achievement. The current research focused on mathematics achievement to establish if similar results can be obtained when different approaches are used.

2.3 Relationship between Metacognition and Mathematics Achievement

A lot of studies have been done on the link between metacognition and academic achievement. However, metacognition has not been extensively studied especially in Kenya as a predictor of mathematics achievement. This study aimed to close this knowledge gap. Gemma (2021) conducted a study to investigate the link between metacognition and pupils mathematics achievement. The research found a substantial link between metacognition and pupils mathematics achievement. In a related study, Toraman et al. (2020) conducted a study to find out how reflective thinking towards problem-solving skills and metacognitive awareness predicted mathematics achievement of students in Ankara. The survey was conducted using a correlational research design. A total of 412 seventh-graders who were selected using simple sampling took part in the study. The study's findings revealed a substantial positive association between students' mathematics achievement, reflective problem-solving thinking, and metacognitive awareness. There was also a significant association between reflective thinking and metacognitive awareness. The samples of the foregoing studies involved young children and since mental processes change with age, the results may not be generalized to secondary school students. The current research was conducted among form three students to address the knowledge gap.

In China, Tian et al. (2018) investigated the impacts of metacognitive knowledge on the achievement of math and whether the link between these two variables can be mediated by student motivation and self-assurance and confidence. The link involved three hundred twenty-four female students and two hundred forty-five male students in high school. The researcher utilized questionnaires to collect data from the selected respondents. The study found out that metacognitive knowledge, student motivation and self-assurance and confidence were significant predictors of the achievement in math. It was also established that the link between metacognitive knowledge and achievement on math was mediated by student motivation and self-assurance and confidence. The study was carried out in China, a more advanced country compared to Kenya and thus the results may not be generalized to the secondary schools in Kenya which are lagging behind in a number of aspects. The present study filled this gap.

A similar study was conducted by Hidayat et al. (2018) in Indonesia to establish the impact of students’ achievement objectives and metacognition on mathematics achievement. The study involved four hundred eighty-three female students and fifty-five male students from various universities in Malaysia and Indonesia. The research design adopted was correlational to help in identifying the existence of the link between study variables. The study established that the students' achievement objectives and metacognition had a positive impact on mathematics achievement. The research was done among university students and thus the results may not be generalized to secondary school students in Kenya, a gap that was filled by the present study.

Another study was conducted by Yurt (2022) to determine whether metacognitive approaches played a mediative role on the association between the gender of the students and how they perform in mathematics. The study involved three hundred and fifty students from various middle schools in Türkiye. The quantitative data was collected using questionnaires and analyzed using SPSS to obtain descriptive and inferential statistics. The study established that the female students performed better than their male counterparts and that metacognition approaches mediated this link between gender and mathematics achievement. The research was conducted in Turkey, a more advanced country in terms of resource allocation to the education sector than Kenya and thus the results may not be generalized to the Kenyan setting.

A study by Nzeadibe et al. (2020) investigated the impact of two meta-cognitive methods on students' academic achievement in Nigeria. Factorial research design was used in this study with a sample of 256 students. The sample was selected using multi-stage sampling procedure. When compared to problem solving, the study's findings showed that collaborative learning technique considerably improved students' academic results. However, the study focused on general academic achievement and therefore it will be necessary to investigate if similar results can be obtained with mathematics achievement.

Okpanachi and Umoru (2021) conducted a study in Kogi State, Nigeria, to examine metacognition as an instructional strategy to improve mathematics teaching and learning among rural and urban pupils. The study used a quasi-experimental design and a total of 72 school-aged children took part in the study. It was established that metacognition is useful in improving pupils' mathematics ability. The findings are important to address the problem of the current study but the results might have been affected by experimenter bias. Therefore, there is need for further research using other research designs to enhance the generalization of the results.

There is a substantial body of knowledge in Kenya about metacognitive knowledge and academic achievement. However, there isn't a lot of emphasis on mathematics achievement. Studies have shown that metacognitive knowledge has a positive impact on academic achievement. Chepkieng (2020) conducted a study in Nairobi Kenya to examine the effects of metacognitive knowledge on academic achievement. The survey was done using descriptive survey research design with a sample of 300 students. The study found a strong link between students' metacognitive awareness and their overall academic achievement. The present study focused on mathematics achievement to bridge the evidence gap.

Another similar study was conducted by Ong'uti et al. (2019) to determine whether metacognitive monitoring could be used to determine achievement in mathematics among secondary school students in Kenya. The study involved three hundred sixty students in form three and eleven teachers who were teaching the form three class at the time of data collection. The sample size was selected using purposive, simple random sampling and stratified sampling methodologies. It was established that metacognitive monitoring can be used to predict achievement in mathematics. This study considered metacognitive monitoring while achievement motivation was not involved as a study variable. The present study included both metacognition and achievement motivation on how they influence mathematics achievement.

2.4 Gender Differences in Achievement Motivation and Metacognition

2.4.1 Gender Differences in Achievement Motivation

A study done by Li and Peng (2020) investigated the role of achievement motivation and self-efficacy on mathematics achievement of students in Zhuang China. The study had a sample of 596 students where 293 were female and 303 were male. The study adopted quasi experimental research design. The findings revealed that there was no statistical difference between mathematics achievement of male and female students. However, male students recorded better level of motivation compared to their female counterparts. Students' motivation may be influenced by the learning context since the study was conducted in China, there was need for this study to establish if similar results can be obtained.

A study conducted in Nigeria by Omotosho (2018) investigated the influence of motivation on achievement in mathematics. Descriptive survey research was used in the study with a sample of 1536 students. It was established that there were significant gender differences in achievement motivation. This was in favour of male who had a better achievement in mathematics compared to their female counterparts. The research recommended that teachers should be well equipped in order to bridge the gap existing between the male and female students. The research was carried out among students in Nigeria and this population may differ from the Kenyan population hence the need for this study to address the population gap. Further, Awofala and Olanyika (2020) did a study on motivation to learning and gender differences in achievement in mathematics. The study sampled 315 students from Lagos, Nigeria. Descriptive survey design was used and the data collected were analyzed using percentages, means and the standard deviation. The results indicated that there was a significant difference in motivation and achievement in mathematics. Male students performed better than female students. There was also a population gap in this study as highlighted earlier hence the need for the present study.

In Kenya, a study by Mwaura and Kimani (2020) investigated gender differences in academic motivation of students in selected secondary schools in Nairobi County. The research used a sample of 397 form four students drawn from 12 public schools. The study used a correlational research design and gender differences in academic motivation was tested using t-test. The research findings showed gender difference in favour of female students. The results contradicted the results of other studies reviewed earlier hence the need for this study to contribute this debate.

2.4.2 Gender Differences in Metacognition

A study done in Turkey by Tuba and Arikan (2022) investigated gender differences in metacognitive strategies and academic achievement. The research involved a sample of 6890 students (3396 female students, 3494 male students). The study adopted meta-analysis research design. It was established that there was an association between metacognition and gender of the student. The results also revealed that female students had a higher metacognitive knowledge than male students. The results revealed that metacognition was associated with academic achievement of male and female students. The study employed meta-analysis research design while the current study used correlational research approach to advance knowledge in this area.

Similarly, Tyovenda and Abari (2021) did a study to reveal the effect of metacognition on secondary school students' mathematics achievement in Nigeria. The main aim was to unearth the effect of metacognitive strategy on male and female students. The study adopted quasi-experimental design. The study used a sample of 120 senior secondary school students. The results of the study revealed that those students who were taught using metacognitive approach performed better in mathematics. However, it was further revealed that achievement in mathematics of both male and female students did not differ significantly. The current study tends to close the existing gap in gender as far as mathematics achievement is concerned by adopting metacognitive strategies in learning.

Furthermore, a study in Tanzania by Matiku (2019) researched on the link between metacognition and academic achievement of secondary school students. The study used a sample of 444 secondary school students where 217 were male and 227 were female. The study found a positive correlation between metacognition and academic achievement. The study also revealed that there was no significant gender difference in metacognition. The results contradicted the results of other studies reviewed hence the need for the current study to address the inconsistency.

Similar contradictory results were reported by Chepkieng (2020) who did a study to investigate metacognitive awareness among students and teachers in teaching and learning and academic performance. A total of 300 form three students from three schools were involved in the study. The research adopted descriptive survey research design. Data collected were analyzed using the mean and standard deviation. The research findings indicated that the learners showed good achievement on metacognitive awareness. It was also revealed that there was no significant difference in metacognitive awareness based on gender. The present study used correlational research design to find out if similar results can be obtained.

2.5 Prediction of Mathematics Achievement from Achievement Motivation and Metacognition

A number of studies have been conducted on the relationship between achievement motivation, metacognition and mathematics achievement. However, the prediction of mathematics achievement from achievement motivation and metacognition has not received much scholarly attention. The current study was intended to address this gap. Rasha (2019) did a study to look into the relationship and impact of metacognitive awareness and academic motivation on students' academic progress at Ajman University. The researcher used descriptive and correlational research designs. A total of 200 students took part in the research. Academic successes and academic motivation; academic achievement and academic intrinsic motivation; academic achievement and academic extrinsic motivation were found to be significantly correlated. This study examined how achievement motivation and metacognition jointly predict mathematics achievement.

Another research done by Tang et al. (2021) investigated the association between self-motivation as an antecedent of academic achievement and metacognitive knowledge in mathematics. The study involved 327 high school learners. The results showed that motivation was positively associated with metacognitive knowledge and negatively related to metacognitive avoidance strategies. The study focused on the association between metacognitive knowledge and mathematics achievement which does not provide the extent to which metacognitive knowledge predicts mathematics achievement. The present study intended to examine how achievement motivation and metacognition predict mathematics achievement among secondary school students.

Another study done by Kwarikunda and Ssenyonga (2020) in Uganda investigated the relationship between motivation and academic achievement of students. The study sample was 374 students randomly selected from five schools. The researchers used descriptive survey analysis and the data collected was subjected to t-test to find out the relationship. The results indicated that motivation was significantly associated to the achievement of the students in mathematics. However, in the study, it was not revealed how metacognitive knowledge predicted mathematics. The current study intended to examine how achievement motivation and metacognition predicts mathematics achievement among secondary school students.

A similar research by Onchiri and Aloka (2019) investigated metacognition as a predictor of mathematics achievement among students in Kenya. The study employed Solomon Four pretest-posttest two group design. The study sampled 360 form three students using purposive and stratified sampling techniques. The results revealed a statistically positive correlation between metacognition and mathematics achievement. However, the study did not report on gender differences in metacognition, an issue the present study addressed.

2.6 Summary of Literature Reviewed and Gap Identification

Literature reviewed indicated that motivation (intrinsic, extrinsic, and amotivation) are essential constructs in mathematical achievement. Some of the studies involved university and college students from developed countries. The concept of achievement motivation is influenced by several variables including the learning environment and therefore the results may not be generalized to secondary school students in Busia County hence the need for the current study. Metacognition (metacognitive knowledge, metacognitive experiences, and metacognitive tactics) is also a strong predictor of mathematics achievement. The samples of the reviewed studies involved young children and since mental processes change with age, the results may not be generalized to secondary school students. Some studies used experimental research design which is prone to experimenter bias. The present study intended to address these gaps. On gender and mathematics achievement, the results revealed that gender had an impact on mathematics achievement but the results were contradictory. Both achievement motivation and metacognition are important factors in predicting mathematics achievement. However, little has been done on how the two variables jointly predict mathematics achievement, a gap this study addressed.

CHAPTER THREE

RESEARCH DESIGN AND METHODOLOGY

3.1 Introduction

This chapter focuses on research design and methodology. It comprises of the research design, methodology, the study variables, study location, target population, sampling techniques and sample size determination. The research instruments and their validity as well as the reliability, data collection techniques, data analysis techniques, logistical and ethical considerations are also presented.

3.2 Research Design

A correlational research design was used to investigate the association between achievement motivation, metacognition and mathematics achievement. Seeram (2019) described correlational research design as a non-experimental research design that facilitates prediction and explanation of the relationship between variables. This research design was appropriate for this study because it enabled the researcher to examine how achievement motivation and metacognition predict mathematics achievement. There exists three types of correlational research design namely explanatory, predictive and model testing (Seeram, 2019). Explanatory emphasizes on the description of the relationship among variables, predictive design focuses on determining how the dependent variable changes with different values of the independent variable and model testing involves statistical analysis to examine how a combination of independent of variables predict the dependent variable. The current study employed the three types of correlational research design based on the study objectives. The above design was appropriate for the current study since the researcher was not able to manipulate student’s achievement motivation and metacognition.

3.3 Variables of the Study

Achievement motivation and metacognition were the predictor variables. Achievement motivation was categorized into extrinsic motivation, intrinsic motivation and amotivation. Similarly, metacognition had three major sub-scales namely; metacognitive knowledge, experience, and strategies. Mathematics achievement was the outcome variable. The predictor and outcome variables were measured at interval scale. The intervening variables was gender of the student which was either male or female. The intervening variable was measured at nominal scale.

3.4 Research Methodology

The current study adopted a quantitative research methodology to examine the link between achievement motivation, metacognition, and mathematics achievement among Form three students. In the social sciences, quantitative approach is the most appropriate methodology especially when the study involves hypothesis testing (Ahmad et al., 2019). According to Ahmad et al. (2019), quantitative research methodology involves the use of computational techniques to investigate psychological, social or economic phenomena with the aim of describing or establishing the relationship between variables. Quantitative research methodology enabled the researcher to collect numerical data on achievement motivation, metacognition, and mathematics achievement and then test the hypotheses to establish the link between these variables. The results generated provide empirical evidence on the psychological variables associated with below average achievement in mathematics in Samia Sub-County. Through this research methodology, inferences were drawn and generalizations made in an effort to improve mathematics achievement in the sub county and the whole country at large.

3.5 Location of the Study

The locale of this study was Samia Sub County, Busia County. According to the KCSE statistics obtained from the education office, the sub county has been performing below average in mathematics in the last four years. The mathematics mean scores of the sub county for the year 2016, 2017, 2018, 2019 and 2021 were 2.246(D-), 2.201(D-), 2.015(D-), 2.435(D-) and 2.342(D-) respectively (SCEO, 2021). This sub county has been among the worst performing sub counties in Busia County. A number of studies have linked below average achievement in mathematics to factors such as attitude, poor teaching methods, shortage of teachers, syllabus coverage and negative attitude (Dawn, 2012; Korir, 2014; Veloo & Rabab, 2015). The problem may also be associated with achievement motivation and metacognition but little is known about these psychological factors in this area. Therefore, there was need for the present study in an effort to find out the relationship between achievement motivation and metacognition to inform all the stakeholders on what may be done to enhance achievement in this subject.

3.6 Target Population

The target population for this study was 5395 Form three students in 28 public secondary schools in Samia Sub-County. The study targeted public secondary schools because documents obtained from the Ministry of Education show that a majority of the public schools in the sub county have been performing far below average in Mathematics over the years (See Table 1.1). The study targeted Form three students because they are considered to have developed a relatively stable achievement motivation and metacognition since they have been in secondary school for three years.

3.7 Sampling Techniques and Sample Size Determination

3.7.1 Sampling Techniques

Samia Sub-County, public secondary schools, and Form three students were selected using purposive sampling. The study focused on public secondary schools because most of them have been performing below average in KCSE every year. Proportionate sampling was used to select the number of students from each school category. Simple random sampling was used to select the stream and students from each school to be involved in the study. Simple random sampling technique gave each student an opportunity to participate in the study which enhanced the reliability of the results (Seeram, 2019).

3.7.2 Sample Size Determination

Krejcie and Morgan's table of sample determination (Krejcie & Morgan, 1970) was used to determine the sample size of the students to be involved in the study. Using this table, a sample size of 361 students was selected from a target population of 5395. The sample size of students from each school category was selected using proportionate sampling as shown in Table 3.1.

Table 3.1

Target Population and Sample Size

Type of school	Population			Sample size		
	Schools	Students		Schools	Students	
		Boys	Girls		Boys	Girls
Boys boarding	5	561	-	2	38	-
Girls Boarding	3	-	531	1	-	36
Coeducational Boarding	3	948	861	2	64	58
Coeducational Day	17	1346	1148	5	90	75
Sub-total		2855	2540		192	169
Total	28	5395		10	361	

Table 3.1 shows that out of the 28 schools in Samia Sub-County, 10 schools were sampled. From the sampled schools, 361 students were selected from the four categories of schools. Based on the target population in each school category and the total sample size, 38 students were proportionately sampled from boys boarding schools, 36 students were sampled from girls boarding schools, 64 boys and 58 girls were selected from coeducational boarding and 90 boys and 75 girls were selected from coeducational day schools.

3.8 Research Instruments

The study used academic motivation scale, metacognition scale and mathematics achievement results to collect data. Section A collected data on background information (gender, type of school and age). Section B collected data on achievement motivation and section C collected data on metacognition.

3.8.1 Academic Motivation Scale

The researcher adapted academic motivation scale by Vallerand et al (1989) to collect data on achievement motivation. The scale had 28 items which measure achievement motivation on a seven point Likert scale. Items 2, 4, 6, 9, 11, 13, 16, 18, 20, 23, 25 and 27 measured intrinsic motivation. Items 1, 3, 7, 8, 10, 14, 15, 17, 21, 22, 24 and 28 measured extrinsic motivation. Items 5, 12, 19 and 26 measured amotivation. Scoring of this scale is provided in Appendix B (Section B). The authors reported a reliability coefficient of 0.79 but the researcher carried out a pilot study to establish the reliability of this scale in Kenya. The researcher had permission from the researchers to use the scale (Appendix F).

3.8.2 Metacognition Questionnaire

Metacognitive knowledge in mathematics questionnaire was used to collect data on metacognition. The questionnaire was developed by Efklides and Vlachopoulos (2012) and it was found to have a reliability coefficient of 0.85. The questionnaire measures metacognition using a five point scale *(not true = 1, a little true = 2, rather true = 3, true = 4 and very true = 5).* The questionnaire consists of three sub scales namely, metacognitive knowledge, metacognitive experiences and metacognitive strategies. Each sub scale consists of seven items. Scoring involved adding the scores with the expected minimum score being 21 and maximum score being 105. The researcher had been granted permission to use the scale (Appendix F).

3.8.3 Mathematics Results Mark Sheet

The researcher used mathematics results mark sheet to collect data on mathematics achievement. The researcher obtained results from the director of studies in the school for end of term one examination 2023. The questionnaire and mathematics scores were given the same code for verification of the mathematics score from the results mark sheet. To make the marks comparable across the different schools, the scores were transformed to Z scores and then to *T* scores using SPSS Version 25.

3.9 Pilot Study

The questionnaires were pretested in one secondary school in Samia Sub-County using a sample of 30 students. The sole purpose of the pilot study was to determine the study instruments' reliability and validity (Andrade, 2018). Piloting enabled the researcher to establish the validity and reliability of achievement motivation and metacognition questionnaires. The school that were used in piloting were not involved in the sampled schools during the actual study.

3.9.1 Validity of the Research Instruments

The study utilized a thorough review of the available literature to establish the content and face validity of the research tools. The researcher made several consultations with the supervisors to ensure that the items contained in the research tools provided relevant information on achievement motivation, metacognition and how they relate with mathematics achievement. The study adopted principal component analysis to determine the construct validity of the questionnaires (Mallah et al., 2020). Validated questionnaires were also used to ensure construct validity of the instruments was met.

3.9.2 Reliability of the Research Instruments

To establish the reliability of the questionnaires, Cronbach alpha was calculated for academic motivation and metacognition questionnaires and the results were discussed as shown in table 3.2. The reliability coefficients obtained by the authors were .79 and .85 for academic motivation and metacognition questionnaire respectively as shown in Table 3.2. The pilot study results show that the reliability coefficient for academic motivation and metacognition scales were .95 and .79 respectively. The reliability coefficients were above 0.7 and therefore acceptable as recommended by Abdella and Al shabibi (2018).

Table 3.2

Reliability Coefficients for Academic Motivation and Metacognition

Scale	Authors	Pilot Cronbach's Alpha
Academic motivation	0.79	0.95
Metacognition	0.85	0.79

3.10 Data Collection Techniques

Self-reports were used to collect data from the students. Before administering the questionnaires, the researcher gave clear instructions to the participants. After which the participants were given the questionnaires to fill in their responses within the allocated time. The participants were assigned unique codes based on their admission numbers that they wrote on the questionnaires. The codes were used to verify the mathematics scores from the mark sheet. The researcher requested for mathematics scores mark sheet for the participants who were involved in the study. In some schools teachers assisted the researcher in data collection. They were taken through the procedure to ensure that reliable data is obtained. Each participants was given about 40 minutes to fill the questionnaire.

3.11 Data Analysis

The data was coded and data files were created for computer analysis using the Statistical Program for Social Sciences (SPSS) Version 25. The data was checked for outliers and missing values. The researcher ran a number of descriptive statistics such as mean, percentage, and standard deviation to describe the study variables. Inferential statistics were used to test the following research hypotheses.

H_{01}: There is no statistically significant relationship between achievement motivation and mathematics achievement among Form three students. Statistical test: Pearson's r.

H_{02}: There is no statistically significant relationship between metacognition and mathematics achievement among Form three students. Statistical test: Pearson's r.

H_{03}: There are no statistically significant gender differences in achievement motivation and metacognition among Form three students. Statistical test: Independent samples t test.

H_{04}: There is no statistically significant predictive weight of achievement motivation and metacognition on mathematics achievement. Statistical test: Multiple regression analysis.

3.12 Logistical and Ethical Considerations

3.12.1 Logistical Considerations

An introduction letter was obtained from Kenyatta University's Graduate School. The letter was used to apply for a research permit from NACOSTI. Once the research permit had been obtained, the researcher sought permission from Busia County Director of Education and Samia Sub County Director of Education. The researcher then booked appointments with the principals of the sampled schools to agree on the date and time of data collection. All the required finances and materials were assembled before embarking on data collection.

3.12.2 Ethical Considerations

Participation in this study was voluntary and the students were not required to write their names on the questionnaire. The students were given unique codes based on their admission numbers which was used to verify their mathematics score. During data collection, the researcher informed the respondents on the nature and goal of the research and then sought their consent to be involved in the study. The respondents' privacy and confidentiality were observed throughout the research process. The results were reported in summary form and the findings were shared with the schools involved in the study to assist them to improve mathematics achievement.

CHAPTER FOUR

PRESENTATION OF FINDINGS, INTERPRETATION AND DISCUSSIONS

4.1 Introduction

This chapter presents the findings based on the study objectives. The chapter is divided into five sections namely general and demographic information, relationship between achievement motivation and mathematics achievement, relationship between metacognition in mathematics and mathematics achievement, gender differences in achievement motivation and metacognition, and predictive weight of achievement motivation and metacognition on mathematics achievement. Each section of the study objectives comprises of the descriptive statistics of the scores of the study variables, hypothesis testing and discussion of the results.

4.2 General and Demographic Information

The researcher administered 361 questionnaires to participants from boys boarding, girls boarding, coeducational boarding, and coeducational day. The results of the return rate are presented in Table 4.1.

Table 4.1

Questionnaire Return Rate

	QA		QR	
	Boys	Girls	Boys	Girls
Boys boarding	38	-	37(97%)	-
Girls Boarding	-	36	-	36(100%)
Coeducational Boarding	64	58	60(94%)	57(98%)
Coeducational Day	90	75	84(93%)	72(96%)
Sub-total	192	169	181(94%)	165(98%)
Total	361		346 (96%)	

Note. QA – Questionnaires administered; QR – Questionnaires returned; (%) Return rate

Out of the 361 questionnaires administered, 346 were returned giving a response rate of 96%. The boys boarding had a response rate of 97%, girls boarding had a response rate of 100%, coeducational boarding had a boys' response rate of 94% and a girls' response rate of 98%, and coeducational day had a boys' response rate of 93% and a girls' response rate of 96%. The overall boys' response rate was 94% while that for the girls was 98%. The response rate of 96% for the questionnaires was appropriate for data analysis.

Table 4.2

Age of the Respondents

Age	Frequency	Percent
16.00	6	1.7
17.00	50	14.5
18.00	144	41.6
19.00	81	23.4
20.00	40	11.6
21.00	16	4.6
22.00	2	.6
23.00	4	1.2
24.00	3	.9
Total	346	100.0

Table 4.2 shows that a majority of the respondents (41.6%) were aged 18, followed by those of age 19 at 23.4%, 17 years of age at 14.5%, 20 years at 11.6%, 16 years at 1.7%, 23 years at 1.2%, 24 years at 0.9%, and the least was those aged 22 at 0.6%.

A cross tabulation of age and gender was obtained and Table 4.3 presents the results.

Table 4.3

Age by Gender Cross Tabulation

		Gender		Total
		Male	Female	
	16.00	4 (1.16%)	2 (0.06)	6
	17.00	27 (7.80%)	23 (6.65%)	50
	18.00	69 (19.94%)	75 (21.68%)	144
	19.00	44 (12.72%)	37 (10.69%)	81
Age	20.00	24 (6.94%)	16 (4.62%)	40
	21.00	10 (2.89%)	6 (1.73%)	16
	22.00	1 (0.29%)	1 (0.29%)	2
	23.00	2 (0.58%)	2 (0.58%)	4
	24.00	0 (0.0%)	3 (0.87%)	3
Total		181 (52.31%)	165 (47.69%)	346

From Table 4.3, majority of the male students were aged 18 represented by 19.94% while the minority were those aged 22, represented by 0.29%. The male students had no respondent aged 24 years. For the female students, the majority were aged 18, represented by 21.68%, while the minority were those aged 22 represented by 0.29%. Unlike the male students who had none, the female students aged 24 were represented by 0.87%.

4.3 Relationship between Achievement Motivation and Mathematics Achievement

The first study objective was to examine the relationship between achievement motivation and mathematics achievement. This section presents the descriptive statistics of achievement motivation, mathematics achievement scores, hypothesis testing and discussion of the results.

4.3.1 Descriptive Statistics of Achievement Motivation

The researcher obtained descriptive statistics of achievement motivation to determine the minimum score, the maximum, the range, mean and standard deviation, coefficient of skewness and kurtosis coefficient. Table 4.4 presents the results.

Table 4.4

Descriptive Statistics of Achievement Motivation

	N	Range	Min	Max	*M*	*SD*	*Sk*	*Kur*
Academic Motivation Score	346	24.53	-11.87	12.67	2.93	2.75	-.51	1.45

Note. *N* = 346; Min = Minimum; Max = Maximum; M = Mean; SD = Standard Deviation; Sk = Skewness; Kur = Kurtosis

As indicated in Table 4.4, the minimum score was -11.87 while the maximum was 12.67 giving a range of 24.53. The expected lowest score was -18 while the expected highest score was 18. The mean score stood at 2.93 with a standard deviation of 2.75. The coefficient of skewness was -.51 indicating that achievement motivation scores were positively skewed. The kurtosis coefficient was 1.45 indicating a platykurtic distribution.

The descriptive statistics of achievement motivation were obtained by gender to determine if gender differences existed. Table 4.5 shows the results.

Table 4.5

Descriptive Statistics of Achievement Motivation by Gender

Gender	N	Min	Max	*M*	*SD*
Male	181	-2.88	12.67	3.15	2.52
Female	165	-11.87	8.42	2.68	2.97
Total	346	-11.87	12.67	2.93	2.75

Note. *N* = 346; Min = Minimum; Max = Maximum; M = Mean; SD = Standard Deviation

As shown on Table 4.5, male students obtained the lowest score of -2.88 and highest score of 12.67, with a mean score of 3.15 and a standard deviation of 2.52. The female students obtained a minimum score of -11.87 and a maximum of 8.42, with a mean score of 2.68 and a standard deviation of 2.97. This shows that the male students did better than their counterparts on achievement motivation.

The descriptive statistics of achievement motivation were also obtained by school type. The results are presented in Table 4.6.

Table 4.6

Descriptive Statistics of Achievement Motivation by School Type

Type of school	N	Min	Max	*M*	*SD*
Boys school	37	-1.50	8.50	4.65	2.69
Girls school	36	2.00	7.83	3.30	1.66
Coeducational boarding	117	1.54	8.42	3.96	1.55
Coeducational day school	156	-11.87	12.67	1.65	3.09
Total	346	-11.87	12.67	2.93	2.75

Note. *N* = 346; Min = Minimum; Max = Maximum; M = Mean; SD = Standard Deviation

As shown on Table 4.6, the boys' boarding schools obtained the highest mean score of 4.65 with a standard deviation of 2.69. Their lowest score was -1.50 while the highest was 8.50. The coeducational boarding followed with a mean score of 3.96 and a standard deviation of 1.55. Then girls' boarding school followed with a mean score of mean score of 3.30 (*SD* = 1.66). The least mean score was obtained by coeducational day school with a mean score of 1.65 and a standard deviation of 3.09. The highest maximum score of 12.67 was obtained by coeducational day school while the lowest minimum score was obtained by the same coeducational day school.

The researcher obtained descriptive statistics of achievement motivation sub scales to determine whether mean differences existed between intrinsic, extrinsic, and amotivation. The results are shown in Table 4.7.

Table 4.7

Descriptive Statistics of Achievement Motivation Sub Scales

	N	Range	Min	Max	*M*	*SD*
Intrinsic Motivation	346	59.00	25.00	84.00	64.92	14.29
Extrinsic Motivation	346	52.00	32.00	84.00	72.63	10.98
Amotivation	346	24.00	4.00	28.00	16.15	7.07

Note. *N* = 346; Min = Minimum; Max = Maximum; M = Mean; SD = Standard Deviation

As shown on Table 4.7, the extrinsic motivation obtained the highest mean score of 72.63 with a standard deviation of 10.98. Their lowest score was 32 while the highest score was 84. The intrinsic motivation followed with a mean score of 64.92 and a standard deviation of 14.29. Their minimum score was 25 while the maximum was 84. The lowest mean score of 16.15 (*SD*=7.07) was obtained by amotivation sub scale. The lowest score was 4 while the highest was 28.

Achievement motivation scores were categorized into low (-18 to -6), moderate (-5 to 7) and high (8 to 18). The frequencies of the levels of achievement motivation were obtained and the results presented in Table 4.8.

Table 4.8

Levels of Achievement Motivation among the Students

	Frequency	Percent
Low	107	30.9
Average	217	62.7
High	22	6.4
Total	346	100.0

Note. N = 346

As indicated in Table 4.8, the majority of the respondents had average achievement motivation represented by 62.7%, followed by those with low achievement motivation at 30.9%, then those with high achievement motivation at 6.4%.

The frequencies of the levels of achievement motivation were also obtained by gender. The results are presented in Table 4.9.

Table 4.9

Levels of Achievement Motivation among the Students by Gender

		Gender		Total
		Male	Female	
	Low	55 (15.90%)	52 (15.03%)	107 (30.92%)
AM Levels	Average	113 (32.66%)	104 (30.06%)	217 (62.72%)
	High	13 (3.76%)	9 (2.60%)	22 (6.36%)
Total		181 (52.31%)	165 (47.69%)	346 (100.00%)

Note. AM = Achievement Motivation

As indicated in Table 4.9, the average level category, the male students were the majority represented by 32.66% while their counterparts were represented by 30.06%. On the low level category, the male students dominated with a representation of 15.90% and the female students followed closely with a representation of 15.03%. The high level category was again dominated by male students with a representation of 3.76% while their counterparts had a representation of 2.60%. The male students dominated in all levels of achievement motivation.

4.3.2 Descriptive Statistics of Mathematics Achievement

The descriptive statistics of the raw scores were obtained to determine the lowest score, highest score, range, mean and standard deviation, coefficient of skewness and kurtosis coefficient.

Table 4.10

Descriptive Statistics of Mathematics Achievement

	N	Range	Min	Max	*M*	*SD*	*Sk*	*Kur*
Maths Scores	346	85.00	1.00	86.00	39.33	23.55	.02	-1.14

Note. *N* = 346; Min = Minimum; Max = Maximum; M = Mean; SD = Standard Deviation; Sk = Skewness; Kur = Kurtosis

As indicated in Table 4.10, the minimum score was 1 while the maximum score was 86 giving a range of 85. The mean for the raw scores stood at 39.33 with a standard deviation of 23.55. The coefficient of skewness was 0.02 indicating that the distribution was nearly symmetrical. The kurtosis coefficient was -1.14.

When the mathematics achievement scores were standardized, the descriptive statistics obtained were as presented in Table 4.11.

Table 4.11

Descriptive Statistics of Mathematics Achievement Standardized Scores

	N	Range	Min	Max	*M*	*SD*	*Sk*	*Kur*
Maths T Score	346	36.09	33.73	69.82	50.00	10.00	.02	-1.14

Note. *N* = 346; Min = Minimum; Max = Maximum; M = Mean; SD = Standard Deviation; Sk = Skewness; Kur = Kurtosis

As indicated in Table 4.11, the minimum score for the standardized score stood at 33.73 while the maximum score was 69.82 giving a range of 36.09. The mean score was 50.00 with a standard deviation of 10.00. The coefficient of skewness was 0.02 indicating that the distribution was nearly symmetrical. The kurtosis coefficient was -1.14. The results indicate that the scores of the students in mathematics were near normal distribution.

The descriptive statistics of mathematics achievement were obtained by gender to determine if there exists gender differences. The results were as presented in Table 4.12.

Table 4.12

Descriptive Statistics of Mathematics Achievement by Gender

Gender	N	Range	Min	Max	*M*	*SD*
Male	181	35.66	34.15	69.82	51.11	9.94
Female	165	33.96	33.73	67.69	48.79	9.96
Total	346	36.09	33.73	69.82	50.00	10.00

Note. *N* = 346; Min = Minimum; Max = Maximum; M = Mean; SD = Standard Deviation; Sk = Skewness; Kur = Kurtosis

As shown on Table 4.12, the male students obtained a higher mean score of 51.11 (*SD* = 9.94). Their minimum score stood at 34.15 while the maximum was 69.82 giving a range of 35.66. The females obtained a mean score of 48.79 (*SD* = 9.96). Their minimum score was 33.73 while the maximum was 67.69. The results showed that male students performed better than female students. The descriptive statistics of mathematics achievement were obtained by school category to determine if there exists mean differences. The results were as presented in Table 4.13.

Table 4.13

Descriptive Statistics of Mathematics Achievement by School Category

Type of school	*N*	Range	Min	Max	*M*	*SD*
Boys school	37	29.29	40.52	69.82	56.48	10.50
Girls school	36	22.93	44.34	67.27	51.79	6.51
Coeducational boarding	117	32.27	35.43	67.69	54.07	6.16
Coeducational day school	156	36.09	33.73	69.82	44.98	10.51
Total	346	36.09	33.73	69.82	50.00	10.00

Note. *N* = 346; Min = Minimum; Max = Maximum; M = Mean; SD = Standard Deviation; Sk = Skewness; Kur = Kurtosis

As shown on Table 4.13, the boys' boarding obtained the highest mean score of 56.48 (*SD* = 10.50) with the lowest score of 40.52 and the highest score of 69.82. The coeducational boarding followed with a mean score of 54.07 (*SD*=6.16) with the lowest score of 35.43 and the highest of 67.69. The girls boarding came third with a mean score of 51.79 (*SD* = 6.51) with lowest score of 44.34 and the highest score of 67.27. The coeducational day obtained the lowest mean score of 44.98 (*SD* = 10.51) on mathematics achievement with the lowest score of 33.73 and the highest score of 69.82.

4.3.3 Hypothesis Testing

In line with the first objective, the study sought to determine the association between achievement motivation and mathematics achievement. The null hypothesis was formulated as follows:

H_{01}: There is no significant relationship between achievement motivation and mathematics achievement.

Linear regression analysis and product moment correlation were used to determine the relationship. First, the relationship between the three domains of achievement motivation (intrinsic, extrinsic, and amotivation) and mathematics achievement were examined using Pearson r and the results are shown in Table 4.14.

Table 4.14

Correlation between Achievement Motivation and Mathematics Achievement

		Mathematics score
	Pearson Correlation	.76**
Achievement Motivation	Sig. (2-tailed)	.00
	N	346
	Pearson Correlation	.77**
Intrinsic Motivation	Sig. (2-tailed)	.00
	N	346
	Pearson Correlation	.58**
Extrinsic Motivation	Sig. (2-tailed)	.00
	N	346
	Pearson Correlation	-.18**
Amotivation	Sig. (2-tailed)	.00
	N	346

From Table 4.14, the achievement motivation score had a strong, positive and significant relationship with mathematics achievement, r (346) = .76, $p < .05$. Therefore, the null hypothesis was rejected. The results suggest that the higher the achievement motivation, the higher the mathematics score. Regarding the sub scales of achievement motivation, intrinsic motivation had a strong positive and significant relationship with mathematics achievement, r (346) = .77, $p < .05$. Similarly, extrinsic motivation had a strong positive and significant relationship with mathematics achievement, r (346) = .58, $p < .05$. Amotivation had a negative significant link with mathematics achievement, r (346) = -.18, $p < .05$. This implies that the lower the amotivation among form three students the higher the mathematics achievement and vice versa. Students with high levels of intrinsic, extrinsic achievement motivation performed better in mathematics compared to students with low levels. Equally, students with lower levels of amotivation perform better than those with higher levels of amotivation.

Having confirmed that there exists a significant relationship between achievement motivation and mathematics achievement, the prediction values of intrinsic motivation, extrinsic motivation, and amotivation on mathematics achievement were computed. The findings are presented in Table 4.15.

Table 4.15

Regression Coefficients for the Prediction of Mathematics Achievement

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	16.71	2.582		6.47	.00
	Intrinsic Motivation	.52	.04	.748	14.545	.00
	Extrinsic Motivation	.13	.47	.14	.271	.00
	Amotivation	-.10	.05	-.07	-2.04	.04

a. Dependent Variable: T_score

From Table 4.15, the results reveal that intrinsic motivation had a positive and significant predictive value of mathematics achievement among form three students in Busia County (β = .52, t (346) = 14.55, $p < .05$). This implies that a unit increase in intrinsic motivation increases mathematics achievement by 0.52. Secondly, the amotivation sub scale had a negative and significant predictive value on mathematics achievement (β = -.10, t (346) = -2.04, $p < .05$). This implies that a unit increase in amotivation decreases mathematics achievement by 0.1. Thirdly, extrinsic motivation had a positive and significant predictive value on mathematics achievement (β = .13, t (346) = .27, p < .05). A unit change in extrinsic motivation is associated with 0.13 change in mathematics achievement. The prediction equation for mathematics achievement from achievement motivation is as follows;

$\hat{Y}$ = 0.52Int. Mot. + 0.13Ext Mot. – 0.1Amotivation

4.3.4 Post-hoc Tests

Post-hoc test was carried out to determine if there exist significant differences in mathematics between the different levels of achievement motivation (low, average, and high). Table 4.16 presents the descriptive statistics of these different levels.

Table 4.16

Level of Achievement Motivation and Mathematics Achievement

AM Levels	N	Mean	Std. Deviation
Low	107	49.36	8.95
Average	217	49.37	10.55
High	22	50.35	9.45
Total	346	50.00	10.00

Note. AM = Achievement Motivation; N = 346

From Table 4.16, the students with high level of achievement motivation had the highest mean score of 50.35 (*SD* = 9.45) followed by those with average level with a mean score of 49.37 (*SD* = 10.55), then those with low level with a mean score of 49.36 (*SD* = 8.95). To determine if there exists significant differences between the groups (i.e., between low and average, low and high, and average and high), the ANOVA test was carried out. Table 4.17 presents the results.

Table 4.17

ANOVA for Mathematics Achievement and AM Levels

	Sum of Squares	*df*	Mean Square	*F*	Sig.
Between Groups	83.96	2	41.98	.42	.00
Within Groups	34416.04	343	100.34		
Total	34500.00	345			

The results in Table 4.17 indicate that the mean differences were statistically significant, F (2, 343) = .42, p < .05). This implies that the differences between the categories (between low and average, low and high, and average and high) were statistically significant. The results suggest that the level of achievement motivation significantly determine the mathematics score a student obtains.

4.3.4 Discussion of the Results

In objective one, the study aimed to examine the link between achievement motivation and mathematics achievement. It was established that there exists a significant positive relationship between achievement motivation and mathematics achievement. When the association between the sub scales of achievement motivation and mathematics achievement was examined, it was established that both extrinsic and intrinsic motivation had a positive and significant relationship with mathematics achievement implying that an increase in any of them will lead to an increase in mathematics achievement. Furthermore, it was established that amotivation had a negative relationship with mathematics achievement implying that the lower the amotivation, the higher the mathematics achievement. The predictive values of intrinsic motivation, extrinsic motivation and amotivation on mathematics achievement were significant. The findings of this study are supported by McClelland's Achievement Theory of Motivation (1985). The theory divides achievement motivation into three sub scales including intrinsic, extrinsic and amotivation. On intrinsic motivation, the theory argues that the students can be pushed by internal factors to perform well so as to achieve the set academic goals. Thus, the spirit of excellence is driven by the student's desire to achieve set academic targets. On extrinsic motivation, the theory asserts that students can get motivated to perform better in mathematics so as to please others, control or influence others by having authority over them. Those possessing such a kind of motivation work to perform well in order to be recognized and direct others. They are driven by the desire to lead others. On amotivation, the theory claims that the students may prefer to maintain personal desires such as relationships in order to gain social recognition and affiliation with others who impel them to achieve success in academics. All these assertions can be used to explain why there exist positive relationship between intrinsic and extrinsic motivation and mathematics achievement, and a negative association between amotivation and mathematics achievement.

The findings of this study on the existence of a positive association between achievement motivation and mathematics achievement agrees with the findings of previous researchers in similar area. For instance, in South Korea, Enhya and Sunghwan (2019) established that the pupils' motivation to pass in mathematics influenced the scores the pupils obtained. This indicated that achievement motivation has a relationship with mathematics achievement. Xiao and Sun (2021) reported results that are congruent to those of the current study. The study established that the students who were self-motivated (intrinsic motivation) to achieve better results in mathematics performed far much better than those who did not.

In Spain, Amanda et al. (2020) found that the pupils with intrinsic motivation did better in mathematics than those who did not, a clear indication of the association between achievement motivation and mathematics achievement. The findings of this study are also consistent with those obtained by Okotie and Adeyemi (2019) in Nigeria while conducting a similar study. The researchers established that the students' achievement motivation impacted on their academic achievement in mathematics. These findings are similar to the results of the current study.

In Kenya, Kariuki and Mbugua (2018) conducted a study to explore teacher-related motivating factors influencing students' academic achievement in Nyeri and Kirinyaga counties. The researchers established that teacher motivation had a positive impact on students' academic achievement. Teacher motivation is a form of extrinsic motivation, and thus the findings are congruent to those of the current study. In Kitui County, Kipngetich (2021) conducted a similar study and established that academic motivation, self-efficacy, and academic achievement were significantly related. However, this study did not investigate mathematics as a subject but the overall impact of academic motivation on academic achievement. Therefore, the findings of the current study support those of previous researchers who conducted studies in similar areas. Clearly, the results demonstrate the importance of achievement motivation in mathematics achievement.

4.4 Relationship between Metacognition in Mathematics and Mathematics Achievement

The second objective of this study was to investigate the relationship between metacognition in mathematics and mathematics achievement. This was achieved by carrying out the following tests.

4.4.1 Descriptive Statistics of Metacognition Scores

The descriptive statistics of metacognition scores were obtained to determine the minimum score, the maximum, the range, mean score and standard deviation, coefficient of skewness and kurtosis coefficient. Table 4.18 presents the results.

Table 4.18

Descriptive Statistics of Metacognition Scores

	N	Range	Min	Max	*M*	*SD*	*Sk*	*Kur*
Metacognition	346	72.00	28.00	100.00	58.75	11.81	.53	1.02

Note. *N* = 346; Min = Minimum; Max = Maximum; M = Mean; SD = Standard Deviation; Sk = Skewness; Kur = Kurtosis

The results in Table 4.18 indicate that the minimum score was 28 while the maximum was 100, giving a range of 72. The mean score stood at 58.75 with a standard deviation of 11.81. The coefficient of skewness was .53 indicting that the data was moderately skewed. The kurtosis coefficient was 1.02 indicating a platykurtic distribution. This suggests that most of the students had extreme scores and in this case low achievement in mathematics.

The descriptive statistics of metacognition scores were also obtained by gender to determine if there exist gender differences. The results are shown in Table 4.19.

Table 4.19

Descriptive Statistics of Metacognition by Gender

Gender	N	Min	Max	Range	*M*	*SD*
Male	181	28.00	100.00	72.00	59.05	11.38
Female	165	28.00	98.00	70.00	58.41	12.28
Total	346	28.00	100.00	72.00	58.75	11.81

Note. *N* = 346; Min = Minimum; Max = Maximum; M = Mean; SD = Standard Deviation

From Table 4.19, the male students did better than their counterparts on metacognition scale with a mean score of 59.05 (*SD* = 11.38). Their lowest score stood at 28 while the highest score was 100 giving a range of 72. The female students obtained a mean score of 58.41 (*SD* = 12.28). Their lowest score was 28 while the highest score was 98, giving a range of 70.

The descriptive statistics of mathematics achievement were also obtained by school category to determine if there exist mean differences among the various categories. The results are presented in Table 4.20.

Table 4.20

Descriptive Statistics of Metacognition by School Type

Type of school	N	Min	Max	Range	*M*	*SD*
Boys school	37	32.00	81.00	49.00	62.37	13.99
Girls school	36	28.00	79.00	51.00	58.31	8.32
Coeducational boarding	117	37.00	87.00	50.00	61.42	7.62
Coeducational day school	156	28.00	100.00	72.00	55.98	13.78
Total	346	28.00	100.00	72.00	58.75	11.81

Note. *N* = 346; Min = Minimum; Max = Maximum; M = Mean; SD = Standard Deviation

As shown on Table 4.20, the boys' schools obtained the highest mean score of 62.37 (*SD* = 13.99). Their lowest score was 32 while the highest score was 81 giving a range of 49. The coeducational boarding followed with a mean score of 61.42 and a standard deviation of 7.62. Their lowest score was 37 while the highest of 87 giving a range of 50. The girls boarding came third with a mean score of 58.31 (*SD* = 8.32). Their minimum score was 28 while the maximum was 79 resulting in a range of 51. The coeducational day obtained the lowest mean score of 55.98 (*SD* = 13.78) with the lowest score of 28 and highest score of 100 resulting in a range of 72.

The descriptive statistics of metacognition sub scales were also obtained. The sub scales included metacognitive knowledge, metacognitive experiences, and metacognitive strategies. The results were as presented in Table 4.21.

Table 4.21

Descriptive Statistics of Metacognition Sub Scales

	N	Range	Min	Max	*M*	*SD*
Metacognitive knowledge	346	28.00	7.00	35.00	12.99	5.38
Metacognitive experiences	346	31.00	7.00	38.00	17.99	7.11
Metacognitive strategies	346	32.00	7.00	39.00	28.11	6.45

Note. *N* =346; Min = Minimum; Max = Maximum; M = Mean; SD = Standard Deviation

As shown in Table 4.21, the metacognitive strategies sub scale had the highest mean score of 28.11 (*SD* = 6.45). Their lowest score was 7 while the highest score was 39 resulting in a range of 28. The metacognitive experiences sub scale followed with a mean score of 17.99 (*SD* = 7.11). Their minimum score was 7 while the highest score was 38 resulting in a range of 31. The metacognitive knowledge had the lowest mean score of 12.99 (*SD* = 5.38). Their minimum score was 7 while the maximum was 35 resulting in a range of 28.

4.4.2 Hypothesis Testing

In line with the second objective, the study sought to determine the relationship between metacognition in mathematics and mathematics achievement among form three students in Busia County, Kenya. The null hypothesis was therefore formulated as follows:

$H_{02:}$ There is no significant relationship between metacognition in mathematics and mathematics achievement.

Linear regression analysis and product moment correlation were used to determine the relationship. First, the relationship between the three domains of metacognition (metacognitive knowledge, metacognitive experiences, and metacognitive strategies) and mathematics achievement were examined. Product moment correlation results are shown in Table 4.22.

Table 4.22

Correlation between Metacognition and Mathematics Achievement

		Mathematics score
Metacognition	Pearson Correlation	.52*
	Sig. (2-tailed)	.00
	N	346
Metacognitive knowledge	Pearson Correlation	.57*
	Sig. (2-tailed)	.00
	N	346
Metacognitive experiences	Pearson Correlation	.49*
	Sig. (2-tailed)	.00
	N	346
Metacognitive strategies	Pearson Correlation	.51*
	Sig. (2-tailed)	.00
	N	346

From Table 4.22, metacognitive knowledge had a positive and significant relationship with mathematics achievement, r (346) = .57, p < .05. Secondly, metacognitive experiences had a positive and significant relationship with mathematics achievement, *r* (346) = .49, $p < .05$. Thirdly, metacognitive strategies had a positive and significant relationship with mathematics achievement, r (346) = .51, $p < .05$. In overall, the metacognition had a positive and significant relationship with mathematics achievement, *r* (346) = .52, p < .05. Therefore, the null hypothesis was rejected. The results suggest that an increase in metacognition in mathematics results in an increase in mathematics achievement.

To determine if each sub scale of metacognition had a significant predictive value on mathematics achievement, regression analysis was done. The results are presented in Table 4.23.

Table 4.23

Regression Analysis for Metacognition Sub Scales

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	27.17	2.09		12.97	.00
	MK	.87	.12	.47	7.31	.00
	ME	.19	.13	.13	1.49	.01
	MS	.53	.11	.34	4.65	.00

From Table 4.23, the results reveal that metacognitive knowledge had a positive and significant predictive value of mathematics achievement ($\beta = .87$, *t* (346) = 7.31, $p < .05$). This implies that a unit change in metacognitive knowledge changes mathematics achievement by 0.87. Secondly, metacognitive experiences had a positive and significant predictive value of mathematics achievement (β = .19, t (346) = 1.49, p < .05). This implies that a unit change in metacognitive experiences changes mathematics achievement by 0.19. Thirdly, metacognitive strategies had a positive and significant predictive value of mathematics achievement (β = .53, t (346) = 4.65, p < .05). This implies that a unit change in metacognitive strategies changes mathematics achievement by 0.53. The results show that the sub scales of metacognition can be used to predict mathematics achievement among secondary school students.

4.4.3 Discussion of the Results

The second objective of this study was to determine if there exists a significant relationship between metacognition in mathematics and mathematics achievement. It was established that there exists a positive and significant relationship between metacognition in mathematics and mathematics achievement. When the relationship between the sub scales of metacognition including metacognitive knowledge, metacognitive experiences, and metacognitive strategies and mathematics achievement was tested, it was established that all the sub scales had a positive and significant relationship with mathematics achievement. It was further established that all the sub scales of metacognition had a positive and significant predictive values on mathematics achievement.

These findings are supported by model of cognitive monitoring theory by Flavell (1976). The theory asserts that students can acquire the ability to store and retrieve information at a later date when deemed helpful at that time. The theory further argues that learning strategies are controlled by an individuals' consciousness of their thinking processes. This theory is based on three concepts including metacognitive knowledge, metacognitive experience, and metacognitive strategies. On metacognitive knowledge, the theory asserts that student characteristics, task, and strategy can determine whether or not to engage in or abandon a particular cognitive enterprise based on its relationship with interests, abilities, and goals. The task category entails knowledge about the tasks that need to be completed to achieve academic success. This knowledge helps students to manage their learning tasks to achieve academic goals. The strategy category involves setting goals and taking appropriate action to realize those goals. These characteristics can influence the mathematics achievement among students. Metacognitive experiences focus on the ability of a student to recall and use information and memories stored to come up with solutions to the current mathematical problems. The higher the ability the better the achievement in mathematics. Metacognitive strategies are ordered steps that are used to monitor one's cognitive activities to achieve set targets. Equipping students with these metacognitive skills helps them to monitor their learning process, plan and engage in activities that lead to academic success.

The findings of these study are consistent with those reported by researchers who conducted studies in similar areas. For example, Gemma (2021) established a positive and significant relationship between metacognition and student's mathematics achievement, results which are congruent with those of the current study. Another study carried out in Turkey by Toraman et al. (2020) established that there exist a substantial positive association between students' mathematics achievement, reflective problem-solving strategies, and metacognitive awareness. There was also a significant association between reflective thinking and metacognitive awareness. These findings are consistent with those of the current study.

In Nigeria, Nzeadibe et al. (2020) established that collaborative learning technique considerably improved students' academic results. The study did not focus on mathematics as a subject but the overall academic achievement. In Kenya, Chepkieng

(2020) conducted a similar study and found a strong link between students' metacognitive awareness and their overall academic achievement. Though this study did not focus specifically on mathematics achievement, the findings are consistent with those of the current study. The results show that metacognition in mathematics is an important aspect in learning mathematics.

4.5 Gender Differences in Achievement Motivation and Metacognition on Mathematics Achievement

The descriptive statistics of achievement motivation and metacognition based on gender of the respondent was obtained. The results are shown in Table 4.24.

Table 4.24

Gender and Metacognition of the Students

Gender		Metacognition	Achievement Motivation Score
	N	181	181
Male	Mean	59.05	3.15
	Std. Deviation	11.38	2.52
	N	165	165
Female	Mean	58.41	2.68
	Std. Deviation	12.28	2.97

From Table 4.24, on the metacognition, male students obtained a higher mean score of 59.05 (*SD* = 11.38). Their counterparts obtained a mean score of 58.41 (*SD* = 12.28). On achievement motivation score, the male students obtained a higher mean score of 3.15 (*SD* = 2.52) while their female counterparts obtained a mean score of 2.68 (*SD* =

2.97). This shows the existence of gender differences on achievement motivation and metacognition. To test whether the differences were significant, independent samples t test was conducted.

4.5.1 Hypothesis Testing

In line with the third objective, the study sought to determine if there exist significant gender differences in achievement motivation and metacognition on mathematics achievement among form three students in Busia County, Kenya. The null hypothesis was therefore formulated as follows:

$H_{03:}$ There is no significant gender differences in achievement motivation and metacognition on mathematics achievement. Independent samples t test was used to determine if the gender differences on achievement motivation and metacognition as obtained in Table 4.24 were significant. The results are presented in Table 4.25.

Table 4.25

Independent Samples t test for Differences in Metacognition and Achievement Motivation

		t	*df*	Sig. (2-tailed)
Metacognition	Equal variances assumed	.51	344	.00
	Equal variances not assumed	.50	334.53	.00
Achievement Motivation	Equal variances assumed	1.58	344	.01
	Equal variances not assumed	1.57	322.99	.01

From Table 4.25, the results on metacognition reveal that the mean differences between male and female students were statistically significant, t (2, 344), p <.05. On achievement motivation score, the results reveal that the mean differences between male and female students were statistically significant, t (2, 344), $p < .05$. These findings indicate that there are significant gender differences among students' metacognition and achievement motivation. For this study it was in in favor of the male students.

4.5.2 Discussion of the Results

The study established that there exist significant gender differences in achievement motivation and metacognition on mathematics achievement. The difference was in favor of the male students in each of the two variables, i.e., achievement motivation and metacognition. The findings of this study are supported by McClelland's Achievement Theory of Motivation (1985) and model of cognitive monitoring theory by Flavell (1976). The McClelland's achievement theory asserts that the students can be motivated by various factors to improve their mathematics achievement. The way the male students will pursue personal goals of mathematics achievement varies with the way the female students will do it. Equally, Flavell's theory argues that student characteristics, task, strategy, ability, and ordered steps can influence how a male and a female student pursue a set academic goal. The findings of this study are consistent with those established by scholars while carrying out similar studies. However, some studies have established results that are inconsistent with those of the current study.

For instance, in Nigeria, Omotosho (2018) investigated the influence of motivation on achievement in mathematics. The researcher established that there were significant gender differences in achievement motivation. This was in favor of male who had a better achievement in mathematics compared to their female counterparts, results which are congruent with that of the current study where achievement motivation was also in favor of the male students on mathematics achievement. In the same country, Awofala and Olanyika (2020) in a similar study established that there was a significant gender difference in motivation and achievement in mathematics which was in favor of the male students who performed better than female students. These findings are very consistent with those of the present study.

In Kenya, Mwaura and Kimani (2020) reported results that were contrary to those of the present study. The researchers established the existence of gender differences in academic motivation but was in favor of the female students, unlike the present study which was in favor of the male students. The contrast can be attributed to the fact that the study did not focus specifically on mathematics achievement, but rather the relationship between achievement motivation and the overall students' achievement.

Further, Li and Peng (2020) established that there was no statistical difference between mathematics achievement between male and female students. However, male students recorded better level of motivation compared to their female counterparts. These findings are not consistent with that of the current study. On gender differences in metacognition, mixed results have also been reported. For instance, in Turkey, Tuba and Arikan (2022) established that there was an association between metacognition and gender of the student. They reported that female students had a higher metacognitive knowledge than male students, results which are contrary to that of the present study which was in favor of the male students. In Nigeria, Tyovenda and Abari (2021) conducted a similar study and established that those students who were taught using metacognitive approach performed better in mathematics and that the achievement of male and female students did not differ significantly. These results are inconsistent with those of the present study. Another similar study carried out by Matiku (2019) in Tanzania revealed that there was no significant gender difference on metacognition, results that are inconsistent with those of the present study. In Kenya, Chepkieng (2020) established the there was no significant gender difference on metacognitive awareness based on gender of the students. These results are inconsistent with that of the present study but in general the results reveal that there are gender differences in metacognition and achievement motivation.

4.6 Predictive Weight of Achievement Motivation and Metacognition on Mathematics Achievement

The fourth objective of this study was to determine the predictive weight of achievement motivation and metacognition on mathematics achievement. This was achieved by conducting the following tests.

4.6.1 Test for Assumptions of Regression Analysis

The test for assumption of regression analysis was determined by carrying out three tests including normality test results, heteroscedasticity and homoscedasticity, and multi-collinearity and singularity. The results for each are discussed below.

To determine the distribution of data for metacognition and achievement motivation, the coefficient of skewness and kurtosis coefficient were obtained for each. Table 4.26 presents the results.

Table 4.26

Normality Test Results

	N	Skewness	Kurtosis
Metacognition	346	.53	1.02
Achievement Motivation Score	346	-.51	2.45

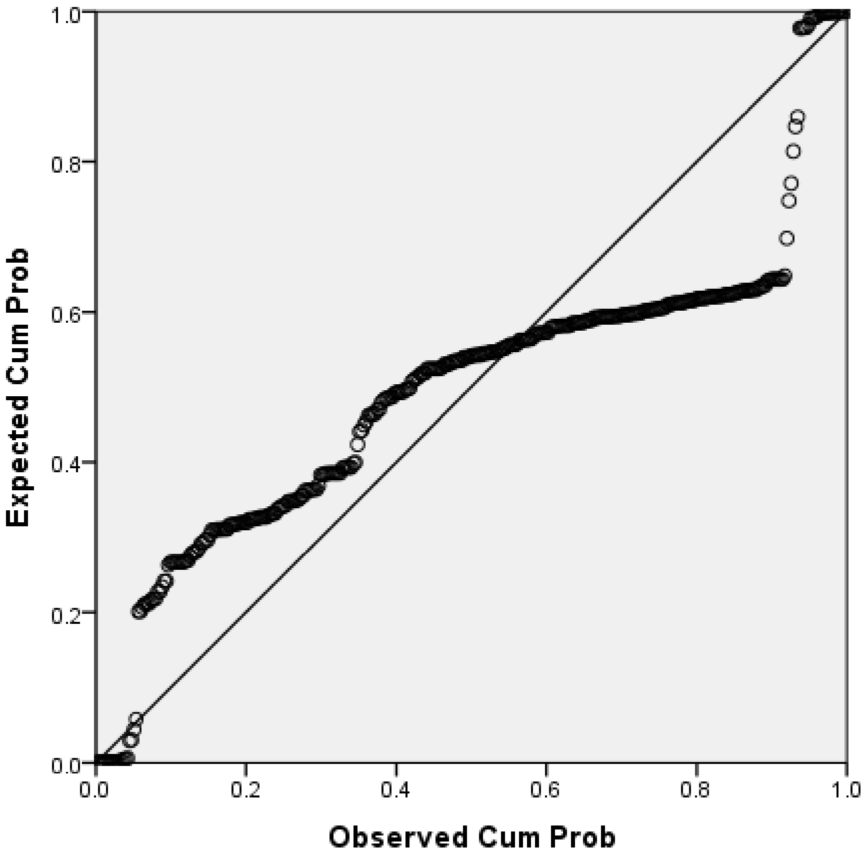
Note. *N* = 346

From Table 4.26 on metacognition, the coefficient of skewness was .53 indicating a distribution that is moderately skewed. The kurtosis coefficient was 1.02 which shows that the distribution was platykurtic suggesting that few students had extreme scores in metacognition. On academic motivation, the coefficient of skewness was -.51 showing a moderately skewed data distribution. The kurtosis coefficient was 2.45 indicating a platykurtic distribution. The results indicate that metacognition scores and achievement motivation scores were near normal distribution.

The assumption on heteroscedasticity and homoscedasticity was tested using normal p-p plot of regression standardized residual.

Figure 4.1

Normal p-p plot of Regression Standardized Residual



From Figure 4.1, the points are almost the same distance from the line indicating that the homoscedasticity rule was not violated. This confirms that the predictive values were reliable and accurate for making an informed conclusion.

The researcher tested for the multi-collinearity and singularity to determine whether independent variables were highly correlated. Table 4.27 presents the results.

Table 4.27

Tolerance and VIF

Model		Collinearity Statistics		
		B	Tolerance	VIF
	(Constant)	24.41		
1	Metacognition	.31	.949	1.054
	Achievement Motivation Score	2.44	.949	1.054

Note. VIF – Variance Inflation Factor

Table 4.27 shows that the tolerance values for achievement motivation and metacognition are not less than 0.1 and their VIF values were less than 10. This indicates that the achievement motivation and metacognition were not highly correlated.

4.6.2 Hypothesis Testing

In line with the fourth objective, the study sought to determine the predictive weight of achievement motivation and metacognition on mathematics achievement. The null hypothesis was formulated as follows:

$H_{04:}$ There is no significant predictive weight of achievement motivation and metacognition on mathematics achievement.

Regression analysis was carried out to determine whether achievement motivation and metacognition could be used to jointly predict mathematics achievement. Tables 4.28, Table 4.29, and Table 4.30 presents the results.

Table 4.28

Model Summary for the Prediction of Mathematics

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.84[a]	.70	.70	5.47

a. Predictors: (Constant), Academic Motivation Score, Metacognition

b. Dependent Variable: T_score

Table 4.28 shows that R square value was .70 which indicates that 70% of the variance in mathematics achievement among form three students in Busia County, Kenya is jointly influenced by achievement motivation and metacognition. The multiple regression coefficient was .84 which indicates a high correlation between achievement motivation, metacognition and mathematics achievement.

ANOVA test was used to determine if this joint influence of mathematics achievement by both achievement motivation and metacognition was significant. Table 4.29 presents the results.

Table 4.29

ANOVA in the Prediction of Mathematics

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	24239.88	2	12119.94	405.17	.00[b]
	Residual	10260.13	343	29.91		
	Total	34500.00	345			

a. Dependent Variable: T_score

b. Predictors: (Constant), Academic Motivation Score, Metacognition

Table 4.29 reveals that both achievement motivation and metacognition had a joint significant relationship with mathematics achievement, F (2, 343) = 405.17, $p < .05$. Therefore, the null hypothesis was rejected implying that achievement motivation and metacognition significantly predict mathematics achievement.

The predictive values for both the achievement motivation and metacognition on mathematics achievement were obtained by carrying out regression analysis. The results are shown in Table 4.30.

Table 4.30

Regression Analysis for Achievement Motivation and Metacognition

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	24.41	1.49		16.35	.00
	Metacognition	.31	.03	.28	12.27	.00
	Achievement Motivation	2.44	.11	1.67	22.25	.00

Table 4.30 indicates that metacognition had a positive and significant link with mathematics achievement, $\beta = .31$, $t\,(346) = 12.27$, $p < .05$. This implies that by holding achievement motivation constant, a unit change in metacognition leads to 0.31 change in mathematics achievement. Secondly, achievement motivation had a positive and significant relationship with mathematics achievement, $\beta = 2.44$, $t\,(346) = 22.25$, $p < .05$. This implies that by holding metacognition constant, a unit change in achievement motivation leads to 2.44 change in mathematics achievement.

The prediction equation for model 1 is as below:

$\hat{Y} = 24.41 + 0.31X_1 + 2.44X_2 + \varepsilon$

Where $\hat{Y}$ = Predicted mathematics achievement; X_1 = metacognition, X_2 = achievement motivation, and $\acute{\varepsilon}$ = standard error.

4.6.3 Discussion of the Results

The study established that the 70% of the changes in mathematics achievement among students are jointly influenced by achievement motivation and metacognition. It was also established that metacognition had a positive and significant link with mathematics achievement. Furthermore, achievement motivation had a positive and significant association with mathematics achievement. These findings are supported by both McClelland's achievement theory of motivation (1985) and model of cognitive monitoring theory by Flavell (1976). The McClelland's achievement theory asserts that the students can be motivated by various factors to improve their mathematics achievement.

This implies that the level of effort a student puts in pursuit of academic goals acts as the motivator can be used to predict whether such a student will achieve better mathematics results or not. Equally, Flavell's theory argues that student characteristics, task, strategy, ability, and ordered steps can influence how a student pursues a set academic goal. This implies that the strategies put in place by a student, for instance, can be used to predict whether such a student will improve on his/her mathematics achievement. Effective strategies may result in better mathematics achievement. The findings of this study are consistent and inconsistent in equal measure with the findings of previous similar studies. However, very few studies have dwelt on the two variables jointly and the current study will add to the available literature and provide latest information.

For example, Areepattamannil (2014) conducted a similar study in India and Canada and established that intrinsic motivation positively predicted mathematics achievement. It was also established that extrinsic motivation negatively predicted mathematics achievement, while amotivation did not significantly predicted mathematics achievement. This study focused solely on achievement motivation and whether it predicts mathematics achievement, the current study included metacognition to examine whether it predicts mathematics achievement. There was a gap on studies involving predictive weight of achievement motivation and metacognition on mathematics achievement. The present study provides additional literature in this area that may guide future studies.

Rasha (2019) established that the academic successes and academic motivation; academic achievement and academic intrinsic motivation; academic achievement and academic extrinsic motivation were found to be significantly correlated. Tang et al. (2021) reported that motivation was positively associated with metacognitive knowledge and negatively related to metacognitive avoidance strategies. The study involved the association between metacognitive knowledge and mathematics achievement and does not provide the extent to which metacognitive knowledge predicts mathematics achievement. In Uganda, the study conducted by Kwarikunda and Ssenyonga (2020) established that motivation was significantly associated to the achievement of the students in mathematics. In Kenya, the study carried out by Onchiri and Aloka (2019) revealed that there exists a statistically positive correlation between metacognition and mathematics achievement. The present study will provide additional literature that may guide future studies in similar areas.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

In this chapter, summary of the findings, conclusions and recommendations are presented.

5.2 Summary of the Findings

The first objective was to determine if there exists a significant link between achievement motivation and mathematics achievement. This relationship was determined by carrying out the following tests. The descriptive statistics of achievement motivation showed that most students had average achievement motivation. To determine whether there exists a relationship between achievement motivation and mathematics achievement, the researcher hypothesized that there is no significant relationship between achievement motivation and mathematics achievement. The relationship was determined using correlation and linear regression analysis. First, the intrinsic motivation was found to have a strong positive and significant relationship with mathematics achievement. Secondly, the extrinsic motivation had a strong positive and significant association with mathematics achievement. Thirdly, the amotivation sub scale had a negative relationship with mathematics achievement. This implies that the lower the amotivation among form three students the higher the mathematics achievement and vice versa.

Overall, achievement motivation had a positive and significant association with mathematics achievement. The null hypothesis was therefore rejected and the alternative one adopted which stated that there is a significant association between achievement motivation and mathematics achievement. When the predictive values of the sub scales of achievement motivation were obtained, the intrinsic motivation had a positive and significant predictive value of mathematics achievement. Amotivation had a negative and significant predictive value on mathematics achievement. Extrinsic motivation had a positive significant predictive value on mathematics achievement. The mean scores for the three levels of achievement motivation revealed that the students with high level of achievement motivation had the highest mean score in mathematics followed by those with average level, then those with low level of achievement motivation.

The second objective of this study was to examine the association between metacognition in mathematics and mathematics achievement. To determine whether there exists a significant association between metacognition in mathematics and mathematics achievement among form three students in Busia County, Kenya, the researcher hypothesized that there is no significant association between metacognition in mathematics and mathematics achievement. When this null hypothesis was tested using linear regression analysis and product moment correlation, it was established that metacognitive knowledge had a positive and significant association with mathematics achievement. Metacognitive experiences also had a positive and significant relationship with mathematics achievement. Furthermore, metacognitive strategies had a positive and significant relationship with mathematics achievement. Overall, metacognition had a positive and significant relationship with mathematics achievement. The regression analysis conducted to determine if each of the metacognition sub scales had a significant predictive value of mathematics achievement, revealed that metacognitive knowledge had a positive and significant predictive value on mathematics achievement. Similarly, metacognitive experiences had a positive and significant predictive value on mathematics achievement. Thirdly, the metacognitive strategies had a positive and significant predictive value on mathematics achievement

The third objective of this study was to determine if there exist gender differences in achievement motivation and metacognition on mathematics achievement. The descriptive statistics of metacognition based on gender, revealed that the male students had a higher mean score of 59.05 with a standard deviation of 11.38. Their female counterparts had a mean score of 58.41 with a standard deviation of 12.28. On achievement motivation scores, male students had a higher mean score of 3.15 with a standard deviation of 2.52 while their female counterparts obtained a mean score of 2.68 with a standard deviation of 2.97. This shows the existence of gender differences on achievement motivation and metacognition. The independent samples t test conducted to determine whether these mean differences were significant, revealed that on metacognition, the mean differences between male and female students were statistically significant. On academic motivation score, the results reveal that the mean differences between male and female students were statistically significant.

The fourth objective of this study was to determine the predictive weight of achievement motivation and metacognition on mathematics achievement. When the hypothesis which stated that there is no significant predictive weight of achievement motivation and metacognition on mathematics achievement was tested, the model summary results established an R square value of 0.70 indicating that the 70% of the changes in mathematics achievement among form three students in Busia County, Kenya were jointly influenced by achievement motivation and metacognition. The ANOVA test conducted to determine if this joint influence of mathematics achievement by both achievement motivation and metacognition was significant revealed that both had a joint, positive and significant relationship with mathematics achievement. On the predictive values for each variable, the metacognition had a positive and significant association with mathematics achievement. Achievement motivation also had a positive and significant association with mathematics achievement.

5.3 Conclusions

The first study objective was to determine if there exists a significant association between achievement motivation and mathematics achievement. The study concludes that there exists a significant relationship between achievement motivation and mathematics achievement. Based on the findings from the sub scales of achievement motivation, the researcher concludes that there exists a positive and significant relationship between both extrinsic and intrinsic motivation and mathematics achievement implying that any change in any of them will lead to a significant change in mathematics achievement. The study further concludes that there exists a negative and significant relationship between amotivation and mathematics achievement implying that the lower the amotivation the higher the mathematics achievement among secondary school students. To improve on mathematics achievement teachers need to support students to reduce on amotivation.

The second objective of this study was to determine if there exists a significant relationship between metacognition in mathematics and mathematics achievement. Based on the results, the study concludes that there exists a positive and significant relationship between metacognition in mathematics and mathematics achievement. This implies that the higher the metacognition the higher the mathematics achievement among secondary school students. Learners need be taught on metacognitive knowledge and metacognitive strategies to use in learning mathematics in order to excel in mathematics, since metacognition is a very important construct in learning mathematics.

The third objective of this study was to determine if there are significant gender differences in achievement motivation and metacognition on mathematics achievement. The study concludes that there exists significant gender differences in achievement motivation and metacognition on mathematics achievement, which was in favor of the male students in each of the two variables, (achievement motivation and metacognition). This implies that the higher the metacognition and achievement motivation among the students, the higher the mathematics achievement among the male students than their female counterparts.

The fourth objective of this study was to determine the predictive weight of achievement motivation and metacognition on mathematics achievement. The study concludes that achievement motivation and metacognition accounted for 70% of the changes in mathematics achievement among form three students in Busia County. The study also concludes that by holding achievement motivation constant, a unit increase in metacognition leads to an increase in mathematics achievement. Furthermore, by holding metacognition constant, a unit increase in achievement motivation leads to an increase in mathematics achievement. This implies that both achievement motivation and metacognition could be used to significantly predict mathematics achievement among secondary schools.

5.4 Recommendations

Based on the study objectives, the following recommendations were made:

5.4.1 Practice Recommendations

i. There is need for teachers to come up with guidance programmes to boost achievement motivation among the students for better mathematics achievement in secondary schools.

ii. Teachers and curriculum developers should include and improve ways of enhancing metacognition like enquiry based learning in their teaching methodologies and in the school curriculum to ensure that it works for the benefit of the students in learning mathematics and better achievement in the subject.

iii. There is a need for the parents and teachers to address the challenges faced by the female students in achievement motivation and metacognition to ensure that they catch up with the male students in mathematics achievement. This can be done through tailored guidance programmes like involvement of mentors and role models who have excelled in STEM to regularly talk to the female students.

5.4.2 Recommendations for Further Research

i. Having established that the predictive values of achievement motivation and metacognition on mathematics achievement of form three students in Busia County are significant, there is need for further research to be done in other counties to establish if similar results would be obtained.

ii. This study used questionnaires only in data collect and therefore there is need for a similar study in Busia County and other counties using mixed methodology to compare the results.

iii. The study used correlational research design and therefore the results cannot be used to make causal effect conclusions. Therefore, further research should be conducted using experimental research to establish causal effect in the association between achievement motivation, metacognition and mathematics achievement.

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APPENDICES

Appendix A: Consent Letter

My name is Mr. Brian Mukani Okaka, a masters student at Kenyatta University in the Department of Educational Psychology. I am conducting a study in Samia Sub County on achievement motivation and metacognition as predictors of mathematics achievement among form three students in public secondary schools. You are free to choose to participate in this study or not and if you decide to participate you can withdraw anytime. The information that you will provide will be handled with uttermost confidentiality and the findings will be reported in summary form without any identifying information being revealed. There is no monetary reward for participation but the findings may be used to enhance mathematics achievement in public secondary schools in the area.

I agree to participate in the study.

Signature………………………………………………Date………………………

Appendix B: Questionnaire for Students

This research is meant for academic purpose. You are kindly requested to provide answers to these questions as honestly and precisely as possible. Responses to these questions will be treated as confidential. Please do not write your name or that of your school anywhere on this questionnaire. Please tick [√] where appropriate or fill in the required information on the spaces provided.

Section A: Background information

Code_________ Adm No…………………………

1 Gender Male [ ] Female [ ]

2 Type of school

Boys school [ ] Girls school [ ] Coeducational boarding school [ ] Coeducational day school [ ]

3 Age ……………..years

4 End of term grade in mathematics………………….. Marks…………………..

Section B: Achievement Motivation Scale

Using the scale below, indicate to what extent each of the following items presently resembles one of the reasons why you go to school.

Does not correspond at all		Corresponds a little	Corresponds moderately	Corresponds a lot		Corresponds Exactly
1	2	3	4	5	6	7

I am going to school because?	**1**	**2**	**3**	**4**	**5**	**6**	**7**
1. I am working to get a good secondary school certificate in order to be admitted for a competitive course in the university							
2. I find it to be fun when my teachers or fellow students teach me something new							
3. I think my secondary school education helps me prepare for the choice of course I will take at the university							
4. I really enjoy going to school							
5. Sometimes I feel like am not making good use of my time when am at home							

6.	It becomes enjoyable when I score grades higher than my set targets in exams							
7.	I need to convince myself that am able to finish my secondary school							
8.	I would like to get good scores in my KCSE exams							
9.	I find it more fun when I know new things							
10.	I will be able to get a good grade and join the university of my choice							
11.	I enjoy being in school							
12.	Initially I had several good reasons to attend secondary school, I don’t know if I should continue believing in them							

13. I find it enjoyable when I score higher than my desired grade.							
14. If I do well in my exams I will feel like am a very great person in this life							
15. I would want to be admitted to the best course in the university							
16. I find it fun in learning new topics in my best subjects							
17. This will make me choose the right course in the field of study that I want							
18. I feel fun when most of my time is taken learning what I love.							
19. Every sibling of mine is attending school							
20. Its fulfilling when am trying to finish hard assignments.							
21. I am proofing to myself that am a bright student							

22. I want to be mentioned among the top students in the country in my KCSE							
23. Being in class gives me the chance to know new things every time.							
24. I believe staying in school for my last two years in secondary will have a positive impact on my grade.							
25. I feel very nice studying topics that interest me.							
26. My parents paid fees for me to be here							
27. Being in school makes me feel like I am happy and working towards good grades							
28. I want to proof that I can excel academically							

SCORING THE AMS

Key for AMS High School version -28 items

Item

Type/ domain/orientation of Motivation measured

2, 9, 16, 23 Intrinsic motivation - to know

6, 13, 20, 27 Intrinsic motivation - toward accomplishment

4, 11, 18, 25 Intrinsic motivation - to experience stimulation

3, 10, 17, 24 Extrinsic motivation - identified

7, 14, 21, 28 Extrinsic motivation - introjected

1, 8, 15, 22 Extrinsic motivation - external regulation

5, 12, 19, 26 Amotivation

Calculations;

To calculate a participant's score on the AMS, the mean response for each of the sub-scales was found. These means varied between 1 and 7. The means were then inserted in the following formula which was used to calculate a self -determination index which was taken as the participant's academic motivation score. The formula had been adapted from Vallerand, Pelletier, Blais, Briere, Senecal, and Vallieres (1992).

2{(know+acc+stim/3)} + iden – {(intro+reg/2) + 2amo} = Academic Motivation.

know = intrinsic motivation to know; acc = intrinsic motivation to accomplishments; stim = intrinsic motivation to experience stimulation; iden =139 identification; intro = introjected regulation; external regulation; amo = amotivation.

This formula gives scores ranging from -18 (very little self-determination/academic motivation) to +18 (extreme self-determination/ high academic motivation)

Section C: Metacognition Scale

Using a scale of: Not true = 1[ ], A little true = 2[ ], Rather true = 3[ ], true = 4[ ] and Very true = 5[ ] respond to the following as honestly as possible. Use tick [√] as appropriate.

Metacognitive knowledge	**1**	**2**	**3**	**4**	**5**
1.When I solve problems with multiplication I get tired					
2. I often have difficulty to think which operations					
3. I do not understand the fractions very well					
4. I often make mistakes when solving problems with decimals					
5. Division is hard for me					
6. When I read a problem with many words I do not understand what I have to do					
7. It takes me a lot of time to solve mathematical problems					

Metacognitive experiences					
How difficult do you think is a problem that;					
i. Has fractions?					
ii. Does not clearly show what it means?					
iii. Has many operations?					
iv. Has numbers one needs to figure out how to combine them?					
v. Has words not clearly showing the operations to be done?					
vi. Requires you to do constructions?					
vii. Requires you to draw solids before solving the problem?					
Metacognitive strategies					
1. When I am reading a mathematical problem I am thinking whether there are various ways for solving it					
2. I pay attention to the words in the phrasing of the problem in order to figure out what is required so that I can solve it					

3. When I do not understand something, I ask my teacher to explain					
4. When I have solved a mathematical problem, I check if I did the computations correctly					
5. When I find the mathematical problem complicated, I think of various pieces of it separately and the sequence to put in to solve it					
6. When I finish the solution of a mathematical problem I read the problem again and check if I did the operations in the order they should be done					
7. When I finish the solution of a mathematical problem I evaluate the outcome if it is in accordance with what the problem required					

Appendix C: Research Permit

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: 978161

Date of Issue: 01/May/2023

RESEARCH LICENSE

This is to Certify that Mr.. Brian Mukani Okaka of Kenyatta University, has been licensed to conduct research as per the provision of the Science, Technology and Innovation Act, 2013 (Rev.2014) in Busia on the topic: ACHIEVEMENT MOTIVATION AND METACOGNITION AS PREDICTORS OF MATHEMATICS ACHIEVEMENT AMONG FORM THREE STUDENTS IN BUSIA COUNTY, KENYA for the period ending : 01/May/2024.

License No: NACOSTI/P/23/25742

978161

Applicant Identification Number

Director General
NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Verification QR Code

NOTE: This is a computer generated License. To verify the authenticity of this document, Scan the QR Code using QR scanner application.

See overleaf for conditions

Appendix D: Authorization Letters

REPUBLIC OF KENYA

MINISTRY OF EDUCATION
STATE DEPARTMENT OF BASIC EDUCATION

Telephone: 055-22152
Fax: 055-22152
When replying please quote
Email:cdebusia@gmail.com

COUNTY DIRECTOR OF EDUCATION
BUSIA COUNTY
P.O. BOX 15 - 50400
BUSIA (K)

25th May, 2023

Ref No. BSA/CDE/ED/9/6/197

All Sub-County Directors of Education

RE: RESEARCH AUTHORIZATION

This office is in receipt of letter from Kenya National Commission for Science, Technology and Innovation (NACOSTI) dated 1st May, 2023 authorizing research on "***Achievement Motivation and Metacognition as Predictors of mathematics Achievement among form three students in Busia County, Kenya***" in your sub-county for the period ending **1st May, 2024.**

This is to inform you that Mr.Brian Mukani Okaka has been authorized to conduct the research. Kindly accord him the necessary assistance.

JAMES EKAALE EKALIYO
COUNTY DIRECTOR OF EDUCATION
BUSIA COUNTY

Appendix E: Sample Size Determination Table

N	*S*	*N*	*S*	*N*	*S*
10	10	220	140	1200	291
15	14	230	144	1300	297
20	19	240	148	1400	302
25	24	250	152	1500	306
30	28	260	155	1600	310
35	32	270	159	1700	313
40	36	280	162	1800	317
45	40	290	165	1900	320
50	44	300	169	2000	322
55	48	320	175	2200	327
60	52	340	181	2400	331
65	56	360	186	2600	335
70	59	380	191	2800	338
75	63	400	196	3000	341
80	66	420	201	3500	346
85	70	440	205	4000	351
90	73	460	210	4500	354
95	76	480	214	5000	357
100	80	500	217	6000	361
110	86	550	226	7000	364
120	92	600	234	8000	367
130	97	650	242	9000	368
140	103	700	248	10000	370
150	108	750	254	15000	375
160	113	800	260	20000	377
170	118	850	265	30000	379
180	123	900	269	40000	380
190	127	950	274	50000	381
200	132	1000	278	75000	382
210	136	1100	285	1000000	384

Note.—*N* is population size; *S* is sample size

Appendix F: Permission to Use Research Instruments

Permission to use academic motivation scale Inbox x

Brian Mukani Thu, Jul 7, 11:32 AM (7 days ago)
Good morning Prof. Vallerand My name is Mr. Brian Okaka, a masters student at Kenyatta University in the Department of Educational Psychology. I am cond...

Sam Tion, Michael <sam_tion.michael@uqam.ca> Thu, Jul 7, 4:16 PM (7 days ago)
to me

Good day Mr Brian,

You will be able to find the different versions of the AMS on our website: https://www.lrcs.uqam.ca/en/scales/ or attached for the College version.

Please note that the Scoring key is at the end of the scale (document). The articles attached will help you understand and interpret the scale so feel free to have a good look at them.

To calculate a person's score on the AMS, you need to find the mean response for each of the subscales. These means will vary between 1 and 7 (or between 1 to 5). You then insert these means in the following formula which will able you to calculate a self-determination index:

2((know+acc+stim/3)) + iden - ((intro+reg/2) + 2amo)= self-determination index

know= intrinsic motivation to know
acc= intrinsic motivation to accomplishments
stim= intrinsic motivation to experience stimulation

Permission to use Metacognitive knowledge in mathematics questionnaire Inbox x

Brian Mukani Thu, Jul 7, 11:48 AM (7 days ago)
Good morning Prof. Anastasia Efklides My name is Mr. Brian Okaka, a masters student at Kenyatta University in the Department of Educational Psychology. I...

efklides@psy.auth.gr Thu, Jul 7, 7:29 PM (7 days ago)
to me

Dear Brian Mukani,

It is my pleasure to grant permission to use the questionnaire. Be aware that you need to ask permission from the Publisher as well. They usually grant permission without any charges when it is for research. However, they also give instructions how to cite the reference.

Wishing you best of success to your research.

Kind regards

A. Efklides

Appendix G: Map of Busia County