EXECUTIVE FUNCTIONING AND ACADEMIC SCAFFOLDING AS PREDICTORS OF ACHIEVEMENT MOTIVATION FOR LEARNING CHEMISTRY AMONG FORM THREE STUDENTS IN KIAMBU COUNTY, KENYA

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A RESEARCH THESIS SUBMITTED IN PARTIAL FULFILMENT OF THE DEGREE OF DOCTOR OF PHILOSOPHY (EDUCATIONAL PSYCHOLOGY) IN THE SCHOOL OF EDUCATION AND LIFE LONG LEARNING OF KENYATTA UNIVERSITY

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DECLARATION

I confirm that this research thesis is my original work and has not been presented in any other university or institution for consideration of any certification. The thesis 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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We confirm that the work reported in this thesis was carried out by the candidate under our supervision as university supervisors.

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This thesis is dedicated to my late mum Mary Moraa for inspiring me to aim higher in education and my wife Purity and children-Reagan, Ryan and Gyan for their sacrifices and understanding that enabled me to pursue PhD studies.

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ABBREVIATIONS AND ACRONYMS

ANOVA	Analysis of Variance
EF	Executive Functioning
KCSE	Kenya Certificate of Secondary Education
KICD	Kenya Institute of Curriculum Development
NACOSTI	National Commission of Science, Technology and Innovation
PISA	Programme for International Student Assessment
SDGs	Sustainable Development Goals
SMTSL	Student's Motivation towards Science Learning Questionnaire
SPSS	Statistical Package for Social Sciences
TIMMS	Trends in International Mathematics and Science Study
WCST	Wisconsin Card Sorting Task

ABSTRACT

Most secondary schools in Kiambu County are grappling with low achievement motivation for learning chemistry as evidenced by below average performance in the subject among students. There is limited research evidence on the predictors of achievement motivation for learning chemistry in Kiambu County that may be used to address this problem. This research was conducted to examine executive functioning and academic scaffolding as predictors of achievement motivation for learning chemistry among form three students in Kiambu County. Specifically, the researcher sought to investigate the relationship between executive functioning and achievement motivation for learning chemistry, the relationship between academic scaffolding and achievement motivation for learning chemistry, the extent to which the student's gender moderates the relationship between executive functioning, academic scaffolding and achievement motivation for learning chemistry and to develop a prediction equation for achievement motivation for learning chemistry from executive functioning and academic scaffolding. The study was anchored on scaffolding theory developed by Bruner, information processing theory by Siegler, and achievement motivation theory by McClelland. The researcher used convergent parallel mixed research design to examine the relationship between the study variables. The target population was 28400 form three students taking chemistry in 285 public secondary schools in Kiambu County in the year 2020. Purposive sampling was used to select Kiambu County and form three students taking chemistry. Stratified sampling was used to select the schools while simple random sampling was used to select students to participate in the study. The study was conducted in 17 secondary schools using a sample of 440 students. A pilot study was done in one school involving 40 students to establish the validity and reliability of the research instruments. Data were collected using questionnaires and interview schedules and then analyzed using, descriptive, inferential statistics and thematic analysis. The results indicated that there was a moderate significant positive correlation between executive functioning and achievement motivation for learning chemistry, r (336) = .39, $p < .05$. There was a moderate positive and statistically significant correlation between academic scaffolding and achievement motivation for learning chemistry, r (336) = .50, $p < .05$. The interaction between executive functioning skills and gender accounted for 2% variance in achievement motivation for learning chemistry. However, ΔR^2 was not statistically significant, ΔF (1, 334) = 0.01, $P > .05$. The interaction between academic scaffolding and gender explained 10% variance in achievement motivation for learning chemistry but ΔR^2 was not statistically significant, ΔF (1, 334) = 3.03, $p > .08$. Academic scaffolding and executive functioning significantly predict achievement motivation for learning chemistry, F (2, 335) = 81.34, $P < .05$. Qualitative results also showed that executive functioning and academic scaffolding were positively associated with student's achievement motivation for learning chemistry. The study recommends that school counsellors and chemistry teachers should guide and support chemistry students (scaffolding) to enhance their executive functioning skills in order to boost the student's achievement motivation for learning chemistry for better learning outcomes 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 and purpose of the study. It also presents the research objectives, research hypotheses, significance, limitations and delimitations, assumptions, theoretical and conceptual framework as well as the operational definition of terms.

1.2 Background to the Study

Achievement motivation has been considered as an important factor for learning and school achievement. In the absence of sufficient achievement motivation, it's very unlikely for meaningful learning to take place (Febriana, 2017). The concept was introduced into behavioral science by Murray (1938) and since then, it has become very popular in the study of human behavior, especially in educational settings. Achievement motivation for learning chemistry is defined as the desire for learning and attaining quality grades in chemistry (Uno, 2013). It is considered as an important factor in learning and achievement in chemistry. Achievement motivation for learning chemistry is significantly associated with the efforts the students put to accomplish tasks in the subject and the grades they score. A student with high achievement motivation for learning chemistry, experiences pleasure from their ability to use efficient strategies and the consequent success attained in learning chemistry concepts. Owing to the abstract nature of most chemistry concepts, learners need to have high achievement motivation to effectively learn what they are taught.

While, efforts have been made to enhance achievement motivation for learning chemistry among learners, many countries across the world are still grappling with low levels of achievement motivation, and consequently below average performance in the subject (Bullock, 2017). In the USA, a report by Mullis et al. (2020) revealed that the country performed dismally in science assessment when compared to other developed countries such as China and Singapore. The report indicated that the average score in science assessment among learners in grade four was 539 compared to 550 average scales in TIMSS internationally. USA was ranked 8th while Singapore was ranked the first. In 2012, USA was ranked position 27th in a science assessment that was conducted by Programme for International Student Assessment (PISA). In Indonesia, Media Indonesia (2015) reported that the students' scores in PISA and TIMSS were among the lowest, pointing to low achievement motivation towards learning of science subjects. Even though these reports were based on achievement in science subjects among children, the findings are a pointer to a worrying trend in achievement motivation for learning and achievement in chemistry in secondary schools, which has not been documented. This is due to the fact that science education in lower grades forms a basis for subsequent achievement in science subjects like chemistry in secondary schools.

In Nigeria, Chikendu (2022) reported that learning of chemistry among students is faced by a myriad of challenges including inadequate learning facilities such as laboratories and teaching methods that do not engage the students in practicals. Olakanmi et al. (2016) established that many science learners are often lowly motivated. Some of the reasons being that they do not see the importance of studying science subjects which they feel are frustratingly hard. In addition, they have low achievement motivation for learning sciences, chemistry being one of them. Reasons, which often lead to below average performance in the science subjects. The problem seems to extend even to higher institutions of learning. For example, Nkiko (2021) observed that most chemistry students in universities in Nigeria had low interest and were ambivalent towards the subject. The researcher noted that this trend threatened the availability of human capital and thus the sustainability and efficiency in chemistry related industries in the country. This problem was attributed to motivation and attitude issues towards the subject in secondary schools.

Regionally, Negassa (2014) reported that most students in Ethiopia performed far below average in sciences, a problem that was partly attributed to low levels of achievement motivation and negative attitude toward the sciences. The researcher established that the average achievement score in sciences of the study group was 44.47% while the national mean score was 49.51% which were all below the expected average score of 50%. The study also revealed that the students were not intrinsically motivated to achieve their full potential in science subjects. Majority of the students reported that science subjects were difficult and that they had no positive feeling towards learning the subjects. The nature of achievement motivation for learning chemistry among secondary school students in Kenya remains largely unexplored. However, there is an abundance of literature on the factors associated with below average achievement in chemistry (Ongeri, 2012; Oluoch, 2018; Ogembo, 2013). Some of the studies revealed that poor achievement motivation for learning chemistry contributed to below average achievement in the subject.

In Kiambu County, Wangui (2017) investigated the influence of motivational strategies on performance in chemistry and reported that among the science subjects, chemistrywas the worst performed. The researcher associated the below average performance with low levels of achievement motivation towards learning chemistry. It was revealed that achievement motivation for learning chemistry determines the goals students set in the subject and how they strive to achieve them. The level of achievement motivation determines the choices that learners make; either to study chemistry or do something else. The initiative to start learning a chemistry task and persistence to work it out successfully largely depends on the achievement motivation of the learner (Wangui, 2017). Based on data available regarding the performance in chemistry in the county, achievement motivation for learning chemistry among secondary school students is still an issue of concern. Table 1.1 shows the KCSE mean scores of science subjects for the year 2016, 2017, 2018, 2019 and 2020.

Table 1.1

Students' KCSE Performance in Physics, Biology and Chemistry in Kiambu County

Year	2016	2017	2018	2019	2020
Subject	Mean	Mean	Mean	Mean	Mean
Physics	4.14	3.65	4.02	3.42	4.11
Biology	3.35	2.26	3.08	3.08	3.33
Chemistry	2.86	2.76	3.06	3.04	2.62

Source: Kiambu County Education Office Examination Report (2021)

As indicated in Table 1.1, the KCSE mean scores for chemistry have been below average. In the year 2020, chemistry recorded the lowest mean score compared to the earlier years.

Chemistry was also the worst performed among the three science subjects in 2016, 2018, 2019 and 2020.

Since research evidence has demonstrated that motivation is significantly related to chemistry performance (Oluoch et al., 2018; Wangui, 2017), the problem of low achievement may be associated with the student's achievement motivation for learning chemistry. Numerous factors have been directly or indirectly associated with achievement motivation for learning and performance in chemistry among secondary school students. Such factors include learners' attitude, shortage of trained chemistry teachers, teaching methods, motivation, and inadequate learning materials (Chepkorir, 2014; Ogembo, 2013; Wangui, 2017). However, there is a scarcity of literature on the cognitive correlates of achievement motivation for learning chemistry. The current study focused on executive functioning and academic scaffolding as predictors of achievement motivation for learning chemistry among secondary school students.

According to Kaufman (2010), executive functioning refers to the cognitive processes that allow individuals to regulate and maintain their learning activities which lead to long term academic achievement. It is one of the cognitive processes for adaptive functioning that enables learners to adopt goal oriented strategies in learning. Research evidence indicates that executive functioning contributes to learner's motivation and success in education (Neuenschwander et al., 2012; Pascual et al. 2019). Studies have consistently linked executive functioning skills to both academic and social success (Allan et al., 2014; Sung et al. 2018). It has also been demonstrated that executive functioning skills are associated with mathematics achievement (Rutherford et al., 2018). Executive functioning domains vary but researchers have majorly focused on initiation, sustained attention, metacognition, shifting and inhibitory control.

Denckla (1994) posited that executive functioning has four control processes namely; initiation, sustained attention, inhibition and shifting. Initiation executive functioning skill refers to a student's ability to independently start a learning task, while sustained attention refers to the ability to use goal directed attention and self-regulation to complete initiated goals. On the other hand, inhibition is described as the ability to maintain attention and disregard prepotent responses (Denckla, 2005). Shifting is characterized by the ability to successfully transition from one task to the other (Kaufman, 2010). The four domains contribute to successful problem solving execution and completion of long term academic goals. Inhibition has been considered to be a main factor in self-regulation (Roth et al., 2005). The concept of inhibition has been defined variously by different scholars; Gioia et al. (2000) defined it as the ability to control impulses and stop behavior. Barkley (1997) defined it as the deliberate suppression of prepotent responses.

Studies have established that lack of inhibitory control is associated with negative learning outcomes (Wu et al., 2013). In Spain, Gutierrez et al. (2020) established that difficulties in executive functioning skills were associated with procrastination tendencies due to lack of motivation to complete learning tasks. The study established that executive functioning skills were negatively associated with procrastination tendencies. Generally, past research has consistently established that executive functioning is significantly associated with academic achievement (Jacob & Parkinson, 2015). However, there is a scarcity of studies on the relationship between executive functioning and achievement motivation for learning chemistry among secondary school students.

Achievement motivation for learning chemistry has also been associated with external factors such academic scaffolding. Academic scaffolding refers to the process that enables learners to solve a task or achieve a learning goal that would be beyond their unassisted effort (Wood et al., 1976). Academic scaffolding requires that the teacher or other significant persons proficient in the chemistry task to guide learning of what is being taught; and once the skill is mastered, the support is withdrawn. Dixon et al. (1993) asserts that for scaffolding to be effective in learning, the support must be gradually withdrawn, otherwise if it's done too quickly, learning will not take place and the learner ends up being frustrated. To ensure effective learning, chemistry teachers must organize the content in ways that are consistent with the working memory and long term transfer (Fisher & Frey, 2010). This can be done through the use of mental schema to represent information. In this regard, the use of teaching aids, practicals and other teaching strategies that expose the learners to real life experiences prove to be vital. The scaffolds provide the chemistry learners with executive schema for mastering the content (Guthrie et al., 2004).

Education researchers have classified academic scaffolding into three categories namely; instructional scaffolding, planned scaffolding, and interactional scaffolding (Athaneses & De Oliveira, 2014; Hammond & Gibbons, 2005). Instructional scaffolding refers to the type of support provided by chemistry teachers, parents, guardians, and peers to a learner's immediate academic needs. It is a dynamic process that involves face to face interaction out of which the learner's academic needs are met. Interactional scaffolding is the support that is mostly provided by the chemistry teachers during academic engagements and peers during group discussions or any other academic activity in the course of learning chemistry. On the other hand, planned scaffolding is the support for learning chemistry that is provided by the instructional materials during the teaching and learning process. According to Volman and Beishuzen (2010), planned scaffolding is not contingent to the immediate needs of the learner.

Research has demonstrated that effective academic scaffolding improves learning behaviour and achievement. Chan (2020) found that cooperative scaffolding influence academic achievement of students in Singapore. Another study by Sutiarso et al. (2018) also demonstrated that media scaffolding had a positive impact on mathematics achievement of students in Indonesia. Similar results were reported by Moe et al. (2018) and Valencia-Vallejo et al. (2018). While, the studies showed that scaffolding was significantly associated with learning behaviour and academic achievement of students, the relationship between academic scaffolding and achievement motivation for learning chemistry has not been extensively studied. This study therefore examined the relationship between executive functioning, academic scaffolding and achievement motivation for learning chemistry.This study also examined gender as a moderator variable in the relationship between executive functioning, academic scaffolding and achievement motivation for learning chemistry. Previous studies have confirmed the existence of gender differences in executive functioning. Slot and Antje (2018) carried out a study in the United States of America and revealed that there were gender differences in executive functioning. Furthermore, it was revealed that there was significant gender difference in cross lagged paths between executive functioning and language skills among boys and girls. Similarly, in Spain Cortes and Munoz (2019) confirmed the existence of gender differences in executive functioning with boys recording better performance than the girls. Additionally, Grissom and Royes (2019) studied gender differences in executive functioning among students in the USA and the results revealed that male and female students differed in their executive functioning in favour of male students. In the same vein, a study done in the USA by Andreoni and Amalia (2020) concluded that boys were better than girls in executive functioning. The findings of these studies demonstrate that there are gender differences in executive functioning but there is scarce information on the same in the Kenyan context.

Regarding gender differences in academic scaffolding, research has shown that boys and girls differ in their scaffolding experiences. In Sweden, Alli and Anders (2020) study concluded that there were gender differences in academic scaffolding. The boys got more support in learning than the girls. Similarly, in Indonesia Budi and Kartono (2021) in their research on problem based learning and scaffolding, confirmed the existence of gender differences in scaffolding in favour of boys. In the contrary, a study in the USA done by Sherry and Tseng (2022) found that girls had better support than boys in scaffolding task based on English logic learning. A study done in Nigeria by Filgona and Sakiyo (2020) found that gender had an effect on achievement in social studies using scaffolding and brainstorming instructional model. It is against this background and the gaps identified that this study aimed to examine how gender moderates the relationship between academic scaffolding and achievement motivation for learning chemistry among secondary school students in Kiambu County.

Previous studies have demonstrated that achievement motivation can be predicted by academic scaffolding and executive functioning, however, most of the studies have focused on these variables independently. Gonzaga and Arellano (2022) established that academic scaffolding predicts students' motivation towards achievement in the USA. Similarly, in USA, Ensoo and Unhee (2022) found that students' reading difficulties and mastery goals positively predicted performance on free recall, a relationship that was mediated by executive functioning. Another study done in USA by Loren and Lindsey (2021) showed that executive functioning positively predicted motivation and achievement among students. Furthermore, Kardloo and Berhangi (2020) revealed that academic scaffolding in education management in the application of new educational technologies is effective on achievement motivation and achievement of students in Iran. The results suggest that scaffolding and executive functioning may be used to predict achievement motivation for learning. The current research aimed to find out the predictive weight of academic scaffolding and executive functioning on achievement motivation for learning chemistry in secondary schools.

1.3 Statement of the Problem

The performance in chemistry experienced in KCSE in the year 2016, 2017, 2018, 2019, and 2020 in Kiambu County presents a worrying trend to any education stakeholder. In the five year period, approximately 80% of the candidates who sat for KCSE in the county scored grade D + and below in chemistry. In the county, the KCSE mean score for chemistry in the year 2016, 2017, 2018, 2019 and 2020 were 2.86, 2.76, 3.06, 3.04 and 2.62 respectively, which were all below average. The below average performance in chemistry among majority of the students may be associated with a low level of achievement motivation for learning the subject. The large number of students who are scoring below average grades in chemistry is a matter of great concern considering the importance of the subject in equipping the learners with practical industrial skills necessary to realize vision 2030 and the SDGs. Therefore, students' achievement in this subject and the factors related to its performance is a matter of serious concern that requires empirical inquiry to avert this situation.

The large number of students who score below average grades in chemistry miss opportunities to advance their studies in science related fields and employment. The consequences of mass failure in chemistry thus include a chain of problems which negatively affect the socio-economic development in the country. There are limited studies on the predictors of achievement motivation for learning chemistry. Related studies only cite school related factors, quality of teaching, and learner factors as the correlates of achievement motivation for learning the subject. Moreover, the studies were carried out outside Kiambu County, and mostly using samples of college students. Additionally, the studies largely focused on factors such as attitude, motivation, learning strategies, learning contexts and how these have influenced performance in chemistry. Other related studies focused on the relationship between motivation and performance in chemistry, hence the need to find out the factors that influence achievement motivation for learning chemistry. To bridge the identified gaps, this research sought to examine executive functioning, academic scaffolding as predictors of achievement motivation for learning chemistry among form three students in Kiambu County, Kenya.

1.4 Purpose of Study

The purpose of this study was to examine executive functioning and academic scaffolding as predictors of achievement motivation for learning chemistry among form three students in Kiambu County. The study also investigated the extent to which gender moderates the relationship between executive functioning, academic scaffolding and achievement motivation for learning chemistry in order to come up with a prediction model for achievement motivation from the predictor variables.

1.5 Research Objectives

This study was guided by the following objectives;

i. To investigate the relationship between executive functioning and achievement motivation for learning chemistry.

ii. To examine the relationship between academic scaffolding and achievement motivation for learning chemistry.

iii. To find out the extent to which the student's gender moderates the relationship between executive functioning, academic scaffolding and achievement motivation for learning chemistry.

iv. To develop a prediction model for achievement motivation for learning chemistry from executive functioning and academic scaffolding.

1.6 Research Hypotheses

The following were the alternative hypotheses of the study;

$Ha_{1:}$ There is a relationship between executive functioning and achievement motivation for learning chemistry.

$Ha_{2:}$ There is a relationship between academic scaffolding and achievement motivation for learning chemistry.

$Ha_{3:}$ Gender moderates the relationship between executive functioning, academic scaffolding and achievement motivation for learning chemistry.

$Ha_{4:}$ Executive functioning and academic scaffolding predict achievement motivation for learning chemistry from the domains of executive functioning skills and academic scaffolding.

1.7 Significance of the Study

This study was carried out in response to dismal performance in chemistry among secondary school students in Kiambu County. The findings of this study may be of benefit to educational planners and KICD as it may provide useful information underlying achievement motivation for learning chemistry. The findings may be used to sensitize chemistry teachers on how to enhance achievement motivation for learning the subject to improve on its performance. The findings may also provide important information to school counselors and chemistry teachers regarding the factors associated with achievement motivation for learning chemistry, thus form a basis for resolving below average performance in chemistry. The results contribute to literature on the psychological factors associated with achievement motivation for learning chemistry among secondary school students. The results may be used for further research in an effort to improve chemistry performance in Kiambu County and the whole country at large.

1.8 Limitations and Delimitations of the Study

1.8.1 Limitations of the Study

The study used a sample of students from public secondary schools in Kiambu County, thus, the results of this study may be generalized to students in private secondary schools and other counties, but with caution because chemistry learning cultures may be different. The study focused on public secondary schools because statistics available indicate that most of these schools have been performing below average in chemistry in national examinations. Another limitation of this study was that data were collected using questionnaires and interview schedules that are prone to subjectivity but the researcher made effort to explained the purpose of the study to the respondents in order to improve the reliability of the responses. The relationship between executive functioning, academic scaffolding and achievement motivation for learning chemistry may not be used to imply causality.

1.8.2 Delimitations of the Study

This study was delimited to form three students taking chemistry in public secondary schools in Kiambu County. There are many factors that may predict achievement motivation for learning chemistry but the study only examined executive functioning and academic scaffolding because there is scanty literature on the two variables in Kenya.

1.9 Assumptions of the Study

The study assumed that the respondents had executive functioning skills and academic scaffolding experiences. Even though these are mental processes, the researcher assumed that the learners would consciously report them and thus were inferred from the responses that were provided. The study was also conducted with the assumption that performance in chemistry is directly related to achievement motivation for learning chemistry.

1.10 Theoretical and Conceptual Framework

1.10.1 Theoretical Framework

This study adopted three theories namely; information processing theory scaffolding theory, and achievement motivation theory. The three theories formed an integrated theoretical framework to explain the constructs; executive functioning, academic scaffolding, and achievement motivation which were explored under different theoretical frameworks by the proponents. Scaffolding theory was used to explain academic scaffolding, information processing theory explained executive functioning and achievement motivation for learning chemistry was based on achievement motivation theory.

1.10.1.1 Information Processing Theory (Siegler, 1986). Siegler suggested that information processing in humans can be compared to the way computers process information. The theorist argued that computers could be used as sources of ideas to explain how human cognition works. In this theory, computer metaphors; software and hardware were used to explain human cognition. The hardware was conceptualized to be consisting of sensory register, short term memory and long term memory (Siegler, 1986). The theorist opined that the software is located in the short term memory. The processing and retrieval of information in humans, according to this theory is comparable to computer functioning. The students thought processes are similar to the way the computer processes information. The sensory information (input) is processed and stored in the brain which then brings about a behavioral response (output).

This theory is based on inherent processes such as attention, initiation, sustained attention, inhibitory control and shifting. These processes also referred to as executive controls, regulate learning processes and response behaviors (Siegler, 1986). The model of information processing consists of three components namely; sensory memory, short term memory and long term memory. Sensory information is what captures the attention of the learners and if information is considered to be important, it is processed and then stored in the working memory. The executive controls in the working memory select the information, method of processing, and whether the information should proceed to the long term memory or not. Information is maintained in the short term memory through elaborative rehearsal. Maintenance of information in the short term memory may be affected by a number of factors such as motivation and cognitive ability. Depending on the relevance of the task at hand, information in the short term memory progresses to the long term memory. The long term memory has unlimited capacity and the type of information stored includes; imagery, declarative and procedural information.

Studies employing this theory show that during instruction, elaboration is key to processing information for storage into the permanent memory, and to facilitate retrieval when the need arises (Anderson & Krathwohl, 2000; Hummel & Huitt, 1994). The theorists suggested that to increase elaboration among learners, then they should be required to demonstrate learnt skills in meaningful tasks such as projects or examinations. These meaningful tasks provide the learners with an opportunity to develop competence and skills in high level thinking.

The theory can be used to explain cognitive processes such as executive functioning used by learners in managing themselves and the resources to achieve learning goals in chemistry. This theory was important to this study because it explains information processing as a fundamental aspect of learning. It also illustrates the mental strategies that students use in information processing. Cognitive development has been shown to be age dependent. The acts of remembering, perceiving, reasoning, problem solving and understanding are all age dependent and therefore vary from childhood to adulthood. Since, the way in which learners process information involves a series of processes that create mental representations, executive functioning and the cognitive strategies used by learners to create mental representations may influence their motivational orientations towards learning chemistry.

1.10.1.2 Scaffolding Theory (Bruner, 1976). Scaffolding is a popular construct in education research introduced by Bruner in 1976. Scaffolding theory is based on Vygotsky's idea of Zone of Proximal Development (ZPD) which states that teachers and significant others act as mediators in learning processes. The concept of ZPD focused on the interactive process of how teachers and the more knowledgeable others facilitate new learning for students. In Bruners' theory, the idea of scaffolding specifically addresses the role played by the more knowledgeable others, the reaction of students to new learning, and how this results in more understanding of the learnt material. The theorist believed that at the start of learning a new concept students, require active support in order to realize the intended learning outcomes. The support that is provided is referred to as a scaffold. It ensures that the students are not left on their own devices in new learning. Once the students are able to demonstrate the new skill, the scaffold is withdrawn. For instance, if a student is learning a new concept in chemistry, the teacher demonstrates step by step while the learner is observing. Once all the steps have been explained, then the student is given an opportunity to demonstrate the learnt skill. If the learner is able to successfully perform the task, efforts will be made for new learning in another context that presents an opportunity to demonstrate a similar skill.

According to this theory, scaffolding can take different forms. Research has shown that there are majorly three types of scaffolding: Interactional scaffolding, instructional scaffolding, and planned scaffolding (Hammond & Gibbons, 2005; Athaneses & De Oliveira, 2014). According to Athaneses and De Oliveira (2014), instructional scaffolding is the support provided by teachers, parents, guardians, and peers to a learner's immediate learning needs. Interactional scaffolding refers to the support provided mainly by teachers and peers during group discussions or individualized learning sessions. Thus in the context of learning chemistry, it is the support provided to learners who are yet to demonstrate proficiency in a chemistry concept, by teachers and competent peers in the subject. This can be done when learners are given a learning task in chemistry, to be done in groups or during help seeking. Planned scaffolding is the support that is provided by instructional tools used during the teaching and learning process. The instructional tools used in the teaching and learning of chemistry may include; charts, videos, realia, and practical lessons. Planned scaffolding is not contingent to the immediate needs of the learner (Volman & Beishuzen, 2010). Instructional scaffolding is a dynamic process that involves face to face interaction, out of which the learner's academic needs are to be met. On the other hand, planned scaffolding is a pre-determined process worked out before the lesson is taught, and is based on the student's learning needs.

Bruner, like Vygotsky, emphasized the importance of the social environment and scaffolding in learning, the latter being an important concept in this study. The theorist argued that the significant others should help children to develop skills through a process he called scaffolding. The product of cognitive development is the ability of a student to solve problems through thinking. A student who has learnt and internalized a concept is able to create new relationships, which enhances learning. Thus, instructionshould be done in such a way as to enable learners to represent 'recurrent regularities.' Effective learning in chemistry depends on the teaching method and selective response to the needs of the learners, in order to achieve learning goals. Thus, student's motivation to succeed in chemistry is influenced by teaching methodologies (instructional scaffolding), preparation (planned scaffolding) and social interactions (interactional scaffolding).

Documented literature anchored on this theory indicates that, providing social contexts where students discuss learning tasks, enhances achievement motivation for learning (Simons & Klein, 2007). A study based on scaffolding theory by Simons and Klein (2007) established that scaffolding enhanced performance of students in science subjects. The researchers argued that academic scaffolding enhanced inquiry in science based learning, a factor that enhances performance. Therefore, teacher and peer scaffolds in which students learn together could be effective in learning chemistry which in turn may bolster achievement motivation for learning the subject. In his study on cognitive development, Bruner (1966) proposed three modes of representation namely: enactive, iconic, and symbolic. Enactive representation involves encoding information and storing it in the memory. It encompasses motor skills for example, typing, drawing, and doing experiments. Iconic refers to the storage of information in form of images (mental pictures). This is important in teaching chemistry because it emphasizes the use of teaching aids (diagrams and illustrations) to accompany verbal information. According to Bruner, in symbolic representation, learnt information in chemistry is stored in code form, meaning that actions and images for learning chemistry concepts have a fixed relation to what they represent. The use of symbols is a flexible method of learning chemistry concepts because the symbols can be manipulated, classified and ordered.The theory suggests that teachers should present new material progressively from enactive to symbolic to enhance learning in chemistry. This theory was important in this study because it suggests that a learner is capable of learning any concept in chemistry as long as the instruction is organized appropriately. Therefore, this theory formed a basis to explain the link between academic scaffolding and achievement motivation for learning chemistry.

1.10.1.3 Achievement Motivation Theory (McClelland, 1961). The theory is also known as learned needs theory. According to this theory human behavior is influenced by three motivators: need for affiliation, need for power, and need for achievement. McClelland asserted that students behave differently because of the different types of motivators behind their behaviour. In fact, regardless of their gender, age or culture, students' behavior in learning is driven by one of the three motivatorsand in each individual, one of them is a dominant motivating driver (McClelland, 1961). The motivators are not inherent but dependent on the culture and life experiences of the learners. According to this theory, students who succeed in academics have a strong need to set and accomplish academic goals, take calculated risks, and like to receive feedback on their learning progress (Ryan & Deci, 2000).

Research based on this theory indicates that the sub domains of achievement motivation, that is; achievement goal, performance goal, self-efficacy, learning value, and active learning strategies play a significant role in the construction of knowledge (Pajares 1996; Deci & Ryan 1991). These factors are important in learning sciences and contribute significantly to learning outcomes. Students with high self-efficacy for learning chemistry believe that they have the capacity to successfully complete any learning task in the subject. The academic success of students with high self-efficacy is associated with persistence, effort, and unwavering determination.

Learning value in the context of chemistry learning, refers to the importance students attach to what they are learning. Learning value consists of critical thinking, relevance, and application of the knowledge and skills acquired. Active learning strategies refers to the processes used by students to construct new knowledge from learning experiences, using existing knowledge. Both learning goals and the student's motivation have an influence on the use of active learning strategies by learners.

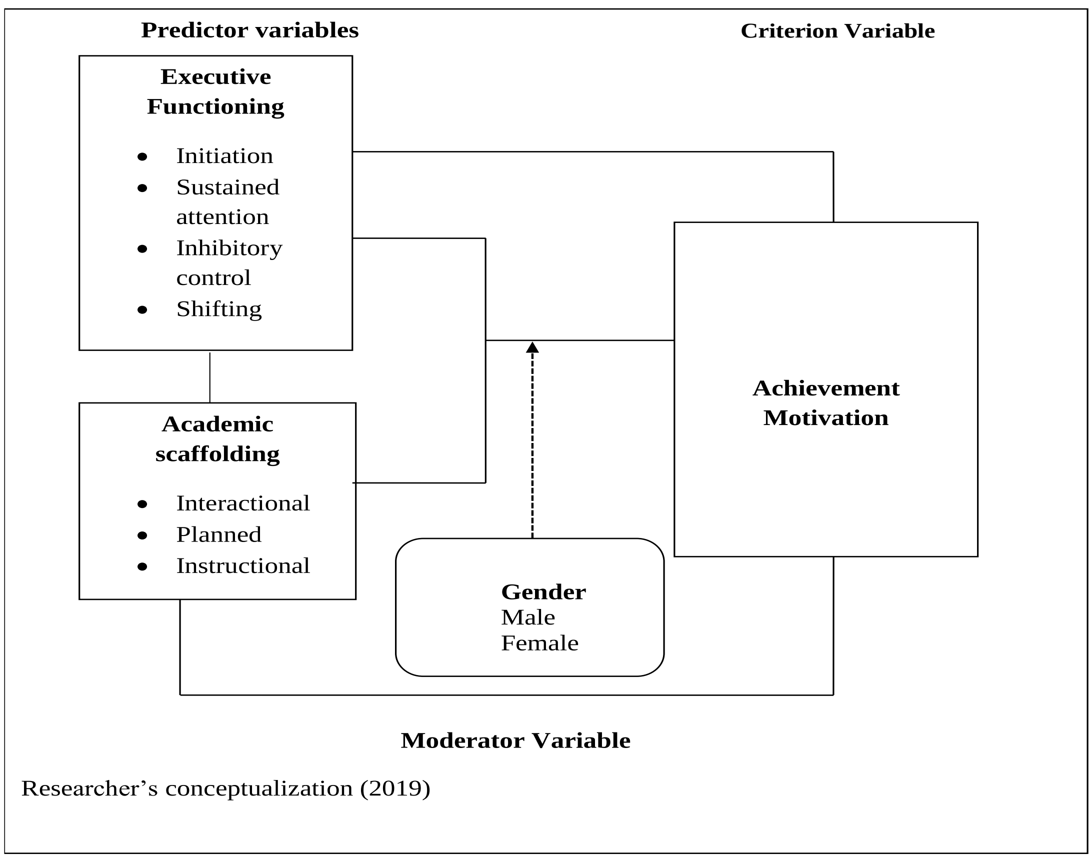
Students with achievement goal orientation are intrinsically motivated and have a strong belief in achieving personal goals. These students are more likely to focus on learning chemistry tasks to enhance their competence in the subject. On the other hand, students with performance goals are extrinsically motivated and only place their focus on outperforming other students.

A study by Wu and Tuan (2000) on student's motivation for learning science established that motivation was related to student factors, relevance of the concepts, teacher factors and the abstractness of the material. In a study by Moore et al. (2010), the respondents exhibited all three needs, that is need for affiliation, need for power and need for achievement. However, Moore noted that some of the motives were more prominent than others. This theory can be used to identify and modify the motivators among students to enhance achievement motivation for learning chemistry. The theory provides information on how to help students set academic goals, provide feedback and adoption of effective rewarding strategies. The theory was appropriate for this study because for learners to be motivated to study chemistry, teachers should provide challenging but achievable goals to enable the students to work effectively with sustained efforts to realize academic success.

1.10.2 Conceptual Framework

Figure 1.1

Model for the Relationship between Executive Functioning, Academic Scaffolding and Achievement Motivation



Note. Anticipated influence → Association between the variables ——

Figure 1.1 illustrates the relationship between predictor variables and criterion variable. The predictor variables were executive functioning and academic scaffolding. Executive functioning was measured at four levels; initiation, sustained attention, inhibitory control, and shifting. It was hypothesized that executive functioning influences achievement motivation for learning chemistry. Academic scaffolding was measured at three levels; instructional, planned, and interactional. Academic scaffolding constituted the support that students get while learning chemistry and it was hypothesized to influence the students' achievement motivation for learning chemistry. The moderating variable was gender of the students. The researcher hypothesized that gender of the student may affect the strength of the relationship between predictor variables and criterion variable. The criterion variable was achievement motivation for learning chemistry.

1.11 Operational Definition of Terms

Achievement Motivation	In this study, it referred to the score of the student on the achievement motivation questionnaire regarding the desire for learning and attaining quality grades in chemistry
Academic Scaffolding	The score of the student on the scaffolding scale concerning learning support provided in learning chemistry
Executive Functioning	Referred to the score of the student on the executive functioning skills scale on the processes that a student uses in managing himself or herself and the resources to achieve their learning goals in chemistry
Inhibitory Control	This was the students' score on the ability to control impulses and manage their behavior while learning chemistry
Instructional Scaffolding	This was the rating score of a student on a variety of teaching techniques that teachers use in class to progressively move the students towards understanding chemistry concepts

Interactional Scaffolding	It was the student's score on the processes by which teachers and peers mediate his/her effort in new learning
Planned Scaffolding	This was the student's score on the support that was provided by instructional tools used during chemistry lessons
Shifting	This was the student's score on the ability to transition from one chemistry task to another
Sustained Attention	It was the student's score on the ability to use goal directed attention and self-regulation to complete initiated goals in learning chemistry

CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.1 Introduction

This chapter presents a review of related literature based on the study objectives. Related literature on academic scaffolding, executive functioning and achievement motivation is reviewed. The chapter ends with a summary of literature reviewed and gap identification.

2.2 Relationship between Executive Functioning and Achievement Motivation

The relationship between executive functioning and achievement motivation for learning chemistry has not attracted much attention from educational researchers. Related studies have focused on the relationship between executive functioning and academic achievement, reading achievement, mathematics achievement and attention deficit hyperactivity disorder. Moreover, most of these studies have used samples of young children. Since past research has established that achievement motivation for learning is significantly related to academic achievement (Mutweleli, 2014; Oluoch, 2018; Wangui, 2017), literature on the relationship between executive functioning and learning outcomes was considered important to guide the current study.

Engel et al. (2014) conducted a study to examine the relationship between executive functioning and reading achievement. A sample of 106 six to eight year old children drawn from different social backgrounds in Brazil was used. Data were collected using a battery of twelve executive functioning tasks. Principal component analysis findings revealed that executive functioning components made differential contributions to early reading achievement. Cognitive flexibility was revealed to be the best predictor of reading performance. Even though the study reported a significant positive relationship between executive functioning and reading ability, principal components analysis ignores latent factors that might have influenced the results. Specifically, previous studies have illustrated the role of motivation on children's reading and mathematics achievement (Barber & Klauda, 2020). To fill this gap and extend knowledge to learning of chemistry, the current study focused on the relationship between executive functioning and achievement motivation for learning chemistry. Additionally, the cultural setting and the age of the respondents prompted a related investigation in Kenya using a sample of secondary school students.

In a related study, Kira et al. (2021) examined the relationship between executive functioning and mental health. The study was conducted among 262 adults. The researchers gathered data using questionnaires and then subjected it to regression analysis. The results showed that better executive functioning skills were associated with low levels of stress, depression, and anxiety. The study concluded that executive functioning skills were associated with better cognitive functioning. This study clearly demonstrated that executive functioning is related to the psychological constructs of stress, depression, and anxiety, suggesting that it could be related to other psychological constructs such as achievement motivation. Thus, the study provided a good foundation for the current study to create knowledge in this area.

In Spain, Gutierrez et al. (2020) examined the association between executive functioning skills and procrastination tendencies among students. The study involved a sample of 52 students who completed an executive function inventory and a procrastination scale. The results showed that procrastination was associated with executive functioning skills. The researchers concluded that students who had a high tendency of academic procrastination, also had difficulties in executive functioning. Previous studies have found a negative correlation between the tendency to procrastinate and learners' achievement motivation. Students who have a high motivation, have less tendencies to procrastinate (Ertem & Ari, 2022). These study findings suggests that procrastination could be as a result of learner motivation, hence the need for a study linking executive functioning and learners' motivation. The current study was therefore conducted to establish the association between executive functioning and achievement motivation for learning chemistry in the Kenyan context.

In another study, Bull (2008) examined executive functioning as a predictor of children's mathematics ability. Multiple measures including Wisconsin Card Sorting Task (WCST), Dual Task Performance, Stroop Task and Counting Span were used to collect data. It was established that mathematical ability was significantly correlated with all measures of executive functioning. The regression analysis findings also revealed that each domain of executive functioning predicted unique variance in mathematics achievement. The results were important to the current study because achievement motivation correlates highly with mathematics achievement (Areepattamannil, 2014; Stevens et al., 2004). The study focused on the relationship between executive functioning and mathematics ability among elementary school children. In order to advance knowledge in this area, the current study investigated the relationship between executive functioning and achievement motivation for learning chemistry. The present study was also carried out amongst a different population, that is secondary school students.

Relatedly, educational psychology researchers have established that executive functioning is significantly related to metacognitive control. Neuenschwander et al. (2012) explored the interrelationship between executive functioning, metacognition, and self-perceived competence in elementary school children. A sample of 209 first grade children was initially assessed in terms of academic self-concept and executive functioning. A year later the children's executive functioning, self-concept, and mathematics achievement were evaluated. Structural equations modeling analyses revealed that executive functioning and metacognitive control were significantly related to academic achievement. However, the study did not focus on the relationship between executive functioning and achievement motivation which is linked to academic achievement, a gap that the current study sought to fill. Furthermore, the age of the participants and the context in which the study was carried out limited the generalization of the results to secondary school students in Kenya, hence the need for the current study.

Research evidence also indicates that executive functioning processes predict academic outcomes (Biederman et al., 2004; Bull & Scorif, 2001; Wagner & Forbes, 2006). Miller and Hinshaw (2011) studied the relationship between executive functioning and academic achievement. Clinical executive functioning and academic tasks tools were administered to 2036 children aged 15-17 years. The findings showed that executive functioning scores had significant correlation with mathematics scores and reading scores across the ages. The study findings are important because they demonstrate the link between executive functioning skills and academic achievement. Nevertheless, like other educational research, the study did not consider achievement motivation, which has been shown to predict academic achievement. Givevn the limited research on the predictors of achievement motivation for learning chemistry, it was necessary to conduct the current research to bridge this gap.

Similarly the findings of Pascual et al. (2019) established that executive functions have a strong predictive power on primary education. Furthermore, the study found that executive functions and unique qualities determine how their components interact to influence learning and the mediation effect of aspects like physical fitness, motor abilities, and memory processes. Based on 21 samples (n = 7,947), a meta-analysis of random effects revealed a moderately significant weighted effect size (r = 0.365) and executive functioning was found to be a good predictor of academic performance. The random effects model produced similar results for language and mathematics, with mathematics somewhat higher (r = .35; r = .37). Because it comprised studies from different continents, socioeconomic levels, and rural or urban areas, the meta-analysis examined the indirect impact that various educational systems can have on intellectual development. However, no significant variations were discovered that could have resulted in executive component variability as a function of the samples' sociocultural and educational backgrounds. The study attempted to address the link between executive functioning, and other predictors of academic achievement but did not expressly focus on achievement motivation. The current research therefore focused on executive functioning and achievement motivation for learning chemistry to address the knowledge gap.

Achievement motivation has also been found to be related to training gains and, potentially, transfer of those gains to non-trained cognitive tasks. Zhao et al. (2018) investigated the effects of working memory training and transfer on accomplishment motivation. Students in two studies; 1 and 2 participated in a 14-day visuospatial WM updating training program with HAM or LAM. The students in study 2 completed a set of activities measuring various executive functions and fluid intelligence before and after training. In both instances, the HAM students received more training than the LAM students. Both groups improved on near-transfer tasks after training in study 2, but not on far-transfer tasks. In contrast to the LAM students, the HAM students' differential training gain was not associated with higher post-training performance on any of the transfer tasks. These findings suggested that AM is associated with the effect of the benefits of WM training, but not on the transfer of those benefits to other tasks. Though their study did not directly look at executive functioning and achievement motivation, it included the cognitive task of working memory related to attention in executive functioning, while accomplishment motivation was akin to achievement motivation. The study demonstrated that working memory was related to accomplishment motivation. Considering that this was an experimental study using different but related variables, it was necessary to conduct another study using correlation to investigate the relationship between executive functioning and achievement motivation for learning chemistry in the Kenyan context.

Sung et al. (2018) conducted a research on the longitudinal relationship between early academic achievement and executive functioning, as well as the mediating impact of learning modalities. Researchers employed latent development curve modeling to examine trajectories of children's reading and math success, executive function (EF), and learning styles from kindergarten to first grade. The researchers also looked at the extent to which initial levels and growth rates of EF and learning styles independently predicted the initial level and growth rate of reading and math achievement. They also examined the extent to which learning styles mediate the relationship between EF and academic achievement. According to the findings from the early childhood longitudinal study-kindergarten cohort of 2011, children's reading and math achievement, EF, and learning styles in the autumn of kindergarten varied greatly. Significant disparities in the rates of change of primary variables over time showed that some children had faster growth in certain qualities than others, while others had declines in some qualities. Children with higher EF and learning styles levels and who grew at a faster rate had a faster rate of change in reading and math achievement. Finally, via learning styles trajectories, EF trajectories had direct and indirect effects on academic achievement trajectories. There was an empirical gap as to whether this was the case among adolescents. This study aimed to address this gap.

In order to facilitate planning, monitoring, and control processes in the service of academic goals, student self-regulated learning (SRL) is believed to be dependent on cognitive processes such as EF. Prior research has shown a link between direct measures of EF and accounts of regulatory behaviors, but this has rarely been extended to classroom behaviors and consequent school accomplishment using SRL framework. Rutherford et al. (2018) investigated the link between achievement, EF and SRL. The study findings showed that there was an association between EF inhibition and shifting elements and SRL teacher reports, as well as student accomplishment in standardized tests and classroom grades in maths and arts. Furthermore, the findings showed that SRL mediates the relationship between EF and mathematics achievement. This implied that some features of EF might help or hinder SRL and hence academic achievement, which has implications for cognitive and educational achievements. The current research aimed to fill the knowledge gap by focusing on EF and achievement motivation for learning chemistry.

In a related study, Obradovic and Finch (2016) conducted a study to investigate the relationship between executive functioning skills and academic achievement of students in elementary school. The sample consisted of 813 students (48% female and 52% male). The study adopted a longitudinal research design. The participants completed executive functioning tasks on tablet computer over a period of three years. The findings revealed that executive functioning had a positive significant relationship with academic achievement. However, the findings might have been influenced by aging as opined by Von Hippel (2007). The current study used cross-sectional survey to control for the effect of age on executive functioning to establish if similar findings would be obtained.

Locally, there is scanty research literature on the predictors of achievement motivation for learning chemistry. However, literature on the predictors of academic resilience both external protective and internal protective factors indicate a positive and significant relationship (Mwangi, 2015). The findings of Mutweleli (2014) revealed that academic motivation has a positive significant relationship with academic achievement. The studies recommended further research on the predictors of achievement motivation to create new knowledge.

Relatedly, Wambua et al. (2017) conducted a study to investigate the predictors of achievement motivation among university students. A total of 167 students were sampled from five universities. The findings revealed that prior achievement predicted achievement motivation. The study involved university students and the domains of executive functioning were not given attention in the prediction of achievement motivation in chemistry. Informed by these studies, the current study investigated the extent to which executive functioning is related to achievement motivation for learning chemistry to address the existing gaps.

2.3 Relationship between Academic Scaffolding and Achievement Motivation

Research on achievement motivation for learning has paid much attention to academic achievement. A number of personal and environmental factors that influence achievement motivation for learning have been identified. These include mastery orientation (Dweck & Leggett, 1988), success expectancy (Atkinson, 1957; McClelland et al., 1961), self-efficacy (Bandura, 1977) and social setting (Osterman, 2000). A quasi experimental research by Byun et al. (2014) explored the influence of question prompts strategies on cognitive scaffolding and how it affected problem solving among university students who were studying chemistry in Korea. The findings showed that teacher-generated cognitive scaffolding was associated with better problem solving in chemistry. The study showed that scaffolding was important for the problem solving ability of learners. Problem solving ability has been linked to learning motivation among students (Chiang & Lee, 2016), pointing to the possibility of a link between scaffolding and achievement motivation. The current study was therefore conducted to determine if there was a relationship between scaffolding and achievement motivation.

Another study carried out in the USA by Toledo and Dubas (2016) analyzed the relationship between academic scaffolding and the development of higher order thinking skills in chemistry among university students. Observations from the study indicated that academic scaffolding had a positive impact on learning chemistry concepts. Another research by Duffy and Azevedo (2015) investigated interactions between achievement goals and scaffolding for self-regulated learning. The study adopted a correlational research design to examine the nature of the relationships. The research involved 83 undergraduate students who were randomly sampled. Multivariate Analysis of Covariance (MANCOVA) analyses revealed that there was a significant interaction between achievement motivation and academic outcomes. The findings also showed that learners adopting dominant performance approach scored highly on achievement motivation. The study used a small sample size of university students which might have affected the power of the statistic used. The current study used a relatively larger sample of secondary school students to examine the relationship between academic scaffolding and achievement motivation for learning chemistry.

In Singapore, Chan (2020) investigated the influence of cooperative scaffolding on academic achievement among secondary school students. The quantitative study involved a sample of students aged between 15 and 17 years, selected from 30 secondary schools. The results of the Pearson correlation analysis showed that cooperative scaffolding was significantly related to academic performance. The findings confirmed the importance of academic scaffolding in learning. Since the relationship between academic scaffolding and achievement motivation for learning chemistry has received little research attention, there was need for the current research to fill the empirical and knowledge gaps. Moreover, the current study was conducted in a different geographical location.

In another research, Sutiarso et al. (2018) examined the impact of media scaffolding on learning mathematics concepts among fifth grade learners in Indonesia. The experimental study used a sample of 40 students who were selected by simple random sampling technique. The sample was divided into two groups; experimental and control groups each with an equal number of participants. The media scaffolding used in the study were; props, charts, and visual scaffolding. The researcher used interviewing, observation, and test techniques to collect data. Independent samples t-test was used to test the hypothesis and the results showed that a majority of male students preferred scaffolding props while female students preferred media charts. It was further established that media scaffolding enhanced understanding of mathematics concepts. However, the statistical design used would not examine the extent to which the media scaffolding was related to learning. The current research was designed to fill the methodological gap and also investigate the relationship between academic scaffolding and achievement motivation for learning chemistry among secondary school learners.

Gita and Apsari (2018) investigated the relationship between scaffolding and performance in algebra. The study was conducted among 23 university students. The researchers used PBL with academic scaffolding in teaching algebra. They employed us a descriptive research design and the results revealed that academic scaffolding was related to improved learning outcomes in algebra. Given the study findings, it was necessary to investigate whether academic scaffolding was associated with achievement motivation. Particularly because previous studies have found a relationship between achievement motivation and academic achievement (Mutweleli, 2014; Oluoch, 2018).Furthermore, the current study used a convergent parallel mixed methods design for in-depth analysis of academic scaffolding and achievement motivation for learning chemistry in order to fill the knowledge, methodological and empirical gaps that prior research did not address.

In a related study, Rienties et al. (2012) explored the role of scaffolding and motivation in computer supported collaborative learning (CSCL) using a quasi-experimental design. The sample consisted of 143 participants who were doing a collaborated online economics course. Multi-method analyses revealed that scaffolding was significantly related to achievement motivation. However, from the results, it was not possible to establish the type of scaffolding that was associated with achievement motivation. Furthermore, the samples used were drawn from college students, prompting the need for the current study, which specifically focused on academic scaffolding.

Similarly, Chen (2020) investigated the potential of augmented reality (AR) to address existing issues with insufficient scaffolding in video learning materials for English as a foreign language (EFL). By overlaying rich media elements on the real-world learning setting, augmented reality (AR) can provide students with adequate contextual scaffolding. To aid students' EFL learning, an AR video-enhanced learning (ARVEL) method was developed. In addition, an experiment was conducted to see how the applied strategy affected students' EFL learning outcomes. The ARVEL technique greatly improved the students' learning successes and intrinsic motivation, as well as their happiness with EFL learning, when compared to those studying EFL using traditional video-based learning. Given the results of the study showing the motivation potential for learners of the media scaffolding, the study provided a base from which the current was developed. The present study sough to extend what is already known by focusing specifically on the influence of academic scaffolding on achievement motivation for learning chemistry. Additionally, it went beyond learners of English as a foreign language to focus on secondary school learners taking chemistry as a subject.

Another research by Moe et al. (2018) looked at the impact of perceived parental autonomy-supportive scaffolding on children's autonomous motivation, self-efficacy, affect, and homework involvement in two studies. A total of 122 parents were surveyed. The results of the first study showed that the more autonomous motivation a parent had when scaffolding for motivation, their children regarded them as more autonomy-supportive. This resulted in increased autonomous motivation, self-efficacy, and assignment involvement among the children. In study 2, 37 parents participated in a four-session training program targeted at maintaining autonomy-supporting scaffolding mechanisms. The lesson lowered parental dissatisfaction, prevented kid dissatisfaction from growing, and kept students motivated at school. The focus of the study was on parents' strengths in terms of aiding their children in having a more positive attitude toward homework by providing autonomous support as a motivational scaffold. The results showed that scaffolding is an important construct in the development of learning behaviour. While this study directly links scaffolding to learners' motivation, it focused on a different type of scaffolding and motivation. The current study focused on academic scaffolding and a specific learning behavior, achievement motivation for learning chemistry. In an e-learning environment, Valencia-Vallejo et al. (2018) explored the effect of motivational scaffolding on self-efficacy and learning accomplishment among students with distinct cognitive styles in the Field Dependence/Independence (FDI) dimension. The study employed a two-group experimental design. One group of the students worked in an e-learning environment with motivational scaffolding built in, while the other group worked in a computational environment without motivational scaffolding. Motivational scaffolding resulted in significant disparities in learning achievement and academic self-efficacy among the learners. Furthermore, engagement with the computational environment negated the impact of cognitive style learning behaviour. The study provided useful information on the influence of scaffolding and motivation on learning achievement, giving impetus to the present study which focused on the relationship between academic scaffolding and achievement motivation for learning chemistry. Given that the study was delimited to an e learning environment, a related study in a classroom environment was necessary to add to the already existing knowledge.

Cai et al. (2020) carried out a meta-analysis to investigate digital game-based learning (DGBL) and the role of scaffolding. To deal with data non-dependency difficulties of multi - effect sizes, the study adopted a 3-level meta-analysis procedure. After a thorough search of the literature, 49 primary studies and 154 effect sizes were included. The results showed that scaffolding in DGBL can help people learn, although there was a lot of variation across trials. Furthermore, studies with primary and university students showed larger scaffolding effect sizes than studies with secondary school students. Scaffolding was also shown to function differently in different types of games, with adventure, puzzle, and simulation games outperforming role-playing and strategic games. The study recommended that future research should focus on the development of scaffold systems in educational online gaming, as well as the impact of scaffolds on learners' behaviour patterns and student learning, an issue addressed by this study. Another important issue worthy of further investigation is the finding that there were larger effect sizes for scaffolding for university students when compared to secondary school students. Though the current study did not compare the two populations in terms of scores on scaffolding, it included secondary school students as the population of interest in determining the relationship between academic scaffolding and achievement motivation.

In the African context, there is a scarcity of literature on the relationship between academic scaffolding and achievement motivation for learning chemistry. However, there is documented literature on the influence of scaffolding on academic achievement. In Nigeria, Enyew and Yigzaw (2015) demonstrated that scaffolding reading strategy is effective in improving students reading ability. Purposive sampling was used to select 42 grade four pupils who participated in the study. The study adopted a quasi-experimental pre-test and post-test. Data collection was done using observation checklists and focused group discussions. The findings reported were based on *t*-test and percentage analyses. From the results of this study, the influence of achievement motivation can only be speculated. There was therefore need for a study specifically reviewing the influence of scaffolding on achievement motivation. The current study als utilized Pearson correlation to establish the nature of the relationship between academic scaffolding and achievement motivation for learning chemistry among secondary school learners.

Locally, Mugambi and Wangeri (2014) carried out a study to investigate peer teaching as a predictor of reading motivation and literacy achievement among standard two pupils. The study sample consisted of 108 pupils who were selected using purposive sampling. Data was collected using a reading motivation questionnaire, peer interaction questionnaire, and a one minute reading fluency test. The findings revealed that peer teaching predicted reading motivation. The findings also showed that reading motivation did not predict reading achievement among learners. While the findings contradicted earlier studies on the role of motivation on academic achievement, it illustrated that scaffolding was an important factor in reading motivativation. Based on the latter finding, the present study went further to investigate the relationship between academic scaffolding and achievement motivation. The sample used in the study by Mugambi and Wangeri (2014) consisted of primary school children, the present study was carried out among secondary school students who were deemed to be better able to respond objectively to a self report questionnaire.

2.4 Gender Differences in Executive Functioning and Academic Scaffolding

This section presents related literature on gender differences in executive functioning and academic scaffolding

2.4.1 Gender Differences in Executive Functioning

Studies that have been carried out on gender differences in executive functioning have reported mixed findings. Veraska and Lepola (2022) carried out a study to investigate learning motivation tendencies among preschoolers and the impact of executive functioning based on gender. Data were collected from a sample of 434 students using questionnaires. The findings of the study revealed that there were no significant gender differences in learning motivation. Furthermore, the results showed that executive functioning had an impact on both boys and girls and helped in reducing gender differences in learning motivation of the students. The findings of the study may not be generalized to secondary school students in Kenya, since it involved young children whose executive functions may be different from those of adolescents, a gap this study addressed.

Another study done by Yamamoto (2019) investigated gender differences in executive function and behavioural self-regulation among 5 year old children in Eastern Japan. The study used a sample of 111 kindergarten pupils. The results of the study revealed that there were significant gender differences in teacher evaluation of the social problems, attention problems, aggression problems with girls demonstrating lower levels of problems compared to boys. The gender differences in executive functioning was attributed to the fact that boys were perceived to have ability to handle more complex tasks compared to girls. Considering that the study utilized a population of young children, it was unclear whether the findings could be generalized to adolescents. The current study was therefore conducted among adolescents in Kenya to establish if similar results would be obtained across different age groups.

A study done by Spencer and Laurie (2021) explored executive functioning decoding and reading comprehension with specific focus on sex differences in the USA. The study used a sample of 298 students (132 boys and 166 girls). Data were collected and analyzed using SPSS software and Mplus software. The findings of the study showed a direct relationship between executive functioning and reading comprehension which was stronger in girls compared to the boys. The learning context in USA differs from the Kenyan context in terms of learning emphasis and domains of learning outcomes. Thus, given the geographical and cultural differences between the USA and Kenya, the results may not be generalized to the general population of secondary school students in Kenya. The present study was therefore necessary to determine if there were gender differences in executive functioning among secondary school students in Kenya.

Another research conducted by Hussain (2016) investigated gender differences in executive function among secondary school students in Pakistan. The study used a sample of 100 students comprising of 50 males and 50 females. The study collected data by use of structured questionnaires. The results of the data analysis revealed that executive functioning differently influenced learning for boys and girls. The findings indicated that male students were better in executive functioning compared to female students. The study used a relatively small sample of 100 students in Pakistan which may have impacted on the results of the study. The current research therefore used a larger sample of 440 students in Kenya for more conclusive findings in the local context.

Furthermore, a study conducted by Roufael (2012) in Egypt investigated gender differences in executive functioning and reading abilities in children with attention deficit hyperactivity disorder. The study sample size was 60 students comprising of 30 male students and 30 females. The results from the study indicated that there were significant gender differences in hyperactivity where boys were more hyperactive than the girls. Considering that the study utilized a population of learners with attention deficit disorder, its findings may not be generalizable to a normal population. Moreover, the sample was a small sample of young children unlike that of the present study which focused on a larger sample of adolescents to examine gender differences in executive functioning with regard to learning chemistry.

Amukune and Gabriella (2022) did a study to compare executive functioning in school readiness of Hungarian and Kenyan preschoolers. The study used a cross-sectional research design. The study sample comprised of 187 Hungarian preschoolers and 420 Kenyan preschoolers. Data collection was done through use of a CHEXI questionnaire. Analysis of the collected data was done using descriptive statistics and confirmatory analysis. The findings of the study revealed that there were no gender differences in executive functioning in both Hungary and Kenyan preschoolers. The findings of the study contradicted those of other studies which have reported gender differences in executive functioning. It is not clear whether this could have been because of the age of the learners included in the study. Research is limited on the gender differences of executive functioning across age groups. The current research thus focused on gender differences in executive functioning of adolescent children seeking to provide information on this age group.

2.4.2 Gender Differences in Academic Scaffolding

A number of studies have been conducted to examine gender differences in scaffolding, but there are marked inconsistencies in the results. A research done by Klapp and Jonsson (2021) investigated scaffolding and students' perception of teacher support in a Swedish compulsory school. The study sampled 1731 grade 9 students. Data were collected using questionnaires. Data were analyzed using confirmatory factor analysis, *t*test, and structural equation modelling. From the findings, there were gender differences in teacher support in favour of boys. The researchers established that gender difference were due to variation in the learning needs of the students. The study was done in Sweden where the education system is more focused on talent development unlike the Kenyan education system where emphasis is on grades. Therefore, there was need for the current research to address the population gap.

Another study done in the UK by Dawkins and Hedgeland (2017) investigated the impact of scaffolding and question structure on gender. The study was carried out using a sample of 360 students taking physics as their favourite and core subject. Data collection was done using questionnaires. The results obtained from the study indicated that there were significant gender differences in scaffolding among the students taking physics in favour of male students. It was perceived that male students had better ability to handle more complex tasks compared to their female counterparts. Given the differences in the educational emphasis and policies in which the study was done, it was necessary to conduct a similar study in a country following a different education system. Thus, the current study was conducted in Kenya, to provide additional information on gender differences in scaffolding in a developing country.

In Malaysia, Rahmani (2014) carried out a study to investigate the influence of single gender peer scaffolding in problem based game learning and sub-dimensions of science process skills. The study sampled 60 fifth grade students and the findings revealed that boys engaged more significantly in deeper level of learning than the girls based on scaffolding. The study suggests that boys benefitted more from scaffolding than girls. The small sample of 60 and the fact that the study was among fifth graders limits the generalizability of the study findings, necessitating further studies. The current study was therefore conducted with a larger sample to examine if there were gender differences in scaffolding among adolescents when learning chemistry in the Kenyan context.

In another study, Sutiarso et al. (2018) investigated the effect of media scaffolding in enhancing understanding of geometry concepts in Indonesia. The study adopted a quasi-experimental research design. The sample size of the study was 40 fifth grade students of a state elementary school. Data collection was done through observation and interviews. The results of the study indicated that male students were better than female students in the use of scaffolding props as compared to female students who used scaffolding media charts. The study compared the way male and females learners benefitted from two types of media scaffolding, it was therefore unclear whether there were differences in scaffolding scores. In other words, the study focused on media scaffolding and mathematics learning while the current study focused on academic scaffolding with regard to achievement motivation for learning chemistry to enhance knowledge in this area.

Another study was done by Okechukwu (2019) with the aim of investigating the effects of scaffolding instructional strategies and gender on the performance of pupils in basic science and technology in Rivers state, Nigeria. The study adopted a non-randomized pre-test, post-test, and control group experimental design. The sample size for the study was 147 students identified using purposive sampling technique. Data were collected using basic science and technology performance test. The findings of the study revealed that the basic science and technology performance of boys and girls taught with scaffolding instructional strategy did not differ significantly. The results contradicted those of previous studies, which were also mostly from more developed countries. Considering that the study was conducted in a developing African country, it was necessary to carry out another study in another developing African country to consolidate evidence on the gender difference in academic scaffolding in Africa.

The results of the study by Okechukwu (2019) have been supported by other scholars in Africa. For instance, those by Onah (2022) in a study carried out to investigate the effect of scaffolding teaching approach on students' academic achievement in quantam physics in Enugu education zone, Nigeria. The study utilised a sample of 85 students selected using multi stage random sampling technique. The study adopted a quasi-experimental design. Analysis of data was done using a *t*- test. The results indicated that there were no significant gender difference in the academic scores of students taught using scaffolding teaching approach. Given the contradictory results, it was necessary to conduct an additional study in a developing country. Moreover, the use of a small sample limited the generalizability of the study results outside of the target population in the study.

Similarly, Olanrewaju (2019) did a study to investigate scaffolding assisted instruction on students' academic achievement on basic science and technology in Ogun state, Nigeria. The study adopted a pretest and post quasi-experimental research design. The study sample was 100 pupils from basic eight public secondary schools in Odeda local government, Ogun state. Data were collected using the basic science achievement test and analysis done using ANOVA and estimated marginal means. Data analysis results showed that there was no significant gender difference in academic achievement on basic science and technology. However, the study did not examine if there were gender differences in scaffolding, leaving a gap in knowledge as to whether the non-significant findings would extend to scaffolding. This study sough to fill this gap and also to contribute to the discussion on gender differences in academic scaffolding in learning chemistry in Kenya.

2.5 Prediction of Achievement Motivation from Executive Functioning and Academic Scaffolding

Previous studies largely focused on how executive functioning and academic scaffolding independently predict learning outcomes and behaviour. In the USA, Bardack and Obradovic (2019) studied teachers' displays and scaffolding of executive Function (T-DASEF) protocol among students. The aim of their study was to examine how teachers' scaffolding in the classroom was associated with EF and learning. Using a sample of 813 children (ages 8–12) and 33 teachers, the study sought to explain the development of the T-DASEF protocol and assess the validity and reliability of the components. According to a multi-level path analysis, elements from the T-DASEF procedure reflected students' EF-related challenges. Scaffolding techniques, the combination of teachers' impulsivity, attention, working memory, and disorganization predicted the direct evaluation of students' EFs in fall. Students' EFs in Spring were predicted by teachers' planning/organization scaffolding and cognitive flexibility scaffolding techniques. The study emphasized the importance of utilizing an observational measure to ascertain how instructors' scaffolding methods and regularly occurring EF-related behaviors link to middle school students' EF skills and school achievement. Academic scaffolding and executive functioning skills are important variables in learning and achievement. However, the study did not examine how academic scaffolding and executive functioning skills predicted achievement motivation, a gap this study aimed to fill.

A related research by Duru and Okeke (2019) examined students' persistent poor performance in mathematics and the predictive role of learning styles, self-regulated learning skills, and achievement motivation of students in Imo State Nigeria. The research employed a correlational research design with a total of 882 students who were randomly selected. The Barsch Learning Style Inventory (BLSI), the Self-regulated Learning Questionnaire (SRLQ), and the Achievement Motivation Scale were utilized to collect data from the students. Academic accomplishment was measured using cumulative average test scores. The data collected were analyzed using Pearson correlation and multiple regression. The findings showed that learning style, self-regulated learning ability, and achievement motivation each accounted for 1.9%, 1.0%, and 0.6% of the variance in students' mathematical achievement scores. The results also revealed that all the predictor variables explained 2.3% of the variance shown in the students' mathematics achievement. The study demonstrated that achievement motivation is an important predictor of academic achievement. However, given the limited literature on the predictors of achievement motivation, the current research was conducted to determine the predictive value of academic scaffolding and executive functioning skills on achievement motivation.

According to Muwonge et al. (2019) who conducted a related study in Uganda there hasn't been much research on how teacher support (scaffolding) helps students to manage their own learning, especially in developing nations. The study examined structural connections between students' support, motivational beliefs, cognitive learning techniques, and academic achievement. A total of 1081 students from seven universities were involved in the research. The modified Motivated Strategies for Learning Questionnaire was used to collect data which were then analyzed using structural equation modeling. Academic achievement and motivational beliefs were significantly correlated and cognitive learning strategies significantly moderated the link between the two variables. The study provided preliminary findings that were useful for the present study. Though it did not directly analyse academic scaffolding and executive function, it did study the related variables of teachers scaffolding and cognitive learning startegies. Thus, to advance knowledge in the area of academic scaffolding, executive functioning, and achievement motivation, the current research examined academic scaffolding and executive functioning as predictors of achievement motivation for learning chemistry.

In Kenya, little has been done on academic scaffolding and executive functioning as predictors of achievement motivation for learning chemistry. A related study was conducted by Amukune and Józsa (2021) on the effectiveness of a model created by Swedish researchers, the Childhood Executive Functioning Inventory (CHEXI) to assess EF abilities of children between the ages of 4 and 12. The purpose of this study was to ascertain the CHEXI's psychometric qualities and the relationship between executive function (EF) abilities and academic success among Kenyan learners. The researchers assessed EF skills of grade one students between the ages of 6 and 11 using the CHEXI and then standardized examinations were used to evaluate intellectual achievement in a classroom context. To evaluate the CHEXI measurement model and create the latent factors, both exploratory and confirmatory factor analyses were used. The data were fitted using a two-factor model that took working memory and inhibition into account. Excellent reliability scores and a significant gender-based measurement invariance were also considered in the CHEXI (boys vs. girls). The CHEXI was deemed suitable for research in the Kenyan context since it showed acceptable psychometric qualities. The findings showed a significant correlation between EF and academic success. Low academic achievement was linked to EF problems and it was concluded that EF can predict academic achievement. The current research, investigated academic scaffolding and executive functioning skills as predictors of achievement motivation for learning chemistry to bridge the knowledge gap.

2.6 Summary of Literature Reviewed and Gap Identification

Research literature on executive functioning has mostly focused on academic achievement as the outcome variable. The reviewed studies established that there was a positive and significant relationship between executive functioning and academic achievement. Thus, there was scanty literature on the relationship between executive functioning and achievement motivation for learning chemistry. There were knowledge and empirical evidence gaps in the literature reviewed because studies have largely focused on academic achievement as the criterion variable. Additionally, most of the studies were conducted using samples of college students, university students, and young children.

Empirical studies on academic scaffolding have also largely focused on how this variable is related to academic achievement. There was a dearth of literature on the relationship between academic scaffolding and achievement motivation for learning chemistry. Furthermore, the literature reviewed presented contradicting results owing to the different designs used, samples sizes, age of participants, and the context in which they were carried out. The extent to which the student's gender moderates the relationship between executive functioning, academic scaffolding and achievement motivation for learning chemistry is largely unexplored especially in the Kenyan context, a knowledge gap that this study aimed to fill. Little has been done in Kenya on how executive functioning and academic scaffolding jointly predict achievement motivation for learning chemistry. Related studies have majorly focused on the prediction of academic achievement. Since achievement motivation has been found to be a significant predictor of academic achievement, this study was necessary to address the gaps and add onto the existing literature on the predictors of achievement motivation for learning chemistry in secondary schools.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter presents the research design, variables, and the location of the study. It also presents the target population, sample size, and sampling procedures, pilot study, the research instruments that were used, data collection, and analyses procedures, logistical and ethical considerations.

3.2 Research Design

The researcher used a convergent parallel mixed research design to examine the relationship between the study variables. In this design, both quantitative and qualitative data are collected, analyzed and then the results are compared to see if they answer the research questions the same way (Creswel & Creswell, 2018). Questionnaires and an interview schedule were used to collect data used to address the research questions. This research approach was a useful strategy for an in depth understanding of the relationship between executive functioning, academic scaffolding, and achievement motivation for learning chemistry. It provided a broader perspective with regard to the cognitive factors that may be associated with below average performance in chemistry among secondary school students in Kiambu County. Creswell and Creswell (2018) state that a mixed research design is important for heightened validity and knowledge on the research problem.

3.3 Research Variables

The predictor variables of this study were:

i. Executive functioning, which was measured at four levels; initiation, sustained attention, inhibitory control, and shifting. This variable was measured at interval level using a five point Likert scale.

ii. Academic scaffolding was measured at four levels; instructional, planned, and interactional scaffolding. The variable was measured at interval level using a five point Likert scale.

iii. The criterion variable was achievement motivation for learning chemistry. This variable was measured at interval level using five point Likert scale. The moderator variable was gender of the student which was categorized as male or female.

3.4 Location of the Study

The study was conducted in public secondary schools in Kiambu County. The county has been registering below average performance in chemistry which may be associated with low achievement motivation for learning chemistry as indicated in Table 3.1.

Table 3.1

Students' KCSE Performance in Physics, Biology, and Chemistry in Kiambu County

Year	2016	2017	2018	2019	2021
Subject	Mean	Mean	Mean	Mean	Mean
Physics	4.14	3.65	4.02	3.42	4.11
Biology	3.35	2.26	3.08	3.08	3.33
Chemistry	2.86	2.76	3.06	3.04	2.62

Source: Kiambu County Education Office Examination Report (2021)

Table 3.1 shows that the KCSE mean scores for chemistry have been below average from the year 2016 to 2021. During this period, chemistry was the worst performed among the three science subjects. The mean scores posted every year were far below average and this prompted the need for the current research, which sought to establish the factors that may be associated with this kind of performance. The choice of Kiambu County was also informed by a study that was conducted by Mwangi (2015) which recommended further studies on the cognitive factors related to student's learning behaviour. Since achievement motivation for learning chemistry has been found to be significantly related to performance in the subject, the current study investigated the relationship between executive functioning, academic scaffolding, and achievement motivation for learning chemistry. It was hoped that this would unearth the cognitive factors that may be associated with the dismal performance in chemistry in Kiambu County.

3.5 Target Population

The target population was 285 public secondary schools with 28400 form three students taking chemistry in the year 2020. Atkins and Stough (2005) reported that cognitive domains advance with age and therefore form three students were the most appropriate for this study. The study would have used form four students but due the busy revision schedule and syllabus coverage, they would not get adequate time to fill the questionnaires. Records obtained from the County Education Office showing dismal achievement in chemistry in most public secondary schools also prompted the need for this study. To address this problem of below average performance in chemistry, this study sought to establish the relationship between executive functioning, academic scaffolding, and achievement motivation for learning chemistry among secondary school students in Kiambu County.

3.6 Sampling Techniques and Sample Size Determination

3.6.1 Sampling Techniques

This study used purposive, stratified, proportionate, and simple random sampling procedures to obtain the sample size. Purposive sampling was used to select Kiambu County and form three classes. Data were collected from four national schools, six county, and extra county schools; and seven sub county schools making a total of 17 secondary schools. Stratified sampling was used to select the secondary schools to participate in the study. This was to enable analysis of potential differences in executive functioning, academic scaffolding, and achievement motivation for learning chemistry across the different categories of schools.

In schools that had more than one stream of students taking chemistry, the researcher used simple random sampling to select one stream. Depending on the number of streams, the researcher wrote the word yes on one piece of paper and the rest were left blank. All the pieces of paper were then folded and put in a bowl. From each stream, one student was selected to pick one piece of paper and the student who picked “yes” was used to select the stream from which the sample of students was obtained. Using Slovin’s (1960) formula, a sample size of 395 students was obtained from a target population of 28400 form three students. The sample of students from each school category was obtained using proportionate sampling.

In national, county, and extra county schools data were collected from single gender schools. To obtain the sample of students from the selected stream, simple random sampling technique was used. In national schools, data were collected from four schools (two boys' schools and two girls' schools). To select the students, the researcher signed sixty pieces of papers and the rest were left blank. The pieces of papers were then folded, mixed and put on a table. The students were asked to pick one piece, each at a time. The students who selected the signed pieces of papers were given an opportunity to participate in the study. This procedure was repeated in the extra county, county, and sub county schools. The study involved chemistry students in Kiambu County because the county has continued to register below average performance in chemistry in national examinations. The use of simple random sample technique ensured unbiased representation of the students.

3.6.2 Sample Size Determination

Table 3.2 presents the sample size of the schools and the students who participated in the study. Sample size was obtained using Slovin's (1960) formula; $n = \frac{N}{1+N(e)^2}$ where *N* is the target population and e is the margin of error (0.05).

$$n = \frac{28400}{1+28400(0.05)^2} = 395$$

To take care of non-response and attrition, the sample size was increased by 11.5% to obtain 440 students as recommended by Draugalis et al. (2008). The sample size from each school type was selected using proportionate sampling as shown.

Sample size of each school category = $\frac{\text{Target population of school category}}{\text{Total target population}} \times 395$

The percentage increase of the sample size of each school type ranged between 11% and 15%. This was done to take care of non-response and to ensure that there was gender balance. Also, increase in the sample size was done to obtain an equal number of boys and girls from each school type. The sample size of the schools and students was as shown in Table 3.2.

Table 3.2

Sample Size

		Target Population			Sample Size		
School Type		Schools	Male	Female	Schools	Male	Female
NS	BS	3	784	-	2	60	-
	GS	6	-	1564	2	-	60
CS & ECS	BS	26	4689	-	3	69	-
	GS	30	-	5523	3	-	69
SCS	CES	220	7495	8345	7	91	91
Sub Total		285	12968	15432	17	220	220
Total		285	28400		17	440	

Note. NS – National Schools; CS – County Schools; ECS – Extra County Schools; SCS-Sub County Schools; BS – Boys' Schools; GS – Girls' Schools; CES – Co-Educational Schools

The study was carried out in seventeen secondary schools: four national schools, six county and extra county schools and seven sub county schools. A total of 440 students were sampled from these schools to participate in the study. Qualitative data were collected from 30 students. Creswell and Creswell (2018) recommends that a sample size of 30-50 is sufficient for a qualitative study.

3.7 Research Instruments

This study used questionnaires and interview schedules to collect data. The questionnaire (Appendix B) consists of four sections. Section A collected demographic data, section B collected data on executive functioning, section C collected data on academic scaffolding, and section D collected data on achievement motivation for learning chemistry.

3.7.1 Executive Functioning Skills Scale

The study adapted the Executive Functioning Skills Scale in children and adolescents developed by Dawnson and Guare (2010), α =.81. This was a free to use questionnaire and the original scale consists of 36 items that measure executive skills on 12 domains. This questionnaire was modified to focus on four domains that were relevant to the current study. The four domains include: initiation, sustained attention, inhibitory control, and shifting. Most of the items in the original scale focused on general tasks or work and so to appropriately address the issue of the current study, in the place of task or work the researcher used the term chemistry.

In the adapted scale, each of the four domains consisted of three items that measured executive functioning skills on a five point Likert scale ranging from *Strongly Disagree* to *Strongly Agree*. The expected lowest score was 12 while the expected highest score was 60. The items that were negatively worded were reverse scored. A score of 12-24 indicated below average executive functioning skills, 25-47 indicated average, while a score of 48-60 indicated a high level of executive functioning skills.

To establish the reliability and validity of the adapted scale, the researcher carried out a pilot study in one school which was not included in the actual study. Content validity of this scale was examined by reviewing literature on measurement of executive functioning skills. Through this process, unclear items were revised and simplified to the level of form three students in Kenya.

The reliability of the adapted scale was examined using Cronbach Alpha coefficient. The results obtained using data from the pilot study are presented in Table 3.3.

Table 3.3

Reliability Coefficients of EF scale

	Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items
Pilot Study	.75	.71
Dawnson and Guare (2010)	.81	-

The results presented in Table 3.3 show that the reliability coefficient of executive functioning skills scale was .75. Dawnson and Guare (2010) reported a reliability coefficient of .81. The reliability coefficient obtained was adequate because it was above .70 as recommended by Oladimeji (2015).

3.7.2 Academic Scaffolding Scale

The researcher used the Academic Scaffolding Scale with 19 items to measure academic scaffolding. This scale was adapted from theTeacher Support Scale (TSS) developed by

Metheny et al. (2008) with 21 items, α = .91. This scale was modified to obtain the Academic Scaffolding Scale which consists of three domains namely: instructional scaffolding, planned scaffolding, and interactional scaffolding. The expected lowest score was 19 while the expected highest score was 95. A score in the range of 19-67 indicated insufficient academic scaffolding, while 68-95 indicated sufficient academic scaffolding. A pilot study was carried out to establish the validity and reliability of the research instrument and the reliability statistics for the scale are presented in Table 3.4.

Table 3.4

Reliability Statistics for Academic Scaffolding Scale

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	Items
.73	.73	19

The results presented in Table 3.4 show that the reliability coefficient of the scale was .73. According to Oladimeji (2015), a reliability coefficient of .70 and above is considered appropriate. Based on this recommendation, the Academic Scaffolding Scale used in this study was reliable. Content validity of this scale was established through literature review, and informed by the operational definition of instructional scaffolding, planned scaffolding, and interactional scaffolding. Construct validity was assessed using principal components analysis and the results yielded three components.

Sampling adequacy for each item in the academic scaffolding scale was assessed using KMO test and the results are results are presented in Table 3.5.

Table 3.5

KMO's Test Academic Scaffolding Scale

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.75
	Approx. Chi-Square	291.17
Bartlett's Test of Sphericity	*df*	171
	Sig.	.00

Table 3.5 shows that the factor analysis of the data was useful. Therefore, the data was suitable for detection of structure in academic scaffolding scale. The results imply that the items were sufficient for each of the factors in the scale.

3.7.3 Student's Motivation towards Science Learning Questionnaire (SMTSL)

This questionnaire obtained from the International Journal of Science Education (α =.89) was developed by Tuan et al. (2005). The researcher was granted permission by the authors to use the questionnaire (Appendix D). The questionnaire has 29 items that measure motivation on a five point Likert scale (*Strongly disagree to Strongly Agree*). The expected lowest score was 29 while the expected highest score was 145. Any score between 29 and 58 indicated low achievement motivation; 59-87 indicated average achievement motivation while any score ranging from 88-145 indicated high achievement motivation.

The original questionnaire comprised of 35 items that measured student's motivation towards science learning. To make the items more focused to suit the current study, the researcher modified all the items to focus on chemistry instead of science in general. The researcher also did not include the aspect of learning environment stimulation which consisted of six items. Therefore, the SMTSL questionnaire used in this study consisted of 29 items.

The researcher used data obtained from the pilot study among 40 students in one school to establish the reliability of the SMTSL questionnaire and the results are presented in Table 3.6.

Table 3.6

Reliability Statistics for SMTSL

Statistic			Reliability Coefficient
Cronbach's Alpha	Part 1 of the SMTSL questionnaire	Value	.75[a]
		N of Items	15[b]
	Part 2 SMTSL questionnaire	Value	.71
		N of Items	14[c]
	Total N of Items		29
Correlation Between Forms			.74
Spearman-Brown Coefficient	Equal Length		.71
	Unequal Length		.71
Guttman Split-Half Coefficient			.79

The researcher used Cronbach’s Alpha and split-half technique to establish the internal consistency of SMTSL. The results indicate that the Cronbach Alpha coefficient for the first part was .75 while that of the second part was .71. The Guttman split half coefficient was .79. Tuan et al. (2005) reported a reliability coefficient of .89. The reliability coefficient obtained was within the acceptable range. Oladimeji (2015) recommends that a reliability coefficient of 0.7 or more is considered to be appropriate for questionnaires used in social sciences.

To establish content validity of the SMTSL questionnaire, the researcher conducted a rigorous literature review on measurement of achievement motivation towards science learning. It was established that all the items sufficiently measured achievement motivation towards science learning. Principal component analysis was used to establish construct validity of the research instruments and the factor loadings are presented in Appendix E.

3.7.4 Interview Schedule

The researcher used a self-constructed interview schedule to collect qualitative data used to complement quantitative data. To ensure that this tool was reliable and valid, the researcher conducted a rigorous literature review on qualitative measurement of psychological constructs. With the knowledge and skills gained together with guidance from the university supervisors, the researcher developed the interview schedule to measure executive functioning skills, academic scaffolding, and achievement motivation for learning chemistry. Regarding executive functioning skills, four items were developed to measure this construct under four domains namely: initiation, sustained attention, inhibitory control, and shifting.

Items on academic scaffolding focused on the support in learning chemistry received from the teacher, other students, and the school in general. This aimed at generating qualitative data on instructional scaffolding, planned scaffolding, and interactional scaffolding. Five questions were developed to measure motivation towards learning chemistry. The university supervisors counterchecked the items in the interview schedule to ascertain face and content validity. The researcher used explicitness, congruence, and thoroughness criteria as suggested by Creswell (2013) to validate the qualitative data collection instrument.

To establish the reliability of the interview schedule, the researcher used theintercoder agreement approach. According to Creswell (2013), in this approach the researcher uses multiple coders to establish the stability of the responses provided. A pilot study was carried out and the data obtained was used to establish the reliability of the research instrument. The stability of the responses was checked using qualitative data codes and themes. In cases where inconsistency was noted, the questions were rephrased and then tested until stability of the responses provided was achieved.

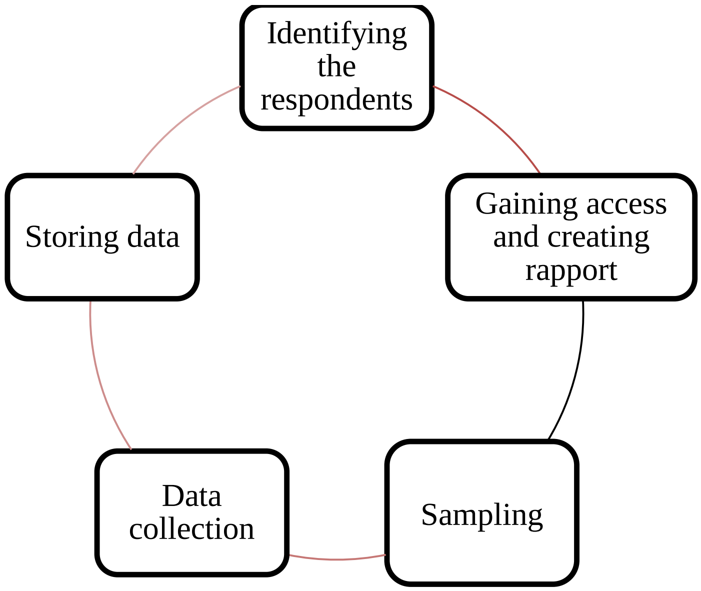
3.8 Data Collection Techniques

Data were obtained from the respondents through administering of questionnaires and interviewing. In each of the schools that were visited for data collection, the researcher/research assistants took about 20 minutes to explain to the respondents what they were required to do. Once they indicated that they have understood what they were required to do, they were allowed to complete the questionnaires and respond to interview questions. After the students were through with filling the questionnaires, the researcher/research assistants collected them the same day. These techniques were appropriate for this study because the researcher intended to gather a lot of information within the shortest time possible. Using the shortest time possible was necessary since the students were very busy trying to recover the time lost when schools were closed during the COVID-19 pandemic. Furthermore, the researcher was competent to handle data collected using self-reports.

Collection of qualitative data was guided by the model presented in Figure 3.1 which was developed by Creswell (2013).

Figure 3.1

Qualitative Data Collection Activities



Note. Adapted from Creswell (2013), Qualitative Inquiry and Research Design

According to Creswell (2013), a researcher can gain entry at any point in the circle but it is important to start with identification of the respondents from which qualitative data is to be collected. As such, the researcher of this study identified form three students who were to be interviewed. Random sampling technique was used to select one school and 30 students who were to be interviewed. To create rapport with the sampled students, the researcher explained to them the purpose of the study. Qualitative data were collected using an interview schedule (See Appendix C) developed by the researcher. The sampled students were required to provide written responses. To ensure that all the students adequately responded to the questions, the researcher counterchecked all the responses in the interview schedules. Those students who did not provide adequate responses were requested to enhance their responses. Qualitative responses were stored in written form ready for analysis.

3.9 Data Analysis

3.9.1 Quantitative Data Analysis

After data collection, the researcher checked all the questionnaires for unanswered questions. The questionnaires that had more than five unanswered questions were excluded from data analysis. The questionnaire responses were then coded and entered into a computer using SPSS program Version 26. The researcher then checked the data for missing values and outliers. Outliers were deleted and the values were then replaced with the mode of the scores. Due diligence was observed to ensure that there were minimal missing values during data entry. However, after data entry missing value analysis showed that five values were missing. The missing values were replaced using imputation method.

Data analysis was done using two methods, descriptive statistics and inferential statistics. Demographic data were analyzed using descriptive statistics (frequencies, means and standard deviation) and executive functioning, academic scaffolding, and achievement motivation for learning chemistry data were analyzed using inferential statistics (Pearson's product moment correlation and multiple regression) were utilized to test the following hypotheses:

H_{01} There is no significant relationship between executive functioning and achievement motivation for learning chemistry. Statistical test: Pearson product moment correlation.

H_{02} There is no significant relationship between academic scaffolding and achievement motivation for learning chemistry. Statistical test: Pearson product moment correlation.

H_{03} Gender does not significantly moderate the relationship between executive functioning skills, academic scaffolding and achievement motivation for learning chemistry. Statistical test: moderated multiple regression analysis.

H_{04} There is no significant prediction equation for achievement motivation for learning chemistry from the domains of executive functioning and academic scaffolding. Statistical test: Multiple regression analysis.

3.9.2 Analysis of Qualitative Data

Analysis of qualitative data involved grouping the responses into themes and sub themes, development of executive functioning skills, academic scaffolding, and achievement motivation for learning chemistry rubrics. The results were used to answer the following research questions.

i. How do executive functioning skills help the students in achievement motivation for learning chemistry?

ii. How does academic scaffolding help the students in achievement motivation for learning chemistry?

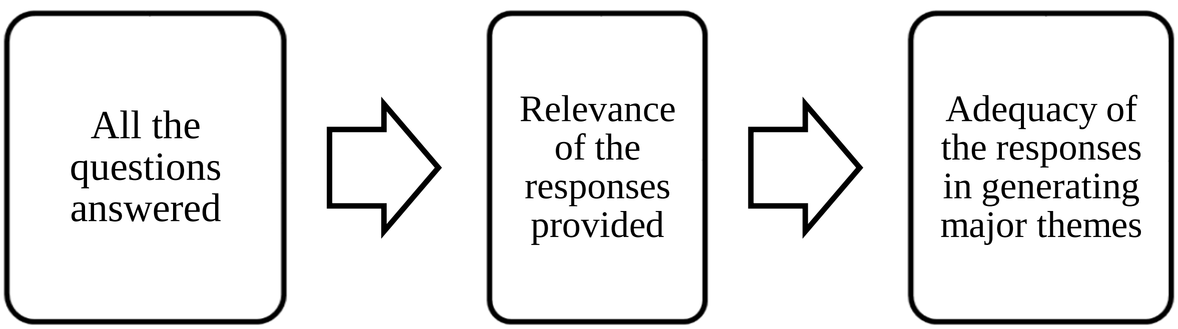
The researcher collected qualitative data through interviews to compare the findings with quantitative results. Thematic analysis technique was used to analyze qualitative data. This technique was appropriate for this study because the researcher aimed at exploring the nature of executive functioning skills, academic scaffolding, and achievement motivation for learning chemistry using both inductive and deductive approaches. According to Jamieson (2016), the approach used to analyze qualitative data reflects the philosophy of the researcher regarding the nature of knowledge. With this view, the researcher worked with the perspective that even though executive functioning skills, academic scaffolding, and achievement motivation for learning chemistry are unseen psychological variables, they can be inferred from the student's behaviour through narratives.

The process of qualitative data analysis included: data preparation, immersion in the data, data coding, generation of themes, interpretation and implication of the findings with regard to the research issue. The study used qualitative data analysis process suggested by Jamieson (2016). The interview schedule comprised of 11 items that were aimed at examining the student's executive functioning skills, academic scaffolding, and achievement motivation for learning chemistry. The items were designed to extract qualitative data on each of the levels of the predictor and outcome variables. In executive functioning skills, the items sought to get information on initiation, sustained attention, inhibitory control, and shifting skills of the students while learning chemistry. On academic scaffolding, the items sought to gather information on interactional scaffolding, planned scaffolding, and instructional scaffolding. Achievement motivation for learning chemistry focused on the students' motivation to learn chemistry.

Data preparation included assigning the respondents pseudo names and codes for easy identification of the data. The interview schedules were also checked for adequacy of the responses provided to ensure the answers satisfactorily addressed the issues that were investigated. The researcher read all the responses provided in each of the interview schedules. The inclusion criteria was as follows;

Figure 3.2

Inclusion Criteria for Qualitive Data



When all the interview schedules were checked, it was established that all the items in in each of the interview schedule were answered. The responses in all the interview schedules were then reviewed to assess for relevance of the responses and from this exercise, three interview schedules were excluded. The interview schedules were excluded because most of the responses provided were not relevant in addressing the issues that were under investigation. Adequacy of the responses in generating major themes in each of the interview schedules was checked and six interview schedules did not meet the inclusion criteria. After this process, a total of nine interview schedules were excluded from data analysis. Thus the interview schedules that met the inclusion criteria were twenty one.

3.10 Logistical and Ethical Considerations

3.10.1 Logistical Considerations

The researcher was given research approval and introduction letters from Graduate school, Kenyatta University, which were then used to apply for a research license from the National Commission for Science, Technology and Innovation (NACOSTI). On obtaining the research license, the researcher reported to the Kiambu County Commissioner and the County Director of Education. Research authorization letters were issued to conduct the research among form three students in the county (Appendix I).

To ensure that the data collection process went on without interruption, the researcher prepared all the resources that were required for the exercise. From personal savings, the researcher set aside enough money to cater for payment of the research assistants, travel, and subsistence. Other preparations included; printing of the questionnaires and interview schedules, sampling and identification of the schools where the study was to be conducted, and training the research assistants on data collection. Once the sampled schools were identified, the researcher contacted the principals of the schools to book appointments for data collection. Data collection was carried out between 11th January, 2021 and 12th February, 2021.

3.10.2 Ethical Considerations

Participation in this study was voluntary and the students had the opportunity to participate or decline to participate in the study. The students were given a consent form to read, afterwhich they indicated, by signing, that they had understood what the study was about and were voluntarily choosing to participate in the study (Appendix A). The researcher explained in details to the respondents the aim of the research and assured them of confidentiality of the information they would provide. After data analysis, the results were discussed in summary form without revealing any information that could be used to identify the respondents.

All the sources of reference materials used in this study were duly acknowledged and referenced according to APA seventh edition guidelines. The results were also shared with secondary schools and other stakeholders in the education sector in Kiambu County to facilitate the use of the study results to address the challenge of below average performance in chemistry.

CHAPTER FOUR

PRESENTATION OF RESULTS, FINDINGS, INTERPRETATION, AND DISCUSSION

4.1 Introduction

This chapter presents the findings, interpretation and discussion of the results. It begins with general and demographic information which include: the return rate of the research instruments, gender, age, and the school type. This information is presented using descriptive statistics. The other findings are presented as per the study objectives. This begins with descriptive statistics of the scores of each of the study variables, hypothesis testing, and discussion of the findings.

4.2 General and Demographic Information

In this section, the return rate of the research instruments, gender of the students, age, and school type are presented.

4.2.1 Return Rate

The study was carried out in 17 secondary schools that comprised of 4 national schools, 6 county and extra county schools and 7 sub county schools. In the national schools, 120 questionnaires were administered while in the county and extra county schools 138 questionnaires were administered. A total of 182 questionnaires were administered to students sampled from sub county secondary schools. To collect qualitative data, 30 students were interviewed. During data coding and entry, 64 questionnaires did not meet the criteria for inclusion in data analysis, while 38 questionnaires were not returned. Some of the questionnaires had more than five items not filled, while in others some items had more than one response. The return rate of the research instruments is presented in Table 4.1.

Table 4.1

Return Rate of the Research Instruments

School Type		Sample of Schools	Sample of students		Return Rate	
			Male	Female	Male	Female
NS	BS	2	60	-	46	-
	GS	2	-	60	-	45
CS & ECS	BS	3	69	-	53	-
	GS	3	-	69	-	43
SCS	CES	7	91	91	75	76
Sub Total		17	220	220	174(88)	164(83)
Total		17	440		338 (86)	

Note. NS – National Schools; CS – County Schools; ECS – Extra County Schools; SCS-Sub County Schools; BS – Boys' Schools; GS – Girls' Schools; CES – Co-Educational Schools;

As shown in Table 4.1, 440 questionnaires were administered to students from three different categories of schools. Calculation of the return rate was done based on the initial sample size of 395 students obtained using Slovin's (1960) formula discussed in section 3.6.2. Out of the 440 questionnaires, 220 were administered to male students and 220 were administered to female students. Some of the questionnaires were administered by the researcher while others were administered by the research assistants.

During data entry, it was found that some of the questionnaires had incomplete responses while others were not returned. The incomplete questionnaires were not included in data analysis. Among male respondents, 174 questionnaires out of the expected 220, were used in data analysis translating to a return rate of 88%. For female respondents, 164 out of 220 administered questionnaires were returned, translating to a return rate of 83%. Based on the initial sample size of 395 students, the questionnaire return rate was 86%. According to Fincham (2008), a questionnaire return rate of 65% and above is considered appropriate for a survey research. Since the questionnaire return rate for this study was 86% which was above the recommended threshold, data analysis was done using the 338 questionnaires.

4.2.2 Gender and Age of the Respondents

The gender and age of the students across the different categories of schools are presented in Table 4.2.

Table 4.2

Gender and Age of the Respondents

	Gender		Age	
School Type	Male	Female	Mean	Std Dev.
NS	46 (13.61)	45 (13.31)	18.31	1.24
CS & ECS	53 (15.68)	43 (12.72)	17.13	1.36
SCS	75 (22.19)	76 (22.49)	18.96	1.76
Total	174 (51.48)	164 (48.52)	18.13	1.45

Note. NS – National Schools; CS – County Schools; ECS – Extra County Schools; SCS- Sub County Schools

The study was carried out in three categories of schools namely, national schools, county and extra county schools, and sub county secondary schools. The sample of male respondents selected from national schools was 46 (13.61%) while female respondents were 45 (13.31%). In county and extra county schools, female respondents were 53 (15.68%) while male respondents were 43 representing 12.72%. Majority of the respondents were selected from sub county secondary schools. The female and male respondents were 75 (22.19%) and 76 (22.49%) respectively.

Respondents from sub county secondary schools had the highest mean age of 18.96 years. The mean age of the respondents from national schools was 18.31 years with a standard deviation of 1.24. Students from county and extra county schools had a mean age of 17.13 (*SD* = 1.36). The findings indicated that the students involved in the study were within the age bracket (16-19) of most form three students in Kenya.

4.3 Relationship between Executive Functioning and Achievement Motivation

In the first objective, the researcher sought to find out the extent to which executive functioning was related to achievement motivation for learning chemistry. To achieve this, it was hypothesized that there was no significant relationship between the two variables. The scores of executive functioning and achievement motivation for learning chemistry were descriptively analyzed before conducting the correlation analysis.

4.3.1 Descriptive Analysis of the Respondents' Executive Functioning Skills

The scores on executive functioning skills were analyzed using descriptive statistics and the results are presented in Table 4.3.

Table 4.3

Description of Executive Functioning Scores

N	Range	Min	Max.	*M*	*SD*	*Sk*	*Kur*
338	44.00	12.00	56.00	37.39	7.07	-.24	.28

Note. Min- Minimum; Max- Maximum; *M* – mean; *SD* – Standard deviation; *Sk*-Skewness; *Kur* – kurtosis

Table 4.3 shows that the mean of executive functioning scores was 37.39 (*SD* = 7.07). The students had a minimum score of 12 and maximum score of 56 with a range of 44. The expected minimum and maximum scores were 12 and 60 respectively. The skewness and kurtosis coefficients were – 0.24 and 0.28 respectively. The skewness and kurtosis coefficients were below two indicating that the scores were normally distributed as suggested by Kim (2013).

Table 4.4

Descriptives of Executive Functioning Scores based on School Category

School type	Range	Min	Max	*M*	*SD*	*Sk*	*Kur*
NS	30	21	51	37.45	6.61	-.18	-.35
ECS & CS	36	20	56	37.78	6.69	-.10	.08
SCS	37	12	54	36.44	8.23	-.77	.38

Note. *N* = 338; NS-National Schools; ECS-Extra County Schools; CS-County Schools; SCS-Sub County Schools; Min- Minimum; Max-Maximum; *M*-Mean; *SD*-Standard deviation; *Sk*-Skewness; Kur – kurtosis

The executive functioning skills mean score of students from National Schools was 37.45 (*SD* = 6.61). The mean score of students from extra county and county schools and sub county schools was 37.78 (*SD* = 6.69) and 36.44 (*SD* = 8.23) respectively. The maximum score of students from national schools was 51 while the minimum score was 21 with a range of 30. The minimum score of students from extra county and county schools was 20 while the maximum score was 56 with a range of 36. The minimum score of students from the sub county schools was 12 while the maximum score was 54 with a range of 37. The results showed that students from the national schools had the highest mean score while students from sub county secondary schools had the lowest mean score. The skewness and kurtosis coefficients for all the scores of students from all the school categories indicate that the scores were approximately normally distributed.

Table 4.5

Descriptives of Executive Functioning Scores by Gender

Gender	*N*	Range	Min	Max	*M*	*SD*	*Sk*	*Kur*
Male	174	32	24.00	56.00	38.13	6.92	.14	-.36
Female	164	40	12.00	52.00	36.60	7.17	-.59	.59

Note. *N*=338; Min- Minimum; Max-Maximum; *M*-Mean; *SD*-Standard deviation; *Sk*-Skewness; Kur – kurtosis

The results indicate that the mean score of male students was 38.13 (*SD* = 6.92) while that of the female students was 36.60 (*SD* = 7.17). The maximum score for male students was 56 while the minimum score was 24 with a range of 32. The maximum score for female students was 52 while the minimum score was 12 with the range of 40. The skewness and kurtosis coefficients indicate that the scores were near normal distribution. The results indicated that male respondents had slightly better executive functioning skills than female students.

Table 4.6

Description of the Scores of the Types of Executive Functioning

	N	Range	Min	Max	*M*	*SD*	*Sk*	*Kur*
Initiation	338	12	3	15	9.17	2.34	.05	-.27
Sustained Attention	338	12	3	15	8.70	2.99	-.04	-.72
Inhibitory Control	338	12	3	15	10.15	2.52	-.44	.14
Shifting	338	12	3	15	9.37	2.79	-.27	-.46

Note. *N*=338; Min- Minimum; Max-Maximum; *M*-Mean; *SD*-Standard deviation; *Sk*-Skewness; *Kur* – kurtosis

Executive functioning skills were measured at four levels namely: initiation, sustained attention, inhibitory control, and shifting. The mean score of the respondents on initiation skills was 9.17 with a standard deviation of 2.34. Regarding sustained attention skills, the mean score of the students was 8.70 (*SD* = 2.99). The mean score of inhibitory control and shifting skills was 10.15 (*SD* = 2.52) and 9.37 (*SD* = 2.79) respectively. The kurtosis and skewness coefficients of the four domains of executive functioning skills were within the recommended range, implying that the scores were normally distributed.

To establish if the types of executive functioning skills were separate and distinguishable from each other, correlation analysis was conducted and the results are presented in Table 4.7.

Table 4.7

Correlations of the Types of Executive Functioning

	1	2	3	4
Initiation	-			
Sustained Attention	.22*	-		
Inhibitory Control	.01	.31*	-	
Shifting	.19*	.42*	.28*	-

Note. $N = 338$; $^{*}p < .05$

The results indicate that the types of executive functioning skills were significantly correlated apart from inhibitory control and initiation skills. However, the correlations ranged from low to moderate. Shifting executive functioning skills and sustained executive functioning skills had the highest correlation coefficient ($r = .42$, $p < .05$), while the lowest correlation coefficient obtained was between shifting executive functioning skills and initiation executive functioning skills. Even though the correlations ranged from low to moderate, to remove the effects of multicollinearity in the regression model, partial least squares regression was used.

The executive functioning skills of the respondents were grouped into three categories namely,below average, average, and above average. A score of 12-24 indicated below average executive functioning skills, 25-47 indicated average, while a score of 48-60 indicated high level of executive functioning skills. The results are presented in Table 4.8.

Table 4.8

Levels of Executive Functional Skills

	Frequency	Percent
Below Average	12	3.6
Average	303	89.6
Above Average	23	6.8
Total	338	100.0

Table 4.8 shows that 12 students, representing 3.6% had below average executive functioning skills. Majority of the students, representing 89.6% had average level of executive functioning skills, while 6.8% of the respondents had above average level of executive functioning skills.

4.3.2 Descriptive Analysis of Achievement Motivation Scores

Table 4.9 presents the descriptive statistics of achievement motivation for learning chemistry scores.

Table 4.9

Descriptives of Achievement Motivation Scores

N	Min	Max	Range	*M*	*SD*	*Sk*	*Kur*
338	52	116	64	96.30	13.18	-.37	.51

Note. Min- Minimum; Max-Maximum; *M*-Mean; *SD*-Standard deviation; *Sk*-Skewness; *Kur* – kurtosis

Table 4.9 shows that the mean of achievement motivation for learning chemistry scores was 96.30 (*SD* = 13.18). The minimum score was 52, while the maximum score was 116 with a range of 86. The expected lowest score was 29 and the maximum expected score was 116. The skewness and kurtosis coefficients were -0.37 and 0.51 respectively. The coefficients were below three implying that the scores were approximately normally distributed.

Table 4.10

Descriptives of Achievement Motivation Scores per School Category

School Category	Min	Max	Range	*M*	*SD*	*Sk*	*Kur*
NS	52	116	64	97.03	14.45	-0.31	0.70
ECS and CS	64	116	52	97.52	14.18	-0.51	0.06
SCS	53	116	63	95.15	12.37	-0.55	-0.55

Note. NS = National Schools; ECS = Extra County Schools CS= County School SCS = Sub County Schools

Table 4.10 shows that the mean score of students from national schools was 97.03 (*SD* = 14.45). Students from extra county and county schools scored the highest mean of 97.52 (*SD* = 14.18) while students from sub county schools scored a mean of 95.15 (*SD* = 12.37). The scores in the school categories ranged from 52 to 116.

Achievement motivation scores for learning chemistry were also descriptively explored based on gender of the respondents and the results are presented in Table 4.11.

Table 4.11

Descriptives of Achievement Motivation Scores by Gender

Gender	*N*	Min	Max	Range	*M*	*SD*	*Sk*	*Kur*
Male	174	53	116	63	97.48	13.67	-0.23	0.47
Female	164	52	116	64	95.06	12.55	-0.63	0.45

Note. *N* = 338; Min- Minimum; Max-Maximum; *M*-Mean; *SD*-Standard deviation; *Sk*-Skewness; Kur – kurtosis

The mean score of male respondents was 97.48 with a standard deviation of 13.67. Female students had a mean score of 95.06 with a standard deviation of 12.55. The results show that male students had a higher mean than female students. The scores for both male and female respondents ranged from 52 to 116.

Achievement motivation scores were categorized into low, average and high. Any score between 29 and 58 indicated low achievement motivation, 59-87 indicated average achievement motivation, while any score ranging from 88-145 indicated high achievement motivation.

Table 4.12

Descriptive Statistics for the Levels of Achievement Motivation

Level	Frequency	Percent
Low	76	22.5
Average	248	73.4
High	14	4.1
Total	338	100.0

The results show that 22.5% of the respondents had a low level of achievement motivation, 73.4% had a moderate level of achievement motivation and only 4.1% had a high level of achievement motivation. The results demonstrated that a majority of the students involved in the study had average level of achievement motivation for learning chemistry.

4.3.2 Hypothesis Testing

To establish the relationship between executive functioning skills and achievement motivation for learning chemistry, the following hypothesis was tested.

H_{01} There is no significant relationship between executive functioning skills and achievement motivation for learning chemistry.

Table 4.13

Correlation between Executive Functioning and Achievement Motivation

		Achievement Motivation
Executive Functioning	Pearson Correlation	$.39^{*}$
	Sig. (2-tailed)	.00
	N	338

The results presented in Table 4.13 shows that there was a significant positive correlation between executive functioning and achievement motivation for learning chemistry, r (336) = .39, $p < .05$. Based on the results that were obtained, the null hypothesis was rejected and the alternative hypothesis adopted. Therefore, executive functioning skills significantly influences achievement motivation for learning chemistry. The findings suggest that an increase in executive functioning skills is associated with an increase in achievement motivation for learning chemistry and vice versa.

The scale that was used to measure executive functioning skills comprised of four sub scales namely; initiation, sustained attention, inhibitory control and shifting. To understand how each of the sub constructs was correlated to achievement motivation for learning chemistry, the following supplementary hypotheses were tested.

$H_{01.i}$ There is no significant relationship between initiation executive functioning skills and achievement motivation for learning chemistry.

$H_{01.ii}$ There is no significant relationship between sustained attention executive functioning skills and achievement motivation for learning chemistry.

$H_{01.iii}$ There is no significant relationship between inhibitory control executive functioning skills and achievement motivation for learning chemistry.

$H_{01.iv}$ There is no significant relationship between shifting executive functioning skills and achievement motivation for learning chemistry.

The hypotheses were tested using Pearson correlation analysis and the results are presented in Table 4.14.

Table 4.14

Correlation between Types of Executive Functioning Skills and Achievement Motivation

Types of Executive Functioning Skills	Achievement Motivation
Initiation	$.21^{*}$
Sustained Attention	$.31^{*}$
Inhibitory Control	$.30^{*}$
Shifting	$.35^{*}$

Note. $N = 338$; $^{*}P < .05$

The results presented in Table 4.14 indicate that shifting executive functioning skills had the highest correlation coefficient with achievement motivation for learning chemistry, r (336) = .35, $p < .05$, followed by sustained attention executive functioning skills, r (336) = .31, $p < .05$. Initiation executive functioning skills and inhibitory control executive functioning skills had a correlation coefficient of r (336) = .21, $p < .05$ and r (336) = .30, $p < .05$ respectively with achievement motivation for learning chemistry.

Executive functioning skills were categorized into three groups namely, below average, average, and above average. To establish if achievement motivation for learning chemistry differed with the different levels of executive functioning skills, the researcher conducted one way ANOVA and the results are presented in Table 4.15.

Table 4.15

ANOVA Results for Mean Differences in Achievement Motivation

	Sum of Squares	*df*	Mean Square	*F*	Sig.
Between Groups	6053.06	2	3026.53	19.32	.00
Within Groups	52480.56	335	156.66		
Total	58533.61	337			

Note. $N = 338$

The results presented indicate that there was a statistically significant difference in achievement motivation for learning chemistry among students with different levels of executive functioning skills, $F(2, 335) = 19.32$, $p < .05$. Tukey’s honestly significant difference (Tukey’s HSD) test was conducted to establish how each pair of the levels of executive functioning skills contributed to the difference.

Table 4.16

Tukey's HSD for Achievement Motivation Scores Across the Levels of EF

(I) EF Levels	(J) EF Levels	Mean Difference (I-J)	Std. Error	Sig.
Low	Average	-15.01^{*}	3.68	.00
	High	-27.13^{*}	4.46	.00
Average	Low	15.01^{*}	3.68	.00
	High	-12.12^{*}	2.71	.00
High	Low	27.13^{*}	4.46	.00
	Average	12.11^{*}	2.71	.00

Note. N = 338; EF- Executive Functioning; Sig. - Significance

The results presented in Table 4.16 show that there was a significant difference in achievement motivation for learning chemistry between students with low and average levels of executive functioning skills. The difference in achievement motivation for learning chemistry between students with low and high levels of executive functioning skills was also significant. The results also indicate that achievement motivation for learning chemistry between students with average and high levels of achievement motivation differed significantly.

Executive functioning scale consisted of four sub scales namely, initiation, sustained attention, inhibitory control, and shifting. Since it was found that there was a positive and significant relationship between the types of executive functioning skills and achievement motivation for learning chemistry, it was important to investigate how each of the types of executive functioning skills predict achievement motivation for learning chemistry. The data were subjected to multiple regression analysis and the results are presented.

Table 4.17

Regression Model Summary for EF Sub Domains

Model	*R*	*R* Square	Adjusted *R* Square	*SE* of the Estimate
1	.45[a]	.21	.19	11.83

Note. N = 338

a. Predictors: (Constant), Shifting, initiation, inhibitory control, sustained attention

b. Dependent Variable: Achievement motivation

Table 4.17 indicates that the multiple regression coefficient was 0.45 which suggests a moderate prediction of achievement motivation for learning chemistry from shifting, initiation, inhibitory control, and sustained attention executive functioning skills. The results also indicate that R square was 0.21 which means that 21% variance in achievement motivation for learning chemistry can be explained by the predictor variables.

To establish if the regression model was significant in predicting achievement motivation for learning chemistry, ANOVA was used and the results are presented in Table 4.18.

Table 4.18

ANOVA for EF Sub Domains

Model		Sum of Squares	*df*	Mean Square	*F*	Sig.
1	Regression	11893.61	4	2973.40	21.23	.00[b]
	Residual	46640.01	333	140.06		
	Total	58533.61	337			

a. Dependent Variable: Achievement motivation

b. Predictors: (Constant), shifting, initiation, inhibitory control, sustained attention

The *F* ratio in the ANOVA suggests that shifting, initiation, inhibitory control, sustained attention executive functioning skills significantly predict achievement motivation for learning chemistry, F (4, 333) = 21.23, $P < .05$. Table 4.19 presents the regression coefficients for the prediction model.

Table 4.19

Regression Coefficients for EF Sub Domains

Model		Unstandardized Coefficients		Standardized Coefficients	*t*	Sig.
		B	*SE*	Beta		
1	(Constant)	64.14	3.81		16.84	.00
	X_1	.79	.29	.14	2.77	.00
	X_2	.58	.25	.13	2.34	.02
	X_3	1.06	.28	.20	3.85	.00
	X_4	.97	.26	.20	3.71	.00

Note. X_1 = Initiation; X_2 = Sustained Attention; X_3 = Inhibitory Control; X_4 = Shifting

As shown in Table 4.19, the regression coefficient for initiation executive functioning skills was 0.79, while that of sustained executive functioning skills was 0.58. Inhibitory executive functioning skills had the highest predictive value of 1.06, followed by shifting executive functioning skills with a predictive value of 0.97. All the executive functioning skills, as shown by the regression coefficients, significantly predicted achievement motivation for learning chemistry.

The prediction equation developed from the regression coefficients is as follows:

$\hat{Y} = 0.79X_1 + 0.58X_2 + 1.06X_3 + .97X_4 + 64.14$

Where $\hat{Y}$ = Predicted achievement motivation

Based on the regression equation, a unit change in initiation executive functioning skills and sustained attention executive functioning skills was associated with 0.79 and 0.58 change in achievement motivation for learning chemistry respectively. A unit change in inhibitory control was associated with 1.06 change in achievement motivation for learning chemistry and a unit change in shifting executive functioning skills to 0.97 change in achievement motivation for learning chemistry.

4.3.3 Qualitative Data Findings

Qualitative data were collected from 30 students to complement quantitative data. The researcher was guided by Levitt et al. (2018) propositions of identifying themes in qualitative data. The suggestions given by the researchers include: repetition, metaphors, and analogies, typologies, transitions, theory related data and linguistic connectors. This study majorly used repetition to identify the themes in the responses that the students provided. Coding of executive functioning qualitative data was as presented in Table 4.20.

Table 4.20

Executive Functioning Skills

Executive functioning skills levels	String
Initiation	Starting to do assignment in good time and completing it
Sustained attention	Focusing on chemistry assignment until it is completed
Inhibitory control	Using effective strategies used to successifully complete chemistry tasks
Shifting	Putting more effort to improve in performance

a. Analysis on Executive Functioning Skills

The participants were assigned pseudo names to conceal their identities. Therefore, the names used in the presentation of the findings are not the real names of the participants.

Jane: This participant was asked about the time she bagan doing chemistry assignments and whether she always finished them. The participant said, " I always start my chemistry assignments immediately after the lessons and when it is time to do the cleaning in the evening. Regarding finishing chemistry assignments, the participant said, " I always finish my assignments and when the questions are difficult, I consult other students or the teacher." The findings indicate that this student had a high level of initiation skills.

Regarding sustained attention, the student was asked to give the strategies she used to remain focused on chemistry assignments until they were completed. The student said, "I always focus on my chemistry assignments until they are completed and get satisfied that I have gotten the correct answers. In case am unable to do the questions, I always consult the teacher or fellow students for assistance." The responses provided indicate that the student was able to come up with innovative strategies to enable her complete learning tasks in chemistry. According to Braem and Egner (2018), students with high levels of sustained attention skills use a variety of strategies in performing learning tasks and modify them depending on the prevailing conditions to achieve learning objectives. In this regard, when Jane was faced with challenges in handling chemistry tasks she sought assistance (scaffolding) to achieve learning objectives.

On inhibitory control, Jane was asked to give the strategies she used to avoid disappointment while answering chemistry questions. Jane replied, "I always read again and again until I master the content. I also avoid distractions that can interfere with my studies. You know chemistry is largely a practical subject and therefore when I learn a concept, I try to relate it to real-life situations. This strategy helps me to understand the concepts thus minimizing chances of forgetting. If a given text book does not present the content in a way that I can understand, I always refer to another text that presents the content in a simpler manner.”

Concerning shifting domain of executive functioning skills, the respondent said, “When am faced with learning challenges while studying chemistry, I look for questions from past papers, revision books that have tested the same concept to give me direction on the most important learning points. This statement demonstrates that Jane had the ability for cognitive adjustment to fit in changing learning contexts, especially when faced with challenges. According to Wixted et al. (2016), shifting skills help students to navigate through dynamic learning contexts and content. For instance, students learn different subjects, face learning challenges concerning the content and are taught by different teachers. Under such circumstances, shifting skills are very instrumental for effective learning.

Mark was asked the strategies he used to avoid disappointments when answering questions and his response was “First I write summary notes on the topic to study and then do questions carefully.” The findings indicate that Marks' active learning strategies are summarizing notes and reading the questions carefully. The study by Muraina et al. (2014) is that summary notes are essential for students especially when studying for approaching exams.

b. Achievement Motivation For Learning Chemistry

The researcher sought to establish the level of achievement motivation for learning chemistry and its relationship with academic scaffolding and executive functioning skills. On whether they have what it takes to do well in chemistry, Jane said, "Yes, it is because I have the best teacher, revision books, and conducive environment for studying. I also participate actively during chemistry lessons." This student applies mastery goal skills of believing in oneself to do well in chemistry. This response also indicates that the student uses active learning strategy while studying Chemistry. However, the student said that the effort has not had a significant impact on learning outcomes in chemistry.

Mark: Marks' response on whether they have what it takes to do well in chemistry was:

"*Yes, chemistry is an interesting subject that makes you want to know more things that you never knew. The teacher has a simple way of teaching chemistry that makes it more interesting. Our teacher goes an extra mile to give us questions, CATS to help us understand and improve in the subject*."

Peter: On the same question, Peter said:

"*I believe I have what it takes to do well in chemistry. My teacher and parents tell me that I am a bright student, I wouldn't like to disappoint them".*

This student was motivated to do well in chemistry to avoid disappointing his teacher and parents. Moreover, the students' source of motivation was from his and parents who insisted that he a bright student.

Moneva et al. (2018) points out that the support that students get from teachers and parents motivates them to put more effort in their studies. Concerning motivation to learn chemistry, Agnes was asked the importance of performing well in Chemistry and she said,

"Performance in Chemistry is important because it will enable me to achieve my career goals. Also it will make me to inspire other students. I feel happy when I pass and help my friends who want to improve their performance. It is a subject with many careers too."

The findings indicate that the participant understood the value of performing well in chemistry. The student indicated that she was aware of the chemistry learning value which was associated with executive functioning skills.

Using qualitative data, in the first question the researcher aimed to establish how executive functioning skills helped students in achievement motivation for learning chemistry. The findings showed that executive functioning skills helped to enhance students' achievement motivation for learning chemistry. The findings supported quantitative data results, which showed that there was a significant relationship between executive functioning skills and achievement motivation for learning chemistry.

4.3.4 Discussion of the Results

The first objective of this study was to investigate the extent to which executive functioning is related to achievement motivation for learning chemistry. The results showed that there was a positive and significant relationship between executive functioning and achievement motivation for learning chemistry. Executive functioning scores of the students were categorized into three levels namely: low, average, and high. The results of further analysis showed that there was a significant difference in achievement motivation for learning chemistry among students with low, average, and high level of executive functioning. Past research on executive functioning mostly focused on academic achievement. Since research has established that there is a significant relationship between achievement motivation and academic achievement, the results were important to guide the discussion of the findings of the present study.

The results of Pascal et al. (2019) support those of the current study. Pascal et al. and colleagues established that there was a significant relationship between executive functions and academic achievement. The researchers determined that the random effects of initiation, sustained attention, shifting, and inhibitory control had a combined random effect of 0.37 on academic achievement. More importantly, they demonstrated that executive functions regulated educational processes such as achievement motivation which in turn affected academic achievement. This seems to suggest that achievement motivation may be a link through which executive functioning skills influence academic achievement. The findings were corroborated by those of Duckworth et al. (2019).Missier et al. (2011) also found that executive functions influenced student's competencies in decision making. The students involved in the study used executive functioning skills in making decisions in educational settings. In turn, the decisions made influenced the amount of effort students put in their study to promote educational achievement. Cognitive reflection especially on matters related to academics was associated with executive functioning skills. Executive functioning skills guide students' actions in academic goal setting. These actions include emotional control, self-regulation, and problem solving. The information processing theory used in the current study argues that these actions comprise the mental strategies used by students in information processing to guide learning.

The results of the current research were also consistent with the findings of Engel et al. (2014) who established that there was a significant relationship between executive functioning and reading comprehension performance. Cognitive flexibility and working memory were the best predictors of reading performance. The researchers argued that individual differences in reading comprehension performance was explained by executive functioning domains. Pupils with low scores in reading performance were found to have limitations in executive functioning skills. Thus, taken together with the current study results, it can be argued that executive functioning skills are crucial in school achievement regardless of age and the learning context.

The results also support the findings of Bull (2015) who demonstrated that executive functioning skills uniquely contributed to learning effort and academic achievement. The researcher observed that the difficulties in school achievement were associated with poor executive functioning skills. Even though the study focused on learning effort and academic achievement as the outcome variable, the results suggest that executive functioning isimportant in relation to achievement motivation because of its significant relationship with academic achievement.

More importantly, the findings of the current study demonstrate that executive functioning is an important construct in educational settings. Not surprisingly then, Pascual et al. (2019) found that the components of executive functioning significantly predicted performance in school. The study also established that age significantly moderated the relationship between executive functioning and achievement. The researchers demonstrated that the domains of executive functioning affect learning orientation and academic achievement. Even though the study focused on academic achievement, the findings suggest that executive functioning skills are important in achievement motivation which is directly related to academic performance. Similar results were obtained by Gomez-Veiga et al. (2013) who demonstrated that 33% variance in reading performance was explained by executive functioning skills.

Information processing theory, in which this study was anchored suggests that learning behaviors that enhance academic achievement, are based on inherent processes of executive functioning skills. As demonstrated by the current study, executive functioning is an important factor for achievement motivation for learning chemistry, which going by the results of previous studies is critical for academic peformance.

4.4 Relationship between Academic Scaffolding and Achievement Motivation

This section presents descriptive statistics of academic scaffolding scores, hypothesis testing, qualitative data findings, and discussion of the results.

4.4.1 Descriptive Statistics for Academic Scaffolding Scores

Table 4.21 presents the descriptive statistics for academic scaffolding scores.

Table 4.21

Descriptive Statistics for Academic Scaffolding

	N	Range	Min	Max	*M*	*SD*	*Sk*	*Kur*
Academic Scaffolding	338	64	28	92	67.53	11.67	-0.52	0.16

Note. Min = Minimum; Max. Maximum; *SD* = Standard deviation; Skew = Skewness; Kur = Kurtosis

The results indicate that the mean score was 67.53 with a standard deviation of 11.67. The minimum score was 28 while the maximum score was 92 with a range of 64. The skewness and kurtosis coefficients were within the recommended range for normal distribution of the scores. In the scale used, the expected minimum score was 28 while the maximum score was 95.

The study was conducted in three categories of schools and the results of descriptive statistics for academic scaffolding in each school category are presented in Table 4.22

Table 4.22

Descriptive Statistics for Academic Scaffolding per School Category

School Category.	*N*	Range	Min	Max	*M*	*SD*	*Sk*	*Kur*
NS	91	64	28	92	67.54	11.96	-0.55	0.42
ECS and CS	96	54	36	90	68.74	6.35	-0.76	0.43
SCS	151	32	35	91	66.56	11.75	-0.43	-0.01

Note. *N* = Sample size; NS = National schools; ECS=Extra county schools; CS=County schools; SCS = Sub County schools; *M* = Mean *SD* = Standard deviation; *Sk* = Skewness; *kur* = kurtosis

As indicated, the mean score of students from national schools was 67.54 (*SD* = 11.96). The minimum score was 28 while the maximum score 92 with a range of 64. The mean of students from extra county and county schools was 68.74 (*SD* = 6.35). The maximum score was 90 while the minimum score was 36 (Range = 19). In the sub county schools, the mean score was 66.56 with a standard deviation of 11.75. In all the categories of schools, the scores were near normal distribution as indicated by the skewness and kurtosis coefficients. From the results, academic scaffolding was highest in extra county and county schools followed by national schools and then sub county schools.

Regarding the descriptive statistics for academic scaffolding scores by gender of the students, the results are presented in Table 4.23.

Table 4.23

Descriptive Statistics for Academic Scaffolding by Gender

Gender	Range	Min	Max	*M*	*SD*	*Sk*	*Kur*
Male	64	28	92	68.45	11.71	-0.41	0.25
Female	53	35	88	64.78	11.58	-0.65	0.03

Note. M = Mean *SD* = Standard deviation; *Sk* = Skewness; *kur* = kurtosis; *N* =

The mean score of male students was 68.45 (*SD* = 11.71). The minimum score was 28 while the maximum score was 92 with a range of 64. Female students scored a mean of 64.78 with a standard deviation of 11.58. The minimum score was 35 while the maximum score was 88 with a range of 53. The results indicate that academic scaffolding was better among male students compared to female students.

Academic scaffolding questionnaire consisted of three sub scales and the descriptive statistics for the scores in each sub scale are presented in Table 4.24.

Table 4.24

Descriptive Statistics for the Types of Academic Scaffolding

Type of Academic Scaffolding	*M*	*SD*	*Sk*	*Kur*
Instructional	39.91	8.07	-0.70	0.48
Planned	13.75	3.40	-0.32	-0.30
Interactional	13.88	3.41	-0.34	-0.41

Note. *M* = Mean; *SD* = Standard deviation; *Sk* = Skewness; *kur* = kurtosis; N= 338The mean score of instructional scaffolding was 39.91 (*SD* = 8.07). On planned scaffolding sub scale, the mean score was 13.75 with a standard deviation of 3.4. The mean score of interactional scaffolding sub scale scores was 13.88 (*SD* = 3.41).

Academic scaffolding was divided into two levels namely, insufficient and sufficient. A score in the range of 19-67 indicated insufficient academic scaffolding while 68-95 indicated sufficient academic scaffolding. The distribution of the respondents across the three levels of scaffolding are presented in Table 4.25.

Table 4.25

Levels of Academic Scaffolding

Level	Frequency	Percent
Insufficient	256	75.7
Sufficient	82	24.3
Total	338	100.0

N = 338

In the scale used to measure academic scaffolding, any score between 19 and 75 would indicate sufficient academic scaffolding while a score ranging from 76 to 95 would indicate sufficient academic scaffolding. The results presented in Table 4.23 indicate that 75.7% of the respondents had insufficient level of academic scaffolding while 24.3% had sufficient level of academic scaffolding. The results indicate that majority of the students involved in the study were not sufficiently supported towards learning chemistry.

To establish if the sub scales of academic scaffolding were independent in measuring academic scaffolding sub constructs, Pearson correlation was conducted and the results are presented in Table 4.26.

Table 4.26

Correlation Matrix of Academic Scaffolding Sub Scales

	1	2	3
1. Instructional	-		.
Planned	.47*	-	
Interactional	.24*	.12*	-

Note. *N* = 338; *$P < .05$

The results indicate that the scores in all the academic scaffolding sub scales were significantly correlated. The correlation between planned scaffolding and instructional scaffolding was r (336) = .47, $p < .05$. Planned scaffolding was also significantly related to interactional scaffolding, r (336) = .12, $p < .05$. Instructional scaffolding and interactional scaffolding also had a positive and significant correlation, r (336) = .24, $p <$ .05 However, the correlations ranged from low to moderate. To assess if the correlations significantly violated the principle of multicollinearity, VIF was used and the results were as presented in Appendix, F Table 1. The results indicate that in all the sub scales, the VIF was below 5 and greater than 0.1 and therefore, the sub scales independently measured the sub constructs of academic scaffolding as suggested by Kim (2019). Kim stated that if the VIF is less than five or greater than 0.1 then multicollinearity does not exist.

Further, the researcher explored descriptive statistics of the subscales of academic scaffolding by gender and school type and the results are presented in Table 4.27.

Table 4.27

Descriptive Statistics of the Sub-dimensions of Academic Scaffolding by Gender

	Instructional		Planned		Interactional	
	Male	Female	Male	Female	Male	Female
N	174	164	174	164	174	164
M	40.51	39.27	14.02	13.46	13.93	13.82
SD	8.25	7.85	3.51	3.27	3.35	3.49
Sk	-.61	-.86	-.17	-.57	-.27	-40
Kur	.35	.66	-.69	-.12	-.48	-.33

Note. *N* = 338

Table 4.27 shows that the mean score of male students in the instructional scaffolding sub scale was 40.51 (*SD* = 8.25) while that of female students was 39.27 (*SD* = 7.85). In this sub scale, male students had a higher mean score than female students. On planned scaffolding sub scale, the mean score of male students was 14.02 (*SD* = 3.51) while that of female students was 13.46 (*SD* = 3.27). Also in this sub scale, male students had a higher mean score than female students. The mean score of male students in the interactional scaffolding sub scale was 13.93 (*SD* = 3.35) while the mean score of female students was 13.82 (*SD* = 3.49). As indicated, in all the sub scales of academic scaffolding male students had a higher mean score than female students. These results may be attributed to the negative attitude that generally girls have towards chemistry. This bias might have contributed to the low rating in academic scaffolding among the female students.

Table 4.28 presents the descriptive statistics of the scores in academic scaffolding sub scales by school type.

Table 4.28

Descriptive Statistics of the Sub-dimensions of Academic Scaffolding by school type

	Instructional			Planned			Interactional		
	NS	ECS,CS	SCS	NS	ECS,CS	SCS	NS	ECS,CS	SCS
N	91	96	151	91	96	151	91	96	151
M	39.74	41.26	39.51	13.60	13.94	13.26	12.88	14.69	14.41
SD	8.23	8.24	8.12	3.26	3.63	3.56	3.62	3.37	3.08
Sk	-.90	-.89	-.51	.20	-.65	-.28	-.16	.06	-.49
Kur	1.61	.40	-.12	-.74	-.64	-.33	-.81	-.93	.22

Note. N= Sample size; NS= National schools; ECS=Extra county schools; CS=County schools; SCS = Sub County schools; SD= Standard deviation

The results in Table 4.28 indicate that the mean score for instructional scaffolding for students from national, county and extra county, and sub county schools was 39.74 (*SD* = 8.23), 41.26 (*SD* = 8.24), and 39.51 (*SD* = 8.12) respectively. The results showed that students from extra-county and county schools had the highest mean score while students from sub county secondary schools had the lowest mean score in instructional scaffolding. In planned academic scaffolding sub scale, the mean score of the students from national schools was 13.60 (*SD* = 3.26).

In county and extra county schools, the mean score was 13.94 (*SD* = 3.63) and sub county schools was 13.26 (*SD* = 3.56). In the interactional scaffolding sub scale, students from national schools scored a mean of 12.88 (*SD* = 3.62), respondents from county and extra county schools scored a mean of 14.69 (*SD* = 3.37), while those from sub county secondary schools scored a mean of 14.41 (*SD* = 3.08).

The results indicate that in all the academic scaffolding sub scales, students from extra-county and county secondary schools had the highest mean score while students from sub county secondary schools had the lowest mean.

4.4.2 Hypothesis Testing

The second objective of this study was to find out the relationship between academic scaffolding and achievement motivation for learning chemistry. To achieve this, the following hypothesis was advanced.

H_{02} There is no significant relationship between academic scaffolding and achievement motivation for learning chemistry. The hypothesis was tested using Pearson correlation analysis and the results are presented in Table 4.29.

Table 4.29

Correlation between Academic Scaffolding and Achievement Motivation

		Achievement Motivation
Academic Scaffolding	Pearson Correlation	.50*
	Sig. (2-tailed)	.00

Note. N = 338; *$P < .05$

The results indicated that there was a moderate positive and statistically significant correlation between academic scaffolding and achievement motivation for learning chemistry, r (336) = .50, $p < .05$. Based on the results, the null hypothesis was rejected. The findings suggest that high academic scaffolding is associated with high levels of achievement motivation for learning chemistry. Further analysis of the correlation between the types of academic scaffolding and achievement motivation for learning chemistry was conducted. The following supplementary hypotheses were tested.

$H_{02.1}$ There is no significant relationship between interactional scaffolding and achievement motivation for learning chemistry.

$H_{02.2}$ There is no significant relationship between planned scaffolding and achievement motivation for learning chemistry.

$H_{02.3}$ There is no significant relationship between instructional scaffolding and achievement motivation for learning chemistry.

Table 4.30

Correlations between Types of Academic Scaffolding and Achievement Motivation

Type of Academic Scaffolding	Achievement Motivation
Instructional Scaffolding	.48*
Planned Scaffolding	.35*
Interactional Scaffolding	.22*

Note. *N* =338; *P < .05

The results indicate that there was a moderate positive correlation between instructional scaffolding and achievement motivation for learning chemistry, r (336) = .48, $p < .05$. The correlation was statistically significant. There was a weak positive correlation between interactional scaffolding and achievement motivation for learning chemistry, r (336) = .22, $p < .05$. The correlation was statistically significant. Planned scaffolding and achievement motivation for learning chemistry had a positive and statistically significant correlation, r (336) = .35, $p < .05$. Based on the results, supplementary hypotheses $H_{02.1}$, $H_{02.2}$, and $H_{02.3}$ were rejected. The study concluded that an increase in the scores of planned scaffolding, interactional scaffolding, and instructional scaffolding was related to an increase in achievement motivation for learning chemistry.

Academic scaffolding was divided into two levels, insufficient scaffolding and sufficient scaffolding. The researcher conducted an independent samples *t*-test, to establish whether students with different levels of academic scaffolding differed in their achievement motivation for learning chemistry. First, descriptive statistics of the level of academic scaffolding and achievement motivation for learning chemistry was conducted and the results are presented in Table 4.31.

Table 4.31

Group Statistics for Levels of Academic Scaffolding

Levels	*N*	*M*	*SD*	*SE*
Insufficient	256	63.07	9.60	.60
Sufficient	82	81.45	4.14	.46

As indicated in Table 4.31, it was established that the mean score difference in achievement motivation for learning chemistry among students who reported different levels of academic scaffolding was statistically significant. The findings support the correlation analysis results which showed that there was a significant positive relationship between academic scaffolding and achievement motivation for learning chemistry. As such, it was expected that respondents who reported sufficient levels of academic scaffolding had higher levels of achievement motivation for learning chemistry compared to respondents who reported insufficient levels of academic scaffolding. To establish if this difference in achievement motivation for learning chemistry between students who reported sufficient academic scaffolding and those who reported insufficient academic scaffolding was significant, the data were subjected to independent samples *t* test and the results are presented in Table 4.32.

Table 4.32

Independent Samples T Test

		t	*df*	Sig. (2-tailed)	Mean difference
Academic Scaffolding	Equal variances assumed	-16.82	336	.00	-18.38
	Equal variances not assumed	-24.36	309	.00	-18.38

Note. $N = 338$

The results obtained showed that there was a statistically significant difference in achievement motivation for learning chemistry among students who reported sufficient academic scaffolding and those who reported insufficient academic scaffolding, t (336) = -16.82, $p < .05$. Therefore, students who were sufficiently supported in learning chemistry had high achievement motivation for learning chemistry.

Academic scaffolding consisted of three levels, instructional scaffolding, planned scaffolding, and interactional scaffolding. Since the study found that there was a significant and positive relationship between the sub scales of academic scaffolding and achievement motivation for learning chemistry, there was need to investigate how the sub scales predict achievement motivation for learning chemistry. To achieve this, a multiple regression analysis was conducted and the results are presented.

Table 4.33

Model Summary for Academic Scaffolding and Achievement Motivation

Model	*R*	*R* Square	Adjusted *R* Square	*SE*
1	.50[a]	.25	.24	11.46

Note. N = 338; Outcome variable = achievement motivation; predictor variables = planned scaffolding, instructional scaffolding, interactional scaffolding.

The results presented in Table 4.33 indicate that planned scaffolding, instructional scaffolding, and interactional scaffolding moderately predicted achievement motivation for learning chemistry. From the findings, 25% (R = .50. R^2 = .25) variance in achievement motivation for learning chemistry can be explained by academic the three types of academic scaffolding (planned, instructional and interactional). To stablish if the types of academic scaffolding significantly predicted achievement motivation for learning chemistry, ANOVA was conducted and the results are presented in Table 4.34.

Table 4.34

ANOVA Summary for the Types of Academic Scaffolding

Model		Sum of Squares	*df*	Mean Square	*F*	Sig.
	Regression	14688.59	3	4896.20	37.30	.00[b]
1	Residual	43845.02	334	131.27		
	Total	58533.61	337			

Note. N = 338
a. Dependent Variable: Achievement motivation
b. Predictors: (Constant), Interactional, Planned, Instructional Scaffolding

Table 4.34 shows that interactional scaffolding, planned scaffolding, and instructional scaffolding significantly predict achievement motivation for learning chemistry. Further, analysis was conducted to establish the predictive weights of the types of academic scaffolding on achievement motivation for learning chemistry. The results are presented in Table 4.35.

Table 4.35

Regression Coefficients of the Types of Academic Scaffolding

Model		Unstandardized Coefficients		Standardized Coefficients	*t*	Sig.
		ß	*SE*	Beta		
1	(Constant)	58.93	3.77		15.63	.00
	Instructional	.63	.09	.39	6.55	.00
	Planned	.44	.22	.11	1.97	.04
	Interactional	.43	.19	.11	2.32	.02

Note. *N* = 338
a. Dependent Variable: Achievement motivation

As shown in Table 4.35, instructional scaffolding had a positive and significant predictive value on achievement motivation for learning chemistry, ß = 0.63, $p < .05$. The results also indicated that planned scaffolding had a positive and significant predictive weight on achievement motivation for learning chemistry, ß = 0.44, $p < .05$. Interactional scaffolding was also found to have a positive and significant predictive value on achievement motivation for learning chemistry, ß = 0.43, $p < .05$.

Using the regression coefficients obtained, the following regression equation was developed.

$$\tilde{y} = 58.93 + 0.63X_1 + 0.44X_2 \quad 0.43X_3 , P < .05$$

Where $\tilde{y}$ = Predicted achievement motivation for learning chemistry, X_1 = Instructional scaffolding, X_2 = Planned scaffolding X_3 = Interactional scaffolding.

Based on the results presented in the regression equation, a unit change in instructional scaffolding resulted in a 0.63 change in achievement motivation for learning chemistry. A unit change in planned scaffolding was associated with 0.44 change in achievement motivation for learning chemistry. The regression equation also indicated that a unit change in interactional scaffolding led to a 0.43 change in achievement motivation. From the results, instructional scaffolding had the highest predictive weight on achievement motivation for learning chemistry, followed by planned scaffolding. Interactional scaffolding had the least predictive value on achievement motivation for learning chemistry. The results imply that adequate preparation and planning for a chemistry lesson greatly enhances students' achievement motivation for learning chemistry.

4.4.3 Qualitative Data Findings on Academic Scaffolding

Table 4.36 shows the coding of qualitative data for academic scaffolding.

Table 4.36

Qualitative Coding for Academic Scaffolding

Academic Scaffolding Levels	String
Interactional	Other students and school environment influence chemistry performance
Planned	Teacher preparation
Instructional	The role the teacher plays to influence performance in chemistry

In the second objective, the study aimed to establish the relationship between academic scaffolding and achievement motivation for learning chemistry. To complement quantitative data, the researcher collected qualitative data on academic scaffolding in learning chemistry. Sampled students were given random names to conceal their identity. Therefore, names used in the presentation of the findings are not their real names.

Concerning instructional scaffolding, the students were asked to discuss ways through which chemistry teachers influenced their performance and the responses were as follows:

> **Jane**: "She gives me the drive of wanting to know more."
>
> **Mike:** "By his teaching skills, some tell it like the story."

The different responses provided indicate that teachers play a significant role in supporting students to learn chemistry. To begin with, teachers enable students to learn chemistry by continuously urging them to put in more effort inorder to enhance their understand of the concepts. This kind of support is called interactional scaffolding and it helps the students to develop a positive attitude towards chemistry. Moreover, the other type of support noted from the responses is instructional scaffolding. It entails the teaching methods and approaches used. As indicated by one respondent, "some teachers pass chemistry knowledge like a story." A study by Peleg et al. (2017) on teachers' perceptions of teaching chemistry through story telling technique indicates that the method was effective in teaching the subject. This is because the technique creates memory cues that enhances recall of the learned information.

Furthermore, some participants said that chemistry teachers set challenging exams as a way of planned scaffolding so that the students could dedicate more time to study the subject. Jedi was asked how teachers supported them in learning chemistry and the response was, "setting challenging exams and pressure from them to score more in the subject." Hirschman (2017) notes that challenging examination makes students to seek more clarification from the teachers and actively participate in the learning process to avoid low scores. It was also noted that pressure from the teachers pushes the students to exert more effort in learning chemistry. This is in line with Malmberg and Martin (2019) who indicated that high academic expectations challenges students to work harder.

One of the participants said that encouragement from the teachers helped him like the subject even though he was not performing well. Cyrus was requested to describe the support offered to him by teachers in learning chemistry and he replied, "He encourages me and tells me that I am a very bright student. He tells me to work hard and he is never disappointed with me as long as I have worked hard. He makes me happy when he motivates me by writing," keep it up", and "good work" in my extra workbook." From the participant's response, the encouragement from chemistry teachers prompts students to work harder to avoid disappointing the teacher. This implies that to some extent chemistry teachers provided instructional and interactional scaffolding, which helped students to develop more interest in learning chemistry. Landrum and Sweigart (2014) concur that praise from teachers is a great motivating factor that enhances learning among students. Based on the analysis of qualitative data, the study established that academic scaffolding took place to a moderate extent, findings which corroborated those of the quantitative data.

Regarding the influence of the teacher on the students' desire to succeed in the subject, Jane responded that "I don't think teachers influence my desire to succeed in the subject. This is because many a times I fail because of lack of concentration in class and excessive anxiety during exams". Jane's response suggests that academic scaffolding by itself may not enhance the desire to succeed in chemistry. On the influence of other students on the desire to learn chemistry, Joan said, "Yes it does but to some extent. This is because my friends sometimes help me to understand some concepts. Somehow they influence my interest and performance in the subject." Joan's response indicates that interactional scaffolding plays a role in the desire to learn chemistry.

Mark's response on whether other students influenced their desire to perform well in chemistry was, "Yes they do because they have a negative attitude towards chemistry. If I need help in chemistry they always say "I don't know". They say so even before reading the questions. I only depend on my teacher." This student's response clearly shows that even though some students fail to get assistance from their classmates, the teacher is always available to help. This position was supported by this response fromJedi, "Yes because they keep on insisting chemistry is hard which demotivates me a lot. From the foregoing, there is evidence to suggest that teachers as well as other students, through the different types of scaffolding, can influence achievement motivation in chemistry.

On the other hand, the below average performance in chemistry can be attributed to low achievement motivation for learning chemistry, as inferred from the students' responses.

First, the study found that any students had developed a negative attitude towards chemistry and these students would negatively influence other students. Thus, those who had a negative attitude not only believed that the subjects was hard, but also influenced others to have a similar attitude, resulting in a general lack of interest in the subject. Such students could not benefit from the instructional, planned, and interactional scaffolding provided by the teachers since they did not even concentrate in class.

Regarding achievement motivation for learning chemistry, Mikes' response on whether they have what it takes to do well in chemistry was, "Yes, chemistry is an interesting subject that makes you want to know more things that you never knew. The teacher has a simple way of teaching chemistry that makes it more interesting. Our teacher goes an extra mile to give us questions, CATS to help us understand and improve in the subject." The response provided indicates that the teacher provides academic scaffolding and the student employs executive functioning skills. This enabled the student to develop interest in learning and a desire for good performance in the subject. Samson and Allida (2018) argue that scaffolding through continuous assessment of students can help to improve academic performance. This demonstrates the importance of academic scaffolding in learning processes such as achievement motivation and its impact on learning outcomes.

Mike indicated that he felt bad when his performance in chemistry was poor when compared to that of his friends. He said, "I feel bad and get the urge to work hard and pass like them. That makes me put extra effort in order to pass in chemistry like them." From his response, Mike has a performance goal orientation in learning chemistry. Moreover, there is evidence of interactional scaffolding from his saying that he is motivated to perform like other students. Similarly, when was asked how he felt when he did not perform well in chemistry compared to his previous performance, Dan indicated that, "I feel bad but tell myself am better than those I defeated." This also denotes interactional scaffolding and its implication for achievement motivation and performance in chemistry.

The researcher collected qualitative data with the aim of answering the question, how does academic scaffolding help the student in achievement motivation for learning chemistry? The qualitative findings showed that academic scaffolding played a role in enhancing achievement motivation for learning chemistry among the students. The findings were consistent with quantitative results which showed a significant positive relationship between academic scaffolding and achievement motivation for learning chemistry.

4.4.4 Discussion of the Results

The present study found that there was a positive and significant relationship between academic scaffolding and achievement motivation for learning chemistry. The results demonstrate that academic scaffolding is an important construct in learning chemistry. The results support past research on the role of academic scaffolding in learning and educational attainment. The findings are in agreement with the results of Murdiyani (2013) in a study that investigated the role of scaffolding in mathematics performance. The researcher demonstrated that the support given to students by teachers has an impact on mathematics performance. Specifically, such support demystifies abstract concepts, which gradually gives students autonomy, resulting in better motivation to perfrom better in chemistry.

The results of the current study corroborate the findings of Sutiarso et al. (2018) who established that media scaffolding improved understanding of mathematics concepts. Given that some of the characteristics of achievement motivation for learning include, persistence, resilience, and attitude of cooperation. Sutiarso et al. finding that improvement in understanding of geometry concepts was associated with enhanced persistence to complete tasks in geometry was particularly illuminating. This denotes that academic scaffolding is an important aspect for achievement motivation.

The results also support the theoretical perspective on academic scaffolding as an effective method in managing the dynamic classroom environment to enhance learning. Constructivisists like Bruner (1976) argue that academic scaffolding helps students in learning abstract concepts. Such abstract concepts are mostly found in mathematics and science subjects. However, there has been a missing link between academic scaffolding, motivation for learning, and learning outcomes. The results of the present study bridge this gap, thus opening new research opportunities on how academic scaffolding improves learning outcomes through achievement motivation.

The results of the present study also support those of Pol et al. (2015) on the effect of scaffolding on student achievement. Pol et al. focused on the support the students receive from their teachers, independent working time, and their effect on student achievement. The results indicated that varying scaffolding time affected student achievement differently. It was also found that scaffolding was associated with increased task effort.

Even though the study did not directly investigate the effect of academic scaffolding on achievement motivation, the increase in task effort suggests that the student is highly motivated to accomplish learning tasks.

Other studies have also established that academic scaffolding, particularly teacher reinforcement, increases students' effort to accomplish academic tasks (Bicard et al. 2012). The results suggest that when students are supported by their teachers, they learn the steps required to produce the desired learning outcome. Academic scaffolding enhances students' motivation because the teachers support given builds their confidence and provides direction on the appropriate path to follow in order to achieve learning objectives. Additionally, in the process of academic scaffolding, the teacher is able to diagnose learning challenges and take remedial action. Also, through academic scaffolding, students can see and appreciate the work of teachers and the value of education, which results in high task commitment.

4.5 Moderator Effect of Gender in the Prediction of Achievement Motivation from Executive Functioning and Academic Scaffolding

4.5.1 Description of Moderator Effect

As indiacted in Table 4.5, male students performed better than female students in executive functioning and Table 4.23 also shows that male students outperformed female students and academic scaffolding. Based on the results of descriptive statistics, the researcher went further to examine the moderator effect of gender in predicting achievement motivation for learning chemistry from executive functioning and academic scaffolding.

According to Froese et al. (2018), persistent inconclusive findings between a predictor and outcome variable may signal the need to explore the presence of moderators. There have been mixed findings on whether boys and girls process information differently and if teaching approaches affect their interest in learning science subjects and consequent performance. In most achievement tests, boys have been found to perform better in science subjects such as chemistry. While performance in chemistry has been directly linked to variables like motivation, attitude, quality of teaching, and availability of resources, little has been done in Kenya on moderator effects of gender in this regard. Specifically, there is a scarcity of research evidence on the moderator effect of gender in the relationship between the processes that students use to manage themselves, their resources in learning chemistry, and the support they get in learning the subject and achievement motivation.

Moderator analysis is used to establish if the relationship between two variables is modified by a third variable. In this objective, the interaction terms between gender and executive functioning and gender and academic scaffolding were introduced into the regression models to assess for moderation.

4.5.2 Hypothesis Testing

Two supplementary hypotheses were advanced as follows;

H_{04a} There is no significant moderator effect of gender in the prediction of achievement motivation for learning chemistry from executive functioning skills.

H_{04b} There is no significant moderator effect of gender in the prediction of achievement motivation for learning chemistry from academic scaffolding.

The hypotheses were tested using moderated regression analysis.

Table 4.37

Regression Model Summary of EF and Gender

Model	*R*	R^2	Adjusted R^2	*SE* of the Estimate	Change Statistics				
					R^2 Change	*F* Change	*df*1	*df*2	Sig. *F* Change
1	.45[a]	.20	.19	11.81	.20	42.19	2	335	.00
2	.46[b]	.22	.19	11.83	.02	.01	1	334	.93

Note. *N* = 338
a. Predictors: (Constant), executive functioning and gender
b. Predictors: (Constant), Executive functioning and gender, interaction between executive functioning and gender
c. Dependent Variable: Achievement motivation

The results presented in Table 4.37 indicate that in model 1, 20% variance in the prediction of achievement motivation for learning chemistry can be explained by executive functioning skills and gender of the student. The results also indicate that executive functioning skills and gender moderately predict achievement motivation for learning chemistry, $R = 0.45$. Model 2 shows the prediction of achievement motivation for learning chemistry from executive functioning skills, gender, and the interaction between executive functioning skills and gender. Table 4.37 indicates that ΔR^2 =

0.02,implying that the interaction between executive functioning skills and gender accounts for 2% variance in achievement motivation for learning chemistry. However, ΔR^2 was not statistically significant, F (1, 334) = 0.01, $P > .05$. Therefore, the null hypothesis was retained. The results suggest that even though the interaction between executive functioning skills and gender accounted for 2% variance in achievement motivation for learning chemistry, the effect was not statistically significant. Based on the results, it was concluded that gender did not have a significant moderating effect in the prediction of achievement motivation for learning chemistry from executive functioning skills. Therefore, the supplementary hypothesis was retained.

To establish the significance of the regression models, ANOVA was used and the results are presented in Table 4.38.

Table 4.38

ANOVA Summary Table for EF and Gender

Model		Sum of Squares	*df*	Mean Square	*F*	Sig.
	Regression	11778.57	2	5889.29	42.19	.00[b]
1	Residual	46755.04	335	139.57		
	Total	58533.61	337			
	Regression	11779.51	3	3926.50	28.05	.00[c]
2	Residual	46754.11	334	139.98		
	Total	58533.61	337			

Note. N = 338

a. Predictors: (Constant), executive functioning and gender

b. Predictors: (Constant), Executive functioning and gender, interaction between executive functioning and gender

c. Dependent Variable: Achievement motivation

As shown in Table 4.38, model 1 which comprised of executive functioning skills and gender was statistically significant in predicting achievement motivation for learning chemistry, F (2, 335) = 42.19, $P < .05$. Similarly, model 2 in which the interaction between executive functioning skills and gender was included was found to be statistically significant in the prediction of achievement motivation for learning chemistry, F (3, 334) = 28.05, $P < .05$. The results suggest that even though the ΔR^2 was not significant, the interaction between executive functioning skills and gender can be used in the prediction of achievement motivation for learning chemistry.

Table 4.39 presents the regression coefficients of the predictor variables in model 1 and model 2.

Table 4.39

Regression Coefficients for EF and Gender

Model		Unstandardized Coefficients		Standardized Coefficients	*t*	Sig.
		B	*SE*	Beta		
	(Constant)	67.23	4.15		16.19	.00
1	EF	.82	.092	.44	8.99	.00
	Gender	-1.15	1.29	-.04	-.89	.37
	(Constant)	66.38	11.17		5.94	.00
	Executive functioning	.85	.29	.45	2.91	.00
2	Gender	-.59	6.98	-.02	-.09	.93
	Interaction between EF and gender	-.02	.18	-.02	-.08	.93

Note. N = 338; EF = Executive functioning

In model 1, executive functioning skills had the highest predictive weight of 0.82. The predictive index of gender on achievement motivation for learning chemistry was – 1.15.

The predictive weight of executive functioning skills was statistically significant while the predictive weight of gender was not statistically significant. In model 2, the predictive weight of executive functioning skills slightly increased to 0.85. The same was observed with gender. The predictive weights of gender and the interaction term were not statistically significant.

In the second supplementary hypothesis, the researcher hypothesized that there is no significant moderator effect of gender in the prediction of achievement motivation for learning chemistry from academic scaffolding.

The hypothesis was also tested using moderated regression analysis and the results are presented in Table 4.40.

Table 4.40

Regression Model Summary of Academic Scaffolding and Gender

Model	*R*	R^2	Adjusted R^2	SE of the Estimate	Change Statistics				
					R^2 Change	*F* Change	*df*1	*df*2	Sig. F Change
1	.50[a]	.25	.24	11.43	.25	56.33	2	335	.00
2	.51[b]	.26	.25	11.40	.01	3.03	1	334	.08

N = 338

a. Predictors: (Constant), academic scaffolding, gender

b. Predictors: (Constant), Academic scaffolding, gender, interaction between academic scaffolding and gender

c. Dependent Variable: Achievement motivation

Table 4.40 indicates that academic scaffolding and gender of the student explained 25% variance in achievement motivation for learning chemistry. However, when the moderator variable was included in model 2, the predictor variables accounted for 26% variance in achievement motivation for learning chemistry. The multiple regression coefficients for model 1 and model 2 were 0.50 and 0.51 respectively, indicating that the models moderately predict achievement motivation for learning chemistry. The results also indicated that $\Delta R^2 = 0.01$, suggesting that the interaction between academic scaffolding and gender explained 1% variance in achievement motivation for learning chemistry. However, ΔR^2 was not statistically significant, ΔF (1, 334) = 3.03, $p = .08$, thus the null hypothesis was retained. This suggests that gender did not have a significant moderator effect in the prediction of achievement motivation for learning chemistry from academic scaffolding.

Table 4.41

ANOVA Summary Table for Academic Scaffolding and Gender

Model		Sum of Squares	*df*	Mean Square	*F*	Sig.
1	Regression	14731.37	2	7365.68	56.33	.00[b]
	Residual	43802.25	335	130.75		
	Total	58533.61	337			
2	Regression	15125.73	3	5041.91	38.79	.00[c]
	Residual	43407.88	334	129.96		
	Total	58533.61	337			

N = 338
a. Dependent Variable: Achievement motivation
b. Predictors: (Constant), Academic scaffolding; gender
c. Predictors: (Constant), Academic scaffolding; gender; Interaction between academic scaffolding and gender

Table 4.41 shows that the prediction of achievement motivation for learning chemistry from academic scaffolding and gender in model 1 was statistically significant, F (2, 335) = 56.33, p <.05. Similarly, model 2 in which the interaction term was included was found to be significant in the prediction of achievement motivation for learning chemistry, F (3,

334) = 38.79, p <.05. The results suggest that even though the ΔR^2 was not significant, the interaction between academic scaffolding and gender can be used to predict achievement motivation for learning chemistry among secondary school students.

Table 4.42 presents the regression coefficients for the predictor variables in model 1 and model 2.

Table 4.42

Regression Coefficients of Academic Scaffolding and Gender

Model		Unstandardized Coefficients B	SE	Standardized Coefficients Beta	*t*	Sig.
1	(Constant)	60.58	4.24		14.28	.00
	Gender	-1.36	1.25	-.05	-1.09	.27
	Academic Scaffolding	.56	.05	.49	10.44	.00
2	(Constant)	79.26	11.52		6.87	.00
	Gender	-13.92	7.32	-.53	-1.90	.05
	Academic Scaffolding	.28	.17	.25	1.69	.09
	Interaction term	.19	.11	.52	1.74	.08

In model 1 (without the interaction term), the regression coefficient of academic scaffolding was 0.56. The regression coefficient was significant in the prediction of achievement motivation for learning chemistry. The predictive weight of gender was 1.36 but it was not statistically significant. When the interaction term was introduced into the regression model (model 2), the predictive index of academic scaffolding decreased to 0.28 and the predictive weight of gender decreased to -13.92. The predictive weight of the interaction term was 0.19. All the regression coefficients in model 2 were not significant. Therefore, with the interaction term, academic scaffolding and gender cannot be used to predict achievement motivation for learning chemistry among secondary school students.

4.5.3 Discussion of the Results

The third objective of this study was to examine the moderating effect of gender in the prediction of achievement motivation for learning chemistry from academic scaffolding. The regression coefficient obtained indicated that gender moderately predict achievement motivation together with executive functioning. The findings of the study established that the interaction between gender and academic scaffolding explained 1% variance in achievement motivation for learning chemistry. This was a positive moderating effect although the effect was not statistically significant. The null hypothesis was therefore retained. The study failed to establish that gender has a significant moderator effect in the prediction of achievement motivation for learning chemistry from academic scaffolding.

The results of the current study were in line with the findings of Praveen (2018. Praveen's study examined the students' ability to solve problems and achievement motivation among secondary school students. The study concluded that there were no significant difference in the problem solving ability of the students based on gender, locality, and the institution of the students. However, there existed a minimal difference between the achievement motivation of the students based on gender and the type of institution they were in, though it was not statistically significant. This was attributed to the fact that students in urban government schools have higher achievement motivation for learning than those in aided schools. Thus, females in urban and government schools have a high achievement motivation for learning compared to boys in rural and aided schools. In the present study however, boys had higher achievement motivation, the type of institution not with standing. Furthermore, the results corroborate those of a similar study that was carried out by Roessler and Allison (2018). The study examined gender differences in scaffolding in learning mathematics among middle school students. The study established that female students enrolled less in Sciences, technology, Engineering, and Mathematics (STEM) courses compared to their male counterparts. Although there existed a difference in their enrolment numbers, the effect was not statistically significant. The difference was attributed to self-efficacy and instructional biases that results to poor preparation for the STEM courses.

The findings by Fredricks, et al. (2018) were in line with the current findings. The study examined how motivation influenced the involvement of girls and boys in maths and science courses. The study focused on similarities and differences in respect to gender. Girls attributed their engagement in science and maths courses to the support they got from the teachers and the relevance of the instruction. Boys on the other hand related their engagement in STEM courses to passion. This implies that the reasons for learning science based subjects may be different but the motivation levels may be the same, a position that is supported by the results of the present study. From the findings of this study, motivation was related to school achievement and had similar effects for both girls and boys, though the effect was not statistically significant.

Similarly the results were consistent with the findings of Jacob and Sakiyo (2018). The study assessed learning retention and students' achievement in social studies through the use of scaffolding and brainstorming models, with gender as a moderating variable. The results of the study showed that students exposed to social studies learning content through the use of scaffolding and brainstorming models had better scores compared to the students that used the conventional method of learning. Like in the present study, gender was not a significant moderator in the relationship between achievement of students and the instructional model used. The current study therefore argues that scaffolding provided students with an opportunity to interact as they were learning and both male and female students had equal opportunities to interact.

The current findings support the results of the study by Ejekwu and Inyon (2019) who examined the implications of using scaffolding strategies on attainment of achievement motivation with gender as a moderating variable. Results showed that there was a significant difference between mean scores of students that used scaffolding strategies and those that used the conventional approach of learning. However, it was found that gender did not significantly influence motivation and performance of the students when taught using scaffolding techniques.

The findings of Akunne and Anyamene (2019) were contradictory to the results of the current study. The purpose of the study was to show the impact of brainstorming approaches to learning on secondary school students study habits and how this influenced achievement motivation. The results of the study showed that brainstorming had a significant influence on learning and that the effect further differed with respect to the student's gender. The research concluded that brainstorming improved the study habits of students and this resulted in achievement motivation for the students.

4.6 Prediction of Achievement Motivation for Learning Chemistry from Executive Functioning Skills and Academic Scaffolding

To test the prediction of achievement motivation for learning chemistry from executive functioning skills and academic scaffolding, the following hypothesis was advanced.

H_0 There is no significant prediction equation for achievement motivation for learning chemistry from the domains of executive functioning skills and academic scaffolding.

The hypothesis was tested using regression analysis, but first the assumptions of regression analysis were asessed.

4.6.1 Test for Assumptions of Regression Analysis

The study assessed the following assumptions of regression analysis: linear relationship, normal distribution of the scores, multicollinearity, and homoscedasticity. The assumption of linearity was tested using deviation from linearity test in ANOVA (See Appendix F, Table F.3 and Table F.4). The results obtained indicated that there was a linear relationship between executive functioning skills, academic scaffolding, and achievement motivation for learning Chemistry. In both cases the *p* value was greater than > .05. The assumption of normality was tested using two methods, skewness and kurtosis coefficients and a histogram (Appendix F; Table F.5 and Figure G). The kurtosis and skewness coefficients for executive functioning scores were -0.24 and 0.27 respectively. With academic scaffolding scores, skewness coefficient was -0.52 while the kurtosis coefficient was -0.37. Regarding the scores of achievement motivation for learning chemistry, the skewness coefficient was – 0.37 while the kurtosis coefficient was

0.51. According to Huck (2012), scores are considered to be normally distributed when the coefficient values fall within the range of 1 for skewness and kurtosis. Since all the skewness and kurtosis values were within the range recommended by Huck, the scores were considered to be normally distributed. The assumption of normality was also tested using a histogram and the results also indicated that the scores of the criterion variable were normally distributed.

To assess for multicollinearity and singularity in the predictor variables, the researcher used Variance Inflation Factor (VIF). The results presented in Table 4.45 indicate that the VIF for executive functioning skills and academic scaffolding were less than 10. Tabachnick and Fidell (2019) recommends that a VIF less than 10 indicates that the variables are not highly correlated. Based on this recommendation, therefore, the data met the multicollinearity and singularity assumption. Concerning the assumption of constant variance, a scatter plot was used. The results presented in Figure G3 (Appendix G) shows that the assumption of constant variance was not violated. Having met all the assumptions, the data were subjected to multiple regression analysis to test the hypothesis.

4.6.2 Hypothesis Testing

The following hypothesis was tested;

H_0 There is no significant prediction equation for achievement motivation for

learning chemistry from the domains of executive functioning skills and academic scaffolding.

Table 4.43

Model Summary for the Prediction of Achievement Motivation

Model	*R*	R^2	Adjusted R^2	*SE*
1	.57[a]	.33	.32	10.84

Note. *N* = 338

a. Predictors: (Constant), Academic scaffolding; executive functioning

b. Dependent Variable: Achievement motivation

Table 4.43 shows that the multiple regression coefficient was 0.57 which implies that executive functioning and academic scaffolding moderately predict achievement motivation for learning chemistry. The value of *R* square was .33 which suggest that 33% variance in achievement motivation for learning chemistry is explained by executive functioning and academic scaffolding. The significance of the prediction model was examined using ANOVA and the results are presented in Table 4.44.

Table 4.44

ANOVA Summary for the Prediction of Achievement Motivation

Model		Sum of Squares	*df*	Mean Square	*F*	Sig.
	Regression	19134.16	2	9567.08	81.34	.00[b]
1	Residual	39399.45	335	117.61		
	Total	58533.61	337			

N = 338

a. Dependent Variable: Achievement motivation

b. Predictors: (Constant), Academic scaffolding and executive functioning

The results presented in Table 4.44 indicate that academic scaffolding and executive functioning skills significantly predict achievement motivation for learning chemistry, *F* (2, 335) = 81.34, $P < .00$.

Table 4.45 presents the regression coefficients for the prediction model.

Table 4.45

Regression Coefficients for the Prediction of Achievement Motivation

Model		Unstandardized Coefficients		Standardized Coefficients	*T*	Sig.	Collinearity Statistics	
		B	*SE*	Beta			Tolerance	VIF
	(Constant)	45.90	3.99		11.49	.00		
1	EF	.56	.09	.30	6.23	.00	.86	1.16
	AS	.44	.06	.39	7.97	.00	.86	1.16

N = 338; EF = Executive functioning; ASF = Academic scaffolding
a. Dependent Variable: Achievement motivation

As indicated in Table 4.45, executive functioning skills had the highest predictive value (ß = 0.56, $p < .05$). Academic scaffolding had a predictive value of 0.44, $p < .05$. The results showed that the predictive values of the independent variables were statistically significant in the prediction of achievement motivation for learning chemistry. The VIF values indicate that the variance of the predictor variables did not significantly violate the assumption of multicollinearity. The prediction equation for achievement motivation for learning chemistry is as follows;

$$\tilde{y} = 45.90 + 0.56EF + 0.44AS$$

Based on the regression equation, a unit change in executive functioning skills leads to 0.56 change in achievement motivation while a unit change in academic scaffolding is leads to 0.44 change in achievement motivation for learning chemistry.

Since the researcher established that executive functioning and academic scaffolding significantly predicted achievement motivation for learning chemistry, further analysis was conducted to establish whether there was an interaction effect between academic scaffolding and executive functioning in the prediction of achievement motivation for learning chemistry. An interaction variable was therefore computed and included in the regression model for the prediction of achievement motivation for learning chemistry.

Table 4.46

Model Summary for the Interaction Effect between EF and ASF

Model	*R*	R^2	Adjusted R^2	SE
1	.57	.33	.32	10.84
2	.57	.33	.32	10.84

Note. *N* = 338
a. Predictors: (Constant), Academic scaffolding; executive functioning
b. Dependent Variable: Achievement motivation

As observed in Table 4.46, the interaction between executive functioning skills and academic scaffolding did not affect the multiple regression coefficient and R square. Concerning the significance of the prediction of achievement motivation for learning chemistry, the regression model significantly still predicted the outcome variable, even when the interaction term was included in the model. However, the inclusion of the interaction term increased the predictive weights of executive functioning skills and academic scaffolding as indicated in Table 4.47.

Table 4.47

Regression Coefficients for the Interaction Effect between EF and AS

Model		Unstandardized Coefficients		Standardized Coefficients	*t*	Sig.
		B	*SE*	Beta		
1	(Constant)	45.90	3.99		11.49	.00
	EF	.56	.09	.30	6.23	.00
	AS	.44	.06	.39	7.97	.00
2	(Constant)	32.00	15.69		2.04	.04
	EF	.97	.46	.52	2.13	.03
	AS	.64	.23	.56	2.81	.01
	Interaction term (EF_AS)	.01	.01	-.03	-.92	.36

Note. *N* = 338; EF = Executive functioning; AS = Academic scaffolding

Model 1 shows the regression coefficients of executive functioning and academic scaffolding in the prediction of achievement motivation for learning chemistry. Model 2 shows the regression coefficients of the predictor variables with the interaction term. The results indicate that when the interaction term was introduced into the regression model, the regression coefficient of executive functioning increased from 0.56 to 0.97. Similarly, the regression coefficient of academic scaffolding increased from 0.44 to 0.64. In both cases the regression coefficients significantly predicted achievement motivation for learning chemistry. The results imply that the combination of executive functioning skills and academic scaffolding is important in predicting achievement motivation for learning chemistry among secondary school students.

Executive functioning skills of the students comprised of initiation, sustained attention, inhibitory control, and shifting skills. On the other hand, academic scaffolding comprised of interactional scaffolding, planned scaffolding, and instructional scaffolding. Since it was found that executive functioning skills and academic scaffolding significantly predicted achievement motivation for learning chemistry, it was necessary to examine how each of the sub domains of the predictor variables predicted achievement motivation. This was important for more conclusive findings on the prediction of achievement motivation for learning chemistry.

Table 4.48

Regression Coefficients of the Sub-Domains of EF and AS

Model		Unstandardized Coefficients		Standardized Coefficients	*T*	Sig.
		B	Std. Error	Beta		
1	(Constant)	45.39	4.42		10.27	.00
	Initiation	.59	.27	.10	2.21	.02
	Sustained Attention	.59	.22	.14	2.68	.01
	Inhibitory Control	.89	.26	.17	3.52	.00
	Shifting	.52	.25	.11	2.11	.03
	Instructional	.49	.09	.31	5.21	.00
	Planned	.32	.22	.08	1.47	.14
	Interactional	.50	.18	.13	2.75	.01

N = 338

a. Dependent Variable: Achievement motivation

Table 4.48 shows that the predictive value of initiation executive functioning skills was positive and statistically significant (ß = 0.59, $P < .05$). Similarly, sustained attention, inhibitory control, and shifting skills were also found to have positive and statistically significant predictive values on achievement motivation for learning chemistry (ß = 0.59, ß = 0.89 and ß = 0.52, $P < .05$ respectively). In relation to academic scaffolding, the results showed that planned scaffolding had a positive but statistically insignificant predictive weight on achievement motivation for learning chemistry (ß = 0.32, $P = .14$).

However, instructional scaffolding and interactional scaffolding had a positive and significant predictive weight on achievement motivation for learning chemistry (ß = 0.49 and ß = 0.50, $P < .05$ respectively).

The prediction equation developed from this analysis is as follows;

$$\tilde{y} = 45.39 + 0.59\,X_1 + 0.59\,X_2 + 0.89\,X_3 + 0.52\,X_4 + 0.49\,X_5 + 0.50\,X_6$$

Where $\tilde{y}$ = predicted achievement motivation; X_1 = Initiation, X_2 = sustained attention, X_3 = inhibitory control, X_4 = shifting, X_5 = instructional scaffolding, X_6 = interactional scaffolding.

The results imply that a unit change in initiation skills and sustained attention skills in each case could lead to a 0.59 change in achievement motivation for learning chemistry. A unit change in sustained attention skills and inhibitory control skills could lead to 0.89 and 0.52 change in achievement motivation for learning chemistry respectively. Concerning the sub domains of academic scaffolding, a unit change in instructional scaffolding and interactional scaffolding could lead to 0.49 and 0.50 change in achievement motivation for learning chemistry respectively.

4.6.3 Discussion of the Findings

In the fourth objective, the study sought to find out the predictive equation for achievement motivation for learning chemistry from executive functioning and academic scaffolding. From the regression model, the coefficients indicated that academic scaffolding and executive functioning skills significantly predicted achievement motivation for learning chemistry. The study results were consistent with the findings of

Mercadar et al. (2017) who carried out a study to establish the contributions of executive functioning skills to mathematics performance. The researchers argued that the complex nature of mathematical competence justified the positive relations towards executive functioning skills and mathematical performance. Mercadar et al. established that inhibition and working memory were the main constituents of executive functioning during the early years of child development. The study found that executive functioning skills especially inhibition, greatly helped children to regulate their emotions, as well as have the best response towards failure and frustrations. This could perhaps provide an explanation of the current study results where inhibitory control was the best predictor of achievement motivation. Camerota and Blair (2020) also reported that executive functioning has a noticeable influence on character development which tends to differentiate gradually over time. The results suggest that executive functioning skills are important in the regulation of learning processes and affect learning constructs such as achievement motivation.

The results are consistent with the information processing theory by Siegler (1986) which suggests that executive controls regulate learning processes and behaviour. This points to the importance of executive functioning skills in achievement motivation for learning Chemistry. Therefore, students with better executive functioning skills have higher levels of achievement motivation for learning compared to students with poor executive functioning skills. The current study established that a majority of the students involved in the study had average executive functioning skills and moderate to low levels of achievement motivation for learning chemistry hence the below average performance in chemistry.

The current study’s results corroborate the findings of Alejandra et al. (2018). The study was carried out to establish the link between executive functions and achievement motivation for learning in primary education. The meta analysis results showed only a moderate but significant predictive value. Executive functioning was found to be a substantial predictor of academic achievement among normal children. The results were slightly higher for mathematics and this was consistent with previous findings.

A similar study by Gordon et al. (2018) related executive functioning skills to achievement motivation and academic achievement. The study concluded that the main component of executive functions is working memory and it is an important aspect for academic performance, especially during early years of primary schooling. This component develops rapidly in early years and becomes stabilizes during adolescence.

This study findings also support the results of Pat and Okeke (2019). The study aimed at investigating the effect of scaffolding instructional strategy on secondary school students’ achievement in biology in Anambra state. The results of the study established that scaffolding instructional strategy positively enhanced achievement in Biology. In the study, two research questions were used and the null hypotheses were tested at the significance level of .05. The experimental group was taught biology using SIS and the control group was taught using the traditional teaching methods. The researchers suggested that Biology teachers should familiarize themselves with the various scaffolding methods and apply them in their biology classes to enhance learning and performance.

A similar study was carried out by Asselman and Aammou (2020). The study investigated the influence of scaffolding on the prediction of overall achievement motivation and academic achievement of the student. Two models were proposed, the first model investigated whether the student's previous scaffolding experiences helped to improve current performance, whereas the second model sought to improve the students' performance through the use of scaffolding questions. The outputs of the two models were compared against the original academic performance. The results of the findings showed that these two models provided were significant in predicting the performance of the study in the future, resulting to academic achievement. The second model had the best increase in the predictive weight.

The current study's results are in support of the findings Abdelrahman (2020). The study was carried out to establish the effect of metacognitive awareness and motivation on learning outcomes among university students. The results revealed that metacognitive awareness has a significant effect on learning and academic achievement. A similar study was carried out by Suhkyung (2020) to examine the impact of hard, peer and teacher scaffolding on the academic achievement and group performance on the ninth grade biology course. The findings of the study were in support of the current findings. It was established that there was a positive impact of students' perceptions of peer and teacher scaffolds on the students' academic achievement motivation. The results suggested that the students perceived usefulness of hard scaffolding followed by the peer scaffolding, these were the most appropriate variables to predict the individual student academic achievement. However, peer scaffolding was the only relevant variable to predict the group performance.

The results of a study by Gita and Apsari (2018) offer an explanation for the significant findings of the present study on the positive prediction of scaffolding on achievement motivation. Gita and Apsari (2018) argued that scaffolding was a problem based approach to increasing student achievements in linear algebra. The main objective of their study was to improve the undergraduate learning achievements in linear algebra. The research had four cycles namely, planning, implementation, evaluation, and reflection. The data comprised of the written work of students in solving the various linear algebra test. The results of the study showed that adoption of scaffolding in the various problem based learning improved the learning achievements of the students.

In contrast, Atsumbe et al. (2018) who analyzed the effect of scaffolding and collaborative instructional approaches to the students' achievements in basic electronics did not find a significant predicitive value of scaffolding. The performance of senior students was obtained after being taught using the scaffolding approach and the collaborative instructional approach using the Basic Electronics cognitive achievement test (BECAT). The results revealed that a collaborative instructional approach produced better result than the scaffolding approach among basic electronic students. Teachers were advised to adopt the use of collaborative approach in teaching basic electronics students.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter presents the summary, conclusions, and recommendations of the study. It begins with the summary of the findings based on the study objectives, followed by conclusion and then the recommendations. The recommendations are divided into two categories namely, policy and practice recommendations and recommendations for further research.

5.2 Summary

The aim of this study was to investigate executive functioning skills and academic scaffolding as correlates of achievement motivation for learning chemistry. Specifically, the study aimed at, investigating the relationship between executive functioning and achievement motivation for learning chemistry; examining the extent to which academic scaffolding is related to achievement motivation for learning chemistry, finding out the moderator effect of gender in the relationship between executive functioning, academic scaffolding, and achievement motivation for learning chemistry and develop a prediction equation for achievement motivation for learning chemistry from executive functioning academic scaffolding.

In the first objective, the study established that a majority of the students had average levels of executive functioning skills and achievement motivation for learning chemistry.

The results revealed that there was a positive and statistically significant correlation between executive functioning skills and achievement motivation for learning chemistry. The study focused on four domains of executive functioning skills and the results showed that shifting executive functioning skills had the highest correlation coefficient with achievement motivation for learning chemistry, followed by sustained attention, and inhibitory control. Initiation executive functioning skills had the lowest correlation coefficient with achievement motivation for learning chemistry. All the domains of executive functioning skills had positive correlation coefficients ranging from weak to moderate.

In objective two, the study examined the relationship between academic scaffolding and achievement motivation for learning chemistry. The results showed that there was a positive and moderate correlation between academic scaffolding and achievement motivation for learning chemistry. The correlation was statistically significant. Instructional scaffolding had the highest correlation coefficient with achievement motivation for learning chemistry, followed by planned scaffolding. Interactional scaffolding had the lowest correlation coefficient. Planned scaffolding and instructional scaffolding had moderate positive coefficients, while interactional scaffolding had a weak positive correlation coefficient with achievement motivation for learning chemistry.

In the third objective, the study examined the moderator effect of gender in the prediction of achievement motivation from executive functioning and academic scaffolding. The results showed that gender had a moderator effect in the prediction of achievement motivation for learning chemistry from executive functioning skills. However, the moderator effect was not statistically significant. Similarly, gender was found to have moderator effect in the prediction of achievement motivation for learning chemistry from academic scaffolding. But the moderator effect was not statistically significant.

The fourth objective of this study was to examine the prediction of achievement motivation for learning chemistry from executive functioning skills and academic scaffolding. The results showed that executive functioning skills and academic scaffolding moderately predicted achievement motivation for learning chemistry. It was found that 33% variance in achievement motivation for learning chemistry was explained by executive functioning skills and academic scaffolding. The results further showed that the interaction between executive functioning skills and academic scaffolding significantly predicted achievement motivation for learning chemistry.

5.3 Conclusion

The study established that there was a significant relationship between executive functioning skills and achievement motivation for learning chemistry. The domains of executive functioning skills namely, shifting, sustained attention, and inhibitory control were found to play an important role in the prediction of achievement motivation for learning chemistry. The results suggest that students with high levels of executive functioning skills have high levels of achievement motivation for learning chemistry and vice versa. Therefore, it is important that students are trained on how to advance executive functioning skills in order to enhance achievement motivation for learning chemistry. This will go a long way in improving performance in chemistry.

In the second objective, the study found that there was a positive and significant relationship between academic scaffolding and achievement motivation for learning chemistry. It was established that instructional scaffolding had the highest correlation coefficient with achievement motivation, followed by planned scaffolding. Interactional scaffolding was found to have the lowest correlation coefficient. The results suggest that academic scaffolding is an important construct that influence achievement motivation for learning chemistry. The results imply that for teachers to enhance achievement motivation for learning chemistry, it is important to support the students in the learning of chemistry through adequate lesson preparation and use of teaching aids which constitute instructional scaffolding.

In the third objective, the study established that gender of the student had a moderator effect on the relationship between executive functioning, academic scaffolding and achievement motivation for learning chemistry. However, the moderator effect was not statistically significant. The study also established that executive functioning and academic scaffolding significantly predicted achievement motivation for learning chemistry. The interaction between executive functioning and academic scaffolding was found to significantly predict achievement motivation for learning chemistry. Therefore, regardless of the gender of the student, executive functioning and academic scaffolding are important constructs that predict achievement motivation for learning chemistry among secondary school students.

5.4 Recommendations

Based on the findings, the study makes the following policy and further research recommendations.

5.4.1 Practice and Theory Recommendations

i. The study established that there was a positive and significant relationship between executive functioning and achievement motivation for learning chemistry. Therefore, school counsellors and chemistry teachers should sensitize and support chemistry students to enhance their executive functioning skills. This will go a long way in boosting the student's achievement motivation for learning chemistry for better learning outcomes. Curriculum developers should also integrate executive functioning learning activities in the learning content in order to enhance the development of these skills for better learning outcomes in chemistry.

ii. The results of the study showed that there was a positive and significant relationship between academic scaffolding and achievement motivation for learning chemistry. Based on the results, the study recommends that chemistry teachers should always strive to use effective teaching methods to enhance achievement motivation for learning chemistry among students. School counsellors should also develop guidance and counseling activities to empower chemistry students with skills to overcome negative peer pressure that affect achievement motivation for learning chemistry.

iii.Teachers and parents should be sensitized that the gender of the student in not significant in learners' achievement motivation for learning chemistry. This will help to eradicate the narrative that boys have better achievement motivation for learning chemistry compared to girls.

iv.The study established that when executive functioning and academic scaffolding are examined together, they significantly predicted achievement motivation for learning chemistry. Based on the results, teachers should focus on both aspects concurrently. Thus, chemistry teachers should not only ensure that they adequately support the students in learning chemistry but also train students to enhance executive functioning skills at the same time. This will go a long way in enhancing achievement motivation for learning chemistry. The parents should also encourage and support their children in learning chemistry in order to enhance their executive functioning skills for better performance in chemistry.

5.4.2 Recommendations for Further Research

i. The study only focused on executive functioning skills and academic scaffolding which only explained a small portion of achievement motivation. Additional studies on other factors that explain achievement motivation in addition to the variables targeted by the current study may offer a better explanation of achievement motivation.

ii. The present study focused on achievement motivation for learning chemistry among high school students and found no significant gender differences in the relationship between executive functioning skills, academic scaffolding and achievement motivation. Further studies among among other populations such as among college and university students may help clarify the curerent results.

iii. The researcher employed convergent parallel mixed methods research design. Further studies should be conducted using other research designs to establish if similar findings would be obtained.

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APPENDICES

Appendix A: Consent Form

My name is Jasper Isoe, a PhD student at the department of educational psychology, Kenyatta University. I am conducting a study in Kiambu County involving form four students. The title of the study is “Executive functioning and academic scaffolding as predictors of achievement motivation for learning Chemistry among form three students in Kiambu County, Kenya.” You have prerogative to participate, decline to participate or withdraw from the study anytime. The findings of this research will be handled with utmost confidentiality and results will only be discussed in summary form without revealing your identity.

I agree to participate in the study.

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

Appendix B : Students Questionnaire

Section A: Demographic Data

Please read the following questions carefully and fill in the blank spaces or tick (√) as appropriate.

1. What is your gender?

Male ☐

Female ☐

2. School code………………

3. Age…………………

4. Type of school

National……………… Extra county or County…………………………….
Sub county ………………..

Section B: Executive Functioning Skills Scale

Rate each item below based on how well it describes you, using the rating scale given to choose the appropriate score.

	Strongly disagree 1	disagree Disagree 2	Neutral 3	Agree 4	Strongly agree 5
Initiation					
No matter what the chemistry task is, I believe in getting started as soon as possible.					

2. Procrastination in chemistry is usually not a problem for me.					
3.I rarely leave chemistry assignments to the last minute					
Sustained attention					
I find it easy to stay focused on my chemistry assignments					
Once I start my chemistry assignment, I work diligently until it's completed.					
Even when interrupted, I find it easy to get back and complete the chemistry assignment at hand.					
Inhibitory control					
While studying chemistry I don't jump to conclusions					
In a chemistry class, I think before I speak.					
In chemistry I don't answer any question if am not sure.					
Shifting					
. I routinely evaluate my chemistry performance and devise methods for personal improvement					
. In learning chemistry I am able to evaluate					

situations in order to make objective decisions.					
12.During chemistry discussions I "read" situations well and can adjust my behavior based on the reactions of others					

Section C: Scaffolding Scale

Below are statements concerning your experiences in the course of learning chemistry. Using the rating scale strongly agree, disagree, neutral, agree and strongly agree, tick(√) one option.

	Strongly disagree 1	**Disagree 2**	**Neutral 3**	**Agree 4**	**Strongly agree 5**
	Instructional Scaffolding				
My chemistry teacher presents the minimum content of his/her subject matter, tailored to the students' knowledge					
He/She allows the student to organize and distribute part of the assignments to be performed in a topic					
He/she provides clear information about objectives, contents, and					

assessment methods in the chemistry topics					
He/She informs the students of the competencies they will be expected to acquire in any topic					
He/She provides me with scientific information that allows me to gain a better and deeper understanding of the subject matter					
He/She presents the contents following a clear and logical framework, highlighting the important aspects					
He/She allows and encourages student participation in chemistry classes					
He/She relates the teachings in chemistry to the real world					
He/She provides initial and final overviews of the lesson in class					
10.He/She encourages student interest and the motivation to learn.					
11.He/She fosters critical thinking spirit in students					

Planned scaffolding					
	Strongly disagree 1	**Disagree 2**	**Neutral 3**	**Agree 4**	**Strongly agree 5**
12.Chemistry teacher comes to class with simplified teaching notes					
13.Chemistry teacher comes to class with appropriate teaching aids					
14.Chemistry teacher uses real life experiences in the course of teaching					
15.We take practical lessons frequently					

Interactional Scaffolding

	Strongly disagree 1	**Disagree 2**	**Neutral 3**	**Agree 4**	**Strongly agree 5**
16.Most of my friends have a negative attitude towards chemistry					
17. In our school, poor performance in chemistry discourages most students					

18. In our school students have the notion that its not easy to pass in chemistry					
19. I think teachers, my friends and my parents contribute to the way I perform in chemistry					

Section D: Student's Motivation towards Science Learning Questionnaire

The following are statements regarding your achievement motivation for learning chemistry. Respond as faithfully and sincerely as possible. Tick [√] as appropriate.

	Strongly disagree	**Disagree**	**Neutral**	**Agree**	**Agree Strongly**
1. Whether the chemistry content is difficult or easy, I am sure that I can understand it.					
2. I am not confident about understanding difficult chemistry concepts.					
3. I am sure that I can do well in chemistry tests.					
4. No matter how much effort I put in, I cannot learn most chemistry concepts.					
5. When chemistry questions are too difficult, I give up or only do the easy parts.					
6. During chemistry learning activities, I prefer to ask other students for the answer rather than think for myself.					
7. When I find the chemistry content difficult, I do not try to learn it.					
8. When learning new chemistry concepts, I attempt to understand them.					

9. When learning new chemistry concepts, I connect them to my previous experiences					
10. When I do not understand a chemistry concept, I find relevant resources that will help me.					
11. When I do not understand a chemistry concept, I would discuss with the teacher or other students to clarify my understanding.					
12. During the learning processes in chemistry, I attempt to make connections between the concepts that I learn.					
13. When I make a mistake in chemistry, I try to find out why.					
14. When I meet chemistry concepts that I do not understand, I still try to learn them.					
15. When new chemistry concepts that I have learned conflict with my previous understanding, I try to understand why.					
16. I think that learning chemistry is important because I can use it in my daily life.					
17. I think that learning chemistry is important because it stimulates my thinking.					
18. In chemistry, I think that it is important to learn to solve problems.					

19. In chemistry, I think it is important to participate in inquiry activities.					
20. It is important to have the opportunity to satisfy my own curiosity when learning chemistry.					
21. I participate in chemistry learning activities to get a good grade.					
22. I participate in chemistry learning activities to perform better than other students.					
23. I participate in chemistry learning activities so that other students think that I'm smart.					
24. I participate in chemistry learning activities so that the teacher pays attention to me.					
25. During a chemistry exam, I feel most fulfilled when I attain a good score in a test.					
26. I feel most fulfilled when I feel confident about the content in chemistry.					
27. I feel most fulfilled when I am able to solve a difficult problem in chemistry.					
28. During a chemistry lesson I feel most fulfilled when the teacher accepts my ideas.					
29. During a chemistry lesson, I feel most fulfilled when other students accept my ideas.					

Appendix C: Interview Schedule

Instructions:

Please answer all the questions as honestly as possible. Information collected will be treated in utmost confidentiality and only used for the purposes of this study.

a. Executive Functioning Skills

i. When do you start doing your chemistry assignments and do you always finish them?

ii. How often do you focus on your chemistry assignment until its completed?

iii. While studying chemistry, which strategies do you use to ensure that you don't get disappointed when answering questions?

iv. Describe how you manage your shortcomings in learning chemistry in order to improve your performance.

b. Academic Scaffolding

i.In what ways does your chemistry teacher influence your performance in the subject?

ii.Do you think your friends and your school influence the way you perform in chemistry? Give reasons

c. Achievement motivation

i.Do you think you have what it takes to do well in chemistry? Explain your answer

ii.Explain how you manage the challenges you encounter while learning chemistry

iii. Is performance in chemistry important? Give reasons

iv.How do you feel when you do not perform well in chemistry compared to other students?

v.How do you feel when you do not perform well in chemistry compared to your previous performance?

Appendix D : Authorization to use SMTSL

Re:Request to use student's motivation towards science learning questionnaire Inbox

J

Jasper Isoe Dec 11

Hello,My name is Jasper Isoe from Kenyatta University, Kenya. I am a PhD

S

suhltuan

to me

Yesterday View details

Hi Jasper,
You are welcome to use SMTSL questionnaire in your study.
Best wishes
Hsiao-Lin Tuan
Graduate Institute of Science Education
National Changhua University of Education
Changhua, Taiwan ROC

Hide quoted text

-----Original message-----
From: Jasper Isoe<jasperisoe@gmail.com>
To:suhltuan<suhltuan@cc.ncue.edu.tw>
Date: Wed, 11 Dec 2019 21:05:03
Subject: Re:Request to use student's motivation towards science learning questionnaire

Appendix E : Factor Loadings For Achievement Motivation Questionnaire

	1	2	3	4	5
AMQ1	.560	-.139	-.206	-.101	.016
AMQ2	-.530	.066	.163	-.261	.294
AMQ3	.450	.406	-.304	-.340	.186
AMQ4	-.595	.125	.310	-.058	.255
AMQ5	-.515	.368	-.318	.428	.038
AMQ6	-.288	-.024	-.353	.606	.173
AMQ7	-.690	.315	.126	.291	-.044
AMQ8	.685	.304	.125	.044	.000
AMQ9	-.188	-.290	-.340	-.212	-.475
AMQ10	.685	-.301	.077	-.131	-.081
AMQ11	.563	-.352	.331	.311	.053
AMQ12	.382	.244	-.122	.368	-.244
AMQ13	.489	-.373	.238	.323	.401
AMQ14	.462	-.505	.296	-.329	-.119
AMQ15	.461	.211	-.093	-.210	-.237
AMQ16	.331	.091	-.424	-.017	.444
AMQ17	.725	-.049	-.064	.196	.032
AMQ18	.532	.221	-.192	.140	-.193
AMQ19	.621	.281	-.040	-.009	.224
AMQ20	.239	-.209	.294	.291	.100
AMQ21	.540	.063	-.160	.301	-.439
AMQ22	.237	.590	.104	.163	-.317
AMQ23	-.262	.452	.381	-.209	-.449
AMQ24	-.210	.026	.697	.469	-.127
AMQ25	.272	.577	-.258	.042	.246
AMQ26	.687	.145	.321	.118	.068
AMQ28	.232	.513	.345	-.251	.259
AMQ29	.228	.483	.495	-.171	.068

Appendix F: Descriptive Statistics of the Study Variables

Table F 1

Collinearity Statistics for Academic scaffolding

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.	Collinearity Statistics Tolerance	Collinearity Statistics VIF
1	(Constant)	58.933	3.770		15.630	.000		
	SC_Instructional	.633	.097	.388	6.551	.000	.641	1.560
	SC_Planned	.441	.224	.114	1.965	.050	.669	1.494
	SC_interactional	.437	.188	.113	2.321	.021	.942	1.062

a. Dependent Variable: AM_TOTAL

Table F 2

Collinearity Diagnostics for Executive Functioning

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions (Constant)	Variance Proportions EF_TOTAL	Variance Proportions SC_TOTAL
1	1	2.966	1.000	.00	.00	.00
	2	.020	12.100	.06	.92	.39
	3	.014	14.445	.94	.08	.61

a. Dependent Variable: AM_TOTAL

Table F 3

Linearity Diagnostics for EF and Achievement Motivation

			Sum of Squares	df	Mean Square	F	Sig.
AM_TOTAL * EF_TOTAL	Between Groups	(Combined)	18847.019	37	509.379	3.851	.000
		Linearity	11667.771	1	11667.771	88.199	.000
		Deviation from Linearity	7179.247	36	199.424	1.507	.074
	Within Groups		39686.594	300	132.289		
	Total		58533.612	337			

Table F 4

Linearity Diagnostics for Academic Scaffolding and Achievement Motivation

			Sum of Squares	df	Mean Square	F	Sig.
AM_TOTAL SC_TOTAL	Between Groups	(Combined)	25269.832	55	459.451	3.895	.000
		Linearity	14575.963	1	14575.963	123.570	.000
		Deviation from Linearity	10693.869	54	198.035	1.679	.065
	Within Groups		33263.780	282	117.957		
	Total		58533.612	337			

Table F5

Test for normality of executive functioning, academic scaffolding and Achievement Motivation scores

	N	Skewness		Kurtosis	
	Statistic	Statistic	Std. Error	Statistic	Std. Error
EF_TOTAL	338	-.241	.133	.278	.265
SC_TOTAL	338	-.516	.133	.161	.265
AM_TOTAL	338	-.368	.133	.509	.265
Valid N (listwise)	338				

Appendix G: Diagnostic Test Plots

Figure G 1 Histogram for Achievement Motivation Scores

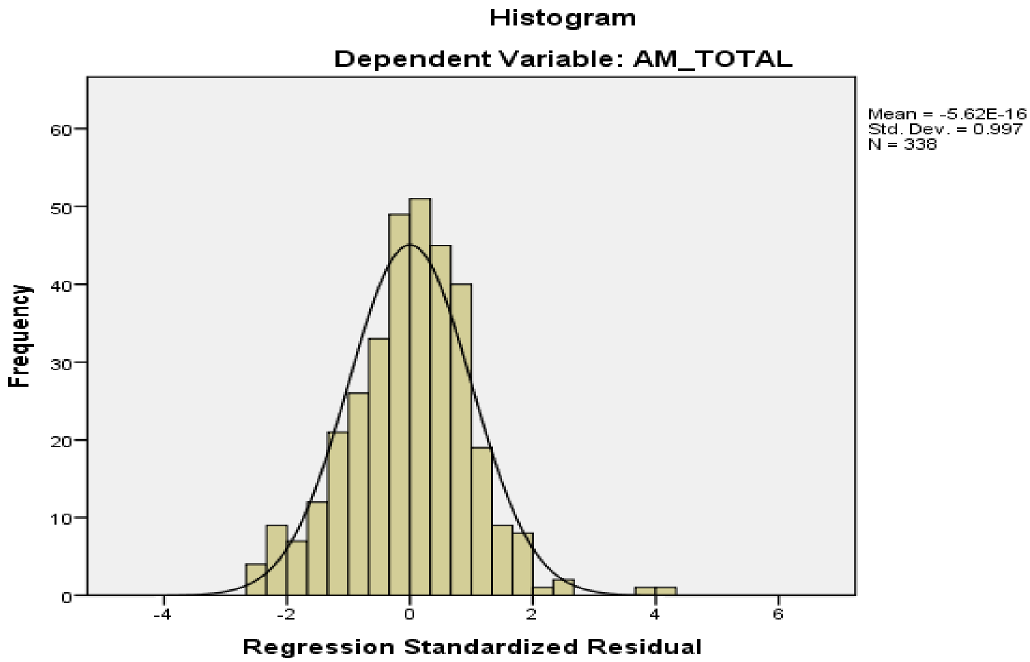


Figure G 2 Normal P-P plot of Regression Standardized Residual

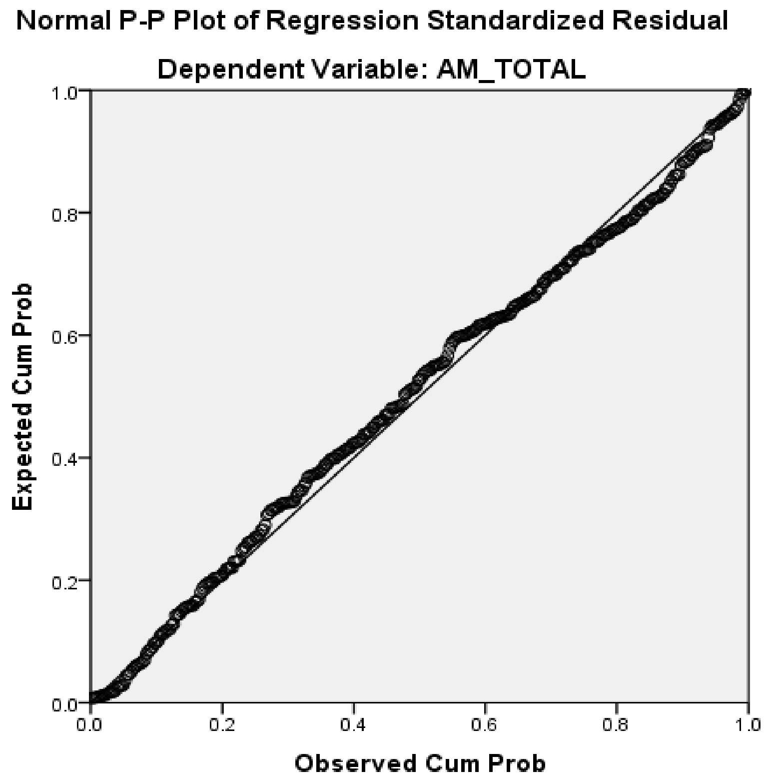
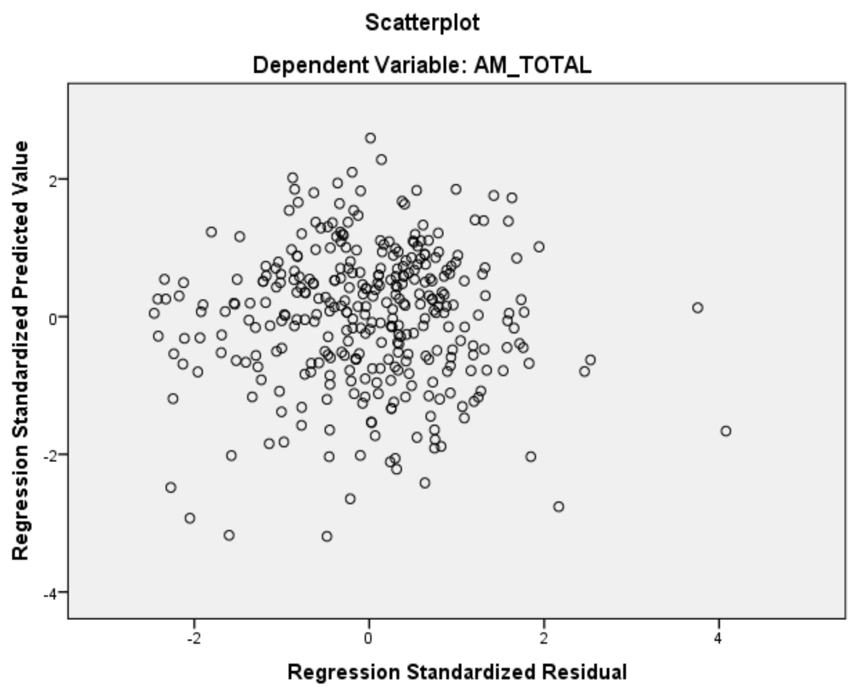


Figure G 3 Scatter Plot for Achievement Motivation Scores


Scatterplot
Dependent Variable: AM_TOTAL
Regression Standardized Predicted Value
2
0
-2
-4
-2
0
2
4
Regression Standardized Residual

Appendix H: Research Permit

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: **274217**

Date of Issue: **28/March/2020**

RESEARCH LICENSE

This is to Certify that Mr.. Jasper Isoe of Kenyatta University, has been licensed to conduct research in Kiambu on the topic: EXECUTIVE FUNCTIONING AND ACADEMIC SCAFFOLDING AS CORRELATES OF ACHIEVEMENT MOTIVATION FOR LEARNING CHEMISTRY AMONG FORM THREE STUDENTS IN KIAMBU COUNTY, KENYA for the period ending : 28/March/2021.

License No: **NACOSTI/P/20/4681**

274217

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.

Appendix I: Research Authorization Letters

KENYATTA UNIVERSITY
GRADUATE SCHOOL

E-mail: kubps@yahoo.com
dean-graduate@ku.ac.ke
Website: www.ku.ac.ke

P.O. Box 43844, 00100
NAIROBI, KENYA
Tel. 8710901 Ext. 57530

Our Ref: E83/37173/16

Date: 2nd March, 2020

The Director General,
National Commission for Science, Technology & Innovation,
P.O. Box 30623-00100,
NAIROBI

Dear Sir/Madam,

RE: RESEARCH AUTHORIZATION FOR MR.JASPER ISOE- REG. NO. E83/37173/16

I write to introduce Mr. Isoe who is a Postgraduate Student of this University. He is registered for a Ph.D. degree programme in the **Department of Educational Psychology in the School of Education.**

Mr. Isoe intends to conduct research for Ph.D. thesis entitled, **"Executive Functioning and Academic Scafffolding as Correlates of Achievement Motivation for Learning Chemistry among Form Three Students in Kiambu County, Kenya".**

Any assistance given will be highly appreciated.

Yours faithfully,

PROF. ELISHIBA KIMANI
DEAN, GRADUATE SCHOOL

RM/cao

OFFICE OF THE PRESIDENT

MINISTRY OF INTERIOR AND CO-ORDINATION OF NATIONAL GOVERNMENT

COUNTY COMMISSIONER, KIAMBU

Telephone: 066-2022709

Fax: 066-2022644

E-mail: countycommkiambu@yahoo.com

When replying please quote

County Commissioner
Kiambu County
P.O. Box 32-00900
KIAMBU

Ref.No: **ED.12/1(A)/VOL.IV/77**

21st October, 2020

Mr.. Jasper Isoe,
Kenyatta University,
P.O. Box 43844-00100,
NAIROBI - KENYA

RE: RESEARCH AUTHORIZATION

Reference is made to National Commission for Science, Technology and Innovation Letter Ref No. **NACOSTI/P/20/4681** Dated **28th March, 2020**.

You have been authorized to conduct research on "***EXECUTIVE FUNCTIONING AND ACADEMIC SCAFFOLDING AS CORRELATES OF ACHIEVEMENT MOTIVATION FOR LEARNING CHEMISTRY AMONG FORM THREE STUDENTS IN KIAMBU COUNTY, KENYA.***" The data collection will be carried out in ***Kiambu County*** *for a period ending* **28th March, 2021.**

You are requested to share your findings with the County Education Office, Kiambu, upon completion of your research.

Festus Kimeu
FOR: COUNTY COMMISSIONER
KIAMBU COUNTY

Cc

National Commission for Science, Technology and Innovation
P.O. Box 30623-00100
NAIROBI

County Director of Education
KIAMBU COUNTY

All Deputy County Commissioners (***For information and record purposes***)
KIAMBU COUNTY

"Our Youth our Future. Join us for a Drug and Substance free County".

MINISTRY OF EDUCATION

State Department of Early Learning and Basic Education

Telephone: Kiambu (office) 0768 970412

Email:directoreducationkiambu@yahoo.com

When replying please quote

COUNTY DIRECTOR OF EDUCATION
KIAMBU COUNTY
P. O. Box 2300
KIAMBU

KBU/CDE/DEPT 8/VOL. I

2nd November, 2020

Jasper Isoe
Kenyatta University
P.O. Box 43844 - 00100
NAIROBI- KENYA

RE: RESEARCH AUTHORIZATION

Reference is made to NACOSTI letter Ref. No. NACOSTI/P/20/4681 dated 28th March, 2020.

You have been authorized to research on " ***Executive functioning and academic scaffolding as correlates of achievement motivation for learning Chemistry among form three students in Kiambu County, Kenya***" for a period ending 28th March, 2021.

Please accord him the necessary assistance. You are requested to share with us a copy of your research findings when you conclude

COUNTY DIRECTOR OF EDUCATION
KIAMBU COUNTY
02 NOV 2020
P.O. Box 2300 - 00900
KIAMBU

VICTORIA W. MULILI
COUNTY DIRECTOR OF EDUCATION
KIAMBU COUNTY

MY EDUCATION, MY FUTURE

MY EDUCATION, MY FUTURE

Appendix J: Map of Kiambu County

Figure F

Map of Kiambu County

Source: **Google Maps (2019)**