EFFECTS OF COOPERATIVE TEACHING STRATEGY ON STUDENTS ACHIEVEMENT AND MOTIVATION TO LEARN AGRICULTURE IN SECONDARY SCHOOLS OF KIRINYAGA EAST SUB-COUNTY, KENYA

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DECLARATION AND RECOMMENDATION

Declaration

This thesis is my original work and has not been presented for an award of a diploma or degree in this or any other university.

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Recommendations

This thesis has been examined, passed and submitted with our approval as the university supervisors.

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DEDICATION

I dedicate this thesis to my parent, Zipporah Mwathi for her unbound support and prayers through out the study period.

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ABSTRACT

Agricultural education plays a pivotal role in preparing secondary school students to become future nutritionists, scientists, instructors, agents of change among others in Kenya. Agricultural educational programmes are also critical components of economic development, as learners are imparted with the knowledge and skills requisite for industrial sector. Despite its importance, achievement in Kenya Certificate of Secondary Education (KCSE) in agriculture in Kirinyaga East sub-County has been below average since the year 2017 to 2022. The low achievement is a pointer that motivation to learn the subject has also been low, since the two are significantly related. It is possible that the unsatisfactory achievement and motivation to learn agriculture could be due to the teaching strategies adopted by instructors. The study, investigated the effect of cooperative teaching strategy (CTS) on students' achievement and motivation to learn agriculture in secondary schools in Kirinyaga East Sub-County, Kenya. The study utilized collaborative and Social Interdependence theory. The study adopted the Solomon Four Group-Design. The study population was 3,570 Form Two students. Purposive and simple random sampling were used to select four county co-educational secondary schools which participated in the study. A sample size of 186 Form Two students was involved in the study. Agriculture Achievement Test (AAT) and Agriculture Motivation Questionnaire (AMQ) were used to collect data. The face and content validity of the instruments were ascertained by the supervisors. The reliability of AAT and AMQ that was tested using, Kuder Richardson KR 21 and Cronbachs' alpha was 0.714 and 0.811 respectively. Hypothesis were tested at $\propto = .05$ significance level using the ANOVA, t-test, Mann Whitney U-test and Kruskal Wallis H-test. The findings of this study showed significant difference in achievement between students exposed to CTS and those taught using conventional strategy. A significant difference in achievement by gender of students exposed to CTS was also observed. The findings further showed an insignificant difference in motivation to learn agriculture by teaching strategy and gender. The study concluded that CTS is more effective in enhancing students' achievement in agriculture than conventional teaching strategy. The study also concluded that improvement in students' motivation to learn agriculture is not affected by teaching strategy and also gender wise. Teacher training institutions may use the results of the study when reviewing their endeavour to improve their effectiveness. Therefore, agriculture teachers should integrate CTS in content deliverly.

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ABBREVIATIONS AND ACRONYMS

AAT: Agriculture Achievement Test

ACTE: Association for Career and Technical Education

AMQ: Agricuture Motivation Questionnaire

ANOVA: Analysis of Variance

CTS: Cooperative Teaching Strategy

FFA: Food For All

GOK: Government of Kenya

KCSE: Kenya Certificate of Secondary School Education

KICD: Kenya Institute of Curriculum Development

KLB: Kenya Literature Bureau

KNEC: Kenya National Examination Council

MOE: Ministry of Education

NACOSTI: National Commission for Scence, Tecnology and Inovation.

SPSS: Statistical Package for Social Science

UNESCO: United Nation Educational, Scientific, Cultural Organisation

CHAPTER ONE
INTRODUCTION

1.1 Background to the Study

Agricultural education plays a pivoted role in imparting knowledge and skills while fostering a comprehensive global awareness of the importance of agriculture. Furthermore, it establishes a symbiotic relationship between the agricultural sector, economics, and the societal structure (Martin & Campbell, 2021). The advocacy for agricultural education spans several decades due to its undeniable influence on agricultural output across various sectors (Wauterse & Badian, 2019). According to Haruna et al. (2019), educators have consistently championed increased agricultural literacy to enhance understanding of healthy eating, environmental stewardship, and global sustainability. The importance of agricultural education is far-reaching and cannot be overemphasized.

In America, the general objective of agricultural education is to impart knowledge and skill in plant and animal production, science, technology, and environmental systems. This education is pivotal for cultivating competencies essential in the agricultural sector (Jibran & Abdullah, 2019). Originating from the Smith-Hughes Act of 1917, the United States incorporates agriculture into its education system, delivering key programs through technical and career education, including contextual and inquiry-based learning and supervised experience programs (Eck & Edwards, 2019). In Europe, agricultural education is integral to developing adaptive skills, while in India, it holds a significant position in higher education, aiming to boost food production (Jibran & Abdullah, 2019).

In Africa, especially Nigeria, agricultural education addresses socio-economic challenges like unemployment, contributing to viable enterprises (Adeosun et al., 2020). Uganda underscores agricultural education from primary to university levels, yet a declining trend in students achievement raises concerns about the labor force and unemployment rates (Jiuuko et al., 2019). To address this, a re-evaluation of teaching strategies is crucial, emphasizing the importance of nurturing agricultural education for knowledge, innovation, economic development, and productivity (Ninh, 2021).

In Kenya, agricultural education spans from primary school to tertiary levels, with Chemjor (2016) noting its integration into the primary school science curriculum and an optional vocational subject at secondary school level. Many students who opt for agriculture at the secondary level pursue it further at tertiary institutions, including universities, colleges, and technical institutes. The overarching goal of agricultural education is to produce graduates who are resourceful, self-reliant, and actively contributing to enhancing the country's economic productivity and food security (Njura et al., 2020). Recognizing the pivotal role of agricultural education, Njega (2018) emphasizes its significance as a crucial component for achieving the country's economic transformation by 2030. Given that the contributions of agricultural education form the backbone of the economy, educators are rightfully concerned about academic achievement in agriculture, highlighting its critical importance in shaping the nation's future (Njura et al., 2020).

Despite the importance of agriculture in the economic development of a country, students achievement in the subject in Kenya Secondary School Examinations (KCSE) has been below average (50%) both nationally and sub counties such as Kirinyaga East, Kenya. Table 1 shows students' achievement in KCSE agriculture subject nationally and in Kirinyaga East sub-county for the years 2017-2022.

Table 1: National and Kirinyaga East Results in Agriculture from (2017-2022)

	KCSE Mean Score in Percentage	
YEAR	National	Kirinyaga East
2017	27.45	25.07
2018	28.32	25.91
2019	32.41	25.07
2020	51.76	38.37
2021	38.84	37.15
2022	49.03	47.50

Source: KNEC (2022), DEO Kirinyaga East from (2017- 2022).

Data in Table 1 reveals fluctuations in performance percentages over the years while the national scores exhibit an overall upward trend, reaching a peak of 51.76% in

2020, the scores for Kirinyaga East, although experiencing some improvement, demonstrates a less consistent trajectory, reaching 38.37% in 2020. Notably, the subsequent years, 2021 and 2022, shows an increase in both national and Kirinyaga East scores, with the national score increasing from 38.84% to 49.03% and Kirinyaga East scores from 37.15% to 47.50%. This divergence between national and the Kirinyaga East scores prompts an exploration of potential factors influencing the performance variation, particularly the impact of teaching strategies. While the national scores indicates a general positive trend, the Kirinyaga East scores, especially in recent years, suggest a potential research gap or disparity in the effectiveness of teaching strategies employed.

Teachers need to adopt strategies that fully engage the students, leading to improved achievement (Njura et al., 2020). Students participation in learning is among significant predictors of achievement, as it encourages them to fully interact with the content towards the set goal. The United Nations, Scientific and Cultural Organisation (UNESCO) (2013) noted that integration of constructivist-based teaching strategies, such as Cooperative Teaching, boosted academic achievement as it enhanced students' active participation in learning during the lesson.

Cooperative Teaching (CT) is an instructional strategy that promoted interaction and collaboration among students during the learning process, thus promoting achievement and motivation towards shared goals (Tran, 2019). Students are at the center of design and implemetation of instruction when cooperative teaching strategies are adopted (Baloche & Brody, 2017). It has thus gained a lot of popularity due to its emphasis on learning together. According to McMillan (2020), the role of a teacher when CT is adopted is to design and introduce classroom activities, organise the students in groups, and allocate them tasks. The teacher also monitors the groups as they carry out given tasks and intervenes whenever need arises. In cooperative teaching strategies, students learn at the same time and answer set questions together (Tran, 2019).

According to Yilmaz et al. (2017), several factors affect students' motivation towards a certain subject. These include internal factors such as motivation to learn and future

prospects, and external factors such as school environment and teaching strategies, among others. Most agriculture teachers use conventional teaching strategies like dictations, lectures, and textbook orientation, which are teacher-centred, thus placing the students in a passive role (Njura et al., 2020). Such strategies lower students' motivation towards learning, resulting in poor academic achievement **(**Njura et al., 2020). Therefore, there is a need for teachers to adopt strategies such as CT, which are student-centred. These strategies may raise students' academic achievement and motivation to study a specific subject like agriculture.

Agriculture, an optional subject in the Kenya secondary schools' curriculum. Therefore, its development depends on the teaching strategy that triggers students' academic achievement and, in turn, influences their motivation towards it (Clarke**,** 2019). The number of students who choose to study agriculture has been below average over the years (KNEC, 2019, 2023). Table 2 shows the number of students' who sat for KCSE agriculture nationally and in Sub Counties such as Kirinyaga East for the years 2017 to 2022.

Table 2: Enrolment in Agriculture at KCSE from the Year (2017-2022)

Year	National Agriculture Candidates	Kirinyaga-East Agriculture Candidates
2017	247265	1362
2018	278656	1352
2019	289315	1310
2020	300878	1322
2021	317692	1242
2022	327993	1216

Source: KNEC (2022), DEO Kirinyaga East from (2017-2022)

An examination of the data in Table 2 reveals that there were fluctuations in enrolment during the six years. While the national enrolment shows an overall upward trend, reaching a peak of 327993 candidates in 2022, the enrolment for Kirinyaga East, although experiencing some slight increase in some years, demonstrates a

consistent decline from the year 2017 to 2019. Notably, in the subsequent year, 2020 witness a slight increase from 1310 in 2019 to 1322 candidates in 2020. The divergence between the national and Kirinyaga East enrolment prompt an exploration of the main factors behind the variation, particularly the influence of teaching strategies employed by teachers. While the national enrolment shows a continuous upward trend, the Kirinyaga East enrolment, particularly in the last three years declined. This is an indicator that students were not motivated to select it. The low motivation could perhaps be due the teaching strategies.

According to Clarke (2019), the choice of a subject is determined by the inner motive in students, which is influenced by the teaching strategy. Motivation is enhanced by encouraging engagement and interaction between teachers and students during lessons (Sackstein, 2018). According to Njura et al. (2020), students' motivation is enhanced by how teachers deliver the content during the lessons since teachers direct students in many ways.

The aspect of gender is a critical factor in academic achievement and motivation in agriculture (Jackman et al., 2019). Boys feel that studying agriculture and finding employment in the field is promising. On the other hand, girls feel less motivated as they perceive labor in agriculture to have no future (Prasetyaningrum et al., 2022). A stereotype exists where agriculture is perceived as an activity that is more suitable for boys than girls (Lamontagne et al.., 2018).

The prime goal for any teaching strategy is to enhance improvement in students' academic achievement by making the teaching process more student-centered (Brooks et al., 2021). According to McMillan (2020), in student-centered strategies, the teacher is considered as a facilitator and guide who shepherds students to perform specified roles during the learning process when student centered teaching strategies are adopted. McMillan recommends adoption of student-centered strategies such as CTS since it enables learners to actively participate in the learning process and enhances chances of realizing set educational obejectives.

In the USA, Evans (2018) investigated whether introducing cooperative teaching strategy would improve academic achievement in high school 10th-grade social studies students. The results of the study indicated that there was a significant improvement in achievement among the participants. Similarly, a study in Pakistan by Ullah et al (2018) established that the experimental group exposed to CTS performed better in high school biology than their counterparts in the control group. The study concluded that CTS influenced academic achievement in biology due to peer tutoring.

Caper (2015) found that exposure to CTS to have led to higher students' achievement in biology. Chebii et al. (2018) study conducted in Kenya noted that achievement and motivation to learn chemistry of students exposed to CTS improved significantly. Kairo et al., (2021) study carried out in Kirinyaga County, also found that CTS boosted students achievement in physics. Despite positive impact of CTS on achievement and motivation to learn, there is dearth in literature that associates it to those agriculture outcomes in Kirinyaga East Sub-County. This study attempted to fill this gap by investigating effects of CTS on achievement and motivation to learn agriculture at the secondary school level in the Sub-County.

1.2 Statement of the Problem

The pivotal role of agricultural education in shaping the future, fostering global awareness, and influencing economic structures has been widely recognized globally. However, despite its, multifaceted impact on societal, economic, and environmental dimensions, challenges persist in optimizing students' achievement and motivation in the agriculture subject. This research was motivated by the observed disparity in KCSE scores over the last six years, specifically in Kirinyaga East Sub-County. While national scores exhibited an overall positive trajectory, Kirinyaga East scores fluctuated and declined, indicating potential gaps in the effectiveness of teaching strategies employed. This study identified a pressing need to reevaluate current teaching strategies in agricultural education, given their influence on learners' academic achievement. Notably, the adoption of Cooperative Teaching Strategy (CTS) has shown promise in enhancing academic achievement and motivation in various subjects globally. However, its application and effectiveness in secondary

school agricultural education in Kirinyaga East Sub-County remain unexplored. Furthermore, the declining trend in students' enrollment in agriculture subject, particularly in Kirinyaga East, raises concerns about the alignment between teaching strategies and students' inherent motives. Understanding the factors influencing this decline, including potential gender-related perceptions, is crucial for creating inclusive and effective educational approaches. This research aimed to bridge the knowledge gap, inform evidence-based educational practices, and contribute to the broader discourse on optimizing agricultural education for economic growth and sustainable development in Kenya by examining the effect of CTS on academic achievement and students' motivation to learn agriculture.

1.3 Purpose of the Study

The purpose of this inquiry was to investigate the effects of CTS on students achievement and motivation to learn agriculture.

1.4 Objectives of the Study

The objectives of the study were:

i. To determine whether there is difference in achievement in agriculture among students exposed to cooperative teaching strategy and those exposed to conventional teaching strategy.
ii. To determine whether there is a difference in motivation to learn agriculture among students exposed to Cooperative teaching strategy and those exposed to conventional teaching strategy.
iii. To determine whether there is a significance gender difference in achievement in agriculture among students exposed to cooperative teaching strategy.
iv. To determine whether there significance gender difference in motivation to learn agriculture by gender among students exposed to cooperative teaching strategy.

1.5 Hypothesis

The following were null hypothesis;

$H0_1$: There is no statistically significant difference in achievement in agriculture among students exposed to cooperative teaching strategy and those exposed to conventional teaching strategy.

$H0_2$: There is no statistically significance difference in motivation to learn agriculture among students exposed to cooperative teaching strategy and those exposed to conventional teaching strategy. .

$H0_3$: There is no statistically significant gender difference in achievement in agriculture among students exposed to cooperative teaching strategy.

$H0_4$: There is no statistically gender difference in motivation to learn agriculture among students exposed to cooperative teaching strategy.

1.6 Significance of the Study

The study findings and recommendations may help contribute to improved students' academic achievement and motivation to learn agriculture subject. The study findings may be helpful to institutions responsible for research and curriculum development, such as the Kenya Insitutute of Curriculum Development (KICD) This contribution can aid in the appraisal and development of relevant teachers' training programmes. Agriculture teachers may find the study findings helpful as it may give them insight into teaching strategies that are more relevant for developing positive relationships among students, promoting diversity in learning, improving learning and social skills, and improving students' academic achievement. The schools teaching agriculture subject may use the findings in their attempts to make secondary agriculture education more relevant. It may also benefit teacher training colleges by guiding the integration of improved teaching strategies into their teacher training programs.

1.7 Scope of the Study

This inquiry was carried out in public co-education secondary schools in Kirinyaga East Sub County, Kenya. The invesgitation examined the effects of CTS on students' achievement and motivation to learn agriculture. It utilized the Solomon four non-equivalent group research design. The study involved only form two students and covered the topic Soil Fertility II (Inorganic fertilizers).

1.8 Limitation of the study

Some of the participants were apprehensive of the purpose of the study, which could have led to withholding of important information. The effect of this was minimised by the researcher explaining to them that the information provided would be used for educational purposes only.

1.9 Assumptions of the Study

This study assumed that:

i. The teachers in the experimental groups used CTS appropriately during the study.
ii. The information provided by the respondents gave a true reflection of what was on the ground.

1.10 Defination of Terms

Academic Achievement: It refers to attainment or accomplishment of learning goals that require knowledge and skills. It was measured in this study using scores obtained in the agriculture achievement test

Co-educational Schools: Are learning institutions which provide education to both boys and girls that learn in the same classroom and compound during the lessons.

Cooperative Teaching: This is an instructional syrategy which encourages interaction and collaboration of students during the learning process thus making them active audiences during the lessons.

Conventional Teaching: This is a mode of instruction where the teacher is the dominant figure during lessons. It involves use of lectures, story telling among others, thus making learners passive audience during the lessons.

Gender: Refers to socially constructed characteristics of a person. In this study it refers to male and female andlearners in secondary schools.

Motivation: Is the willingness and desire of a student to learn. In this study is reflected by the student choice, effort, persistence and level of achievement in a subject after exposure to a certain teaching strategy.

Teaching Strategy: Are the methods that teachers ues to deliver course materials as reflected in both cooperative and convectional teaching strategy.

CHAPTER TWO
LITERATURE REVIEW

2.1 Agricultural Education

Agricultural education entails the teaching of concepts like agriculture, food, land management and natural resources (Mathews, 2022). In formal instructive processes, agricultural education is principally undertaken to prepare young people for employment in the agricultural sector (National FFA, 2018). History reveals that the first lessons of agricultural education were developed in the early 19th century between 1820s and 1850s. However, it was not until 1862 that agricultural education was formalized and incorporated into the American education sector through the Morrill land grants Act (Morrill Act, 1862).

According to the Association of Career and Technical Education (ACTE) (2021), support for agricultural education in the United States intensified in the twentieth century through passage of various laws. These include the Smith-Lever Act of 1914, which established what is referred to as the cooperative extension system (1988). The Smith-Hughes Act of 2017 and George-Barden Act of 1946, which established the financing of agricultural-related training in high schools were also enacted during that time. Recent reports indicate that even though students enrollment in agricultural courses had no upward trend between the year 2005 and 2015, there has been remarkable uptake of agricultural-related programmes particularly those devoted to sustainable farming methods since 1988 (Barth, 2018).

Some of the courses that students cover in agricultural education include agricultural science, weed and crop identification among others (North Dakota State, 2022). Despite the progress and numerous reforms rolled out in the education sector, Goodman (2023) observes that recruitment and retention of teachers is still a major challenge affecting agricultural education programmes both in urban and rural American schools. This report by Goodman reinforces the findings by Guffey and Young (2020) that recruitment of agriculture teachers was lagging necessitating further investigations on policy regarding filling vacant teaching positions and creating new ones in schools

Research has shown that there are numerous benefits to teaching and learning agriculture in schools (Njura et al., 2020). According to Agricultural Recruitment Specialists (2021), in addition to the common benefits that agriculture has in our everyday lives, there are many other advantages of incorporating it as a key discipline in schools. Some of these benefits include teaching students about survival, and self-sustenance. Learners also get to learn more about soil conservation, food safety, plant identification and a range of basic survival skills that they can apply in their everyday routines (Njura et al., 2020**).**

Various studies across the world indicate that over the years, development of agriculture education in both primary and secondary schools has faced several challenges (Brooks et al., 2019). According to Tomsikova et al. (2019), in a study conducted in the Czech Republic, some of the challenges faced by the country are attributed to the current school funding system, which determines the amount of financial allocation per student. The method favours schools with a high number of students. For this reason, schools tend to admit students for the sake of attracting funding irrespective of whether they are interested or motivated to learn agriculture.

In India, agricultural education is esteemed for its significance in promoting economic development, food security and sustainability (Jibran et al., 2020). Nonetheless, Hedge and Lokanadhareddy (2019) observed the need for immediate measures to be put in place to boost the overall quality of agriculture education in India. These

included change in approach, transparency, accountability, governance, control and financial sustainability. Such recommendations come against the background of government commitment to introduce wide-ranging reforms. These reforms help to improve the quality of agricultural education, noting that quantitative expansion only could not translate to the desired outcomes in a constantly evolving domestic and global setup (Gautam, 2018).

Many education systems have agriculture as a mandatory subject at both primary and secondary school levels. This demonstrates the critical role of agricultural education in society, therefore, the need for governments and education ministries to change their pedagogical approaches to its teaching. This will make learning institutions to continuously produce graduates with skills requisite for promoting economic and sustainable development (Waruru**,** 2021). According to Bosompen and Numo (2017), stakeholders in the Ghanaian education sector have repeatedly raised concerns following exclusion of agricultural science as an examinable subject in the country. Most of those sampled in this study registered their disapproval of the abolition, with the study recommending that the action needed to be revisited.

In Kenya, Konyango and Onyango (2018), argue that most curriculum reforms aimed at innovations though school agricultural education have to date remained elusive. The authors suggest that more needs to be done in policy monitoring and better implementation mechanisms as a way of ensuring effective policy interpretation and implementation. A lot of attention is emphasized in agricultural education as it is among the key drivers of economic growth towards realization of Kenya Vision 2030 as conveyed in Government of Kenya (GOK) (2010). Learning agricultural education in Kenyan schools remains optional, suggesting that it ranks lower than other mandatory subjects such as mathematics.

Agricultural education is facing challenges and the subsequent students academic achievement (Kisirikoi & Malusu, 2008). Such challenges include; the state of teaching and learning resources such as libraries, farm structures, textbooks, laboratories, classrooms and school farm (Ogweno, 2015). Students perceive agriculture as an important subject not only to themselves but also to their institutions

and the community at large as the knowledge and skills they gain are critical in overall development of the nation (Ongang'a et al., 2020). According to Shikanga et al. (2022), teacher characteristics are among significant predictors of students' enrolment in agriculture in Kenya. The study noted that teaching strategy was a among key teacher characteristics which influence students' enrolment in agriculture.

2.2 Conventional Teaching Strategy

Conventional Teaching Strategy is illustrated as a teacher-directed instructional strategy (Tularam & Machisella, 2018). Students learn by sitting and listening to their teacher, with the primary responsibility of the teacher being to facilitate learners acquisition of knowledge and skills and assess on students (Tularam & Machisella, 2018). As a direct instructional strategy, conventional teaching strategy entails straight forward teaching techniques in which the teacher is at the front of the class to to impart knowledge and skills to students (Tularam & Machisella, 2018). According to Ordu (2021) in conventional teaching strategy, teachers make use of a variety of teaching resources such as textbooks, blackboards, charts, science laboratory apparatus, dramatization, storytelling among others.

Some of the existing research indicates that conventional teaching strategy has been successfully used to teach agriculture and other subjects in many places around the world (Gmax, 2022). According to Zakirman et al. (2018), experiences in learning institutions in Serbia, Bosnia and Herzegovina established that implementation of Conventional Teaching Strategy and specifically reliance on lecture methods in teaching agriculture can be useful in terms of efficiency and time saving since a significant amount of information can be delivered to many students within a short duration. However, this strategy is prone to several shortcomings such as reduced multiple perception, passivity of students and monotony, generally resulting in loss of concentration, forgetfulness and the likelihood of missing out on important information.

Educational leaders have persistently advocated for the continued use of conventional teaching strategies. However, some researchers have argued tat conventional teaching strategies are not effective in providing valuable skills to learners. Some have even

gone to the extent of claiming that the strategy may not help retain students' knowledge after examinations (Tularam & Machisella, 2018). However, proponents of conventional teaching strategies believe that the strategy has been successful in enhancing students' academic achievement. In addition, great scientists, mathematicians, and economists are known to have positively changed the course of human lives and have all been products of Conventional teacher-oriented instructional strategies (Abah**,** 2020).

There has been debate as to whether some conventional teaching strategies are more effective than others. It has been argued that various strategies for teaching agriculture such as lectures, demonstrations, discussions and field trips among others serve as different tools for students with varied abilities (Damiani et al., 2021). In India Tularam and Machisella (2018), carried out a study which compared effectiveness of the lecture and discussion teaching methods. The experiment showed that the discussion strategy was more effective compared to the lecture strategy and was found to increase students' knowledge due to an increased level of participation. Lecture strategy is seen as the most used in teaching agriculture. However, students have been found to give greater preference to field trips as opposed to lectures (Nzomo, 2020).

Field trips are described as forms of experiential learning strategy through which students are allowed to learn through the integration of outside experiences into their course (Campbell & Gedat, 2021). Field trips have also been termed as learning experiences for students in interactive locations tailored for educational purposes outside the typical classrooms (Latipah et al., 2019). Students who participate in field trips have been found to develop a greater interest in science subjects such as agriculture. However, field trips face challenges such as transportation costs and time constraints as well as difficulties in controlling students (Campbell & Gedat, 2021). Moreover, agricultural science teacher education programmes do not adequately equip preservice teachers on how to conduct field trips (Njura et al., 2020).

Teaching agriculture through demonstrations has however been recommended as a strategy that makes it possible to teach skills in a variety of steps. This is because demonstrations have been found to promote students' engagement and active

participation (Damiani et al., 2021). When teaching through demonstrations, teachers demonstrate to the students what they need to do from one stage to the other (Tersoo, 2017). Demonstrations may take the form of charts, diagrams as well as any other demonstrative materials used together with oral narrations (Damiani et al., 2021). According to Njura (2020) in the context of agricultural education, demonstrations may include tree grafting, milking using a machine and fish preservation techniques among others.

However, according to Damiani et al. (2021), when using demonstrations for teaching agriculture instructors should fully explain the process without rushing and allow students sufficient time to practice and complete the tasks. Generally, the most frequently utilized conventional methods of teaching agriculture rae class projects, lectures, discussions, field trips, demonstrations and problem-solving (Njura et al., 2020). Nonetheless, some studies have shown that the demonstrations method can be problematic as it requires extra effort from the teacher and is not appropriate for all learning situations (Tersoo, 2017).

2.3 Cooperative Teaching Strategy

Cooperative teaching strategy has been around for more than eight decades (Johnson & Johnson, 2021). Its inception is perceived to be before World War II. During this period, social theorists among them Shaw, Allport and Mead started introducing cooperative teaching theory following the discovery that working in groups was more productive and effective than working individually (Lombardi, 2021). However, the concept started to be fully embraced in 1937 after psychologists May and Doob reviewed the principles of cooperative and collaborative theory and established that collaboration and working in groups towards shared goals made people more successful (Pappas, 2014).

CTS is an instructional strategy is not only about putting students in groups but it requires teachers to structure students in a manner that builds interdependence among them (Lombardi, 2021). According to Baloche and Brody (2017), this objective is achieved through several key principles that distinguish cooperative teaching strategy from others. The authors put forward five key elements that distinguish cooperative

teaching from other instructional strategies. These include positive independence, individual accountability, face-to-face interraction, also known as promotive interaction, interpersonal and small group social skills and group processing (Science Education Resource Center [SERC], 2023).

By integrating the components of cooperative teaching strategy in their instructional procedures, teachers have discovered greater achievement in all students due to the benefits gained through group work. Students also achieve additional benefits, such as increased motivation, self-esteem and enhanced acceptance as well as respect for others (Tran & Lewi, 2012). It has been established that the participatory process and cooperative teaching strategy produce learning activities that fit the needs of students (Nataliningsih, 2017). There is evidence that group work or learning in groups which is a foundational principle for cooperative teaching strategy serves as an incentive for students to learn (Johnson & Johnson, 2018).

According to Tran (2019), there are numerous benefits to learning collaboratively which are consistent in all students from pre-school age to college level. The scholar argues that when students work interactively with others, they hae the benefit of learning various skills including sharing ideas, solving problems, making inquiries, clarifying differences and building new understandings among others (Happe & Marchewka, 2022). According to Appavoo et al. (2019), it is not well documented as to what takes place in groups and what factors influence academic achievement in students. Nevertheless, while there is plenty of research regarding the relationship between cooperative teaching strategy and general educational achievement, little seems to have been done on the learning strategy's usefulness in agriculture academic achievement.

2.4.1 Students' Academic Achievement in Agriculture

Academic achievement represents learning outcomes that show the level of scores by a student following the completion of specific goals that were the focus of instructional processes (Barowski, 2021). Students academic achievement in agriculture has been termed as a fundamental component for preparing young people for occupational success and economic development (Onanuga et al., 2020). Studies

indicate that students' academic achievement in agriculture, depends on several factors, including appropriate teaching strategies, quality of instructional delivery and teachers' training (Njura et al., 2020).

According to Samosa (2021) CTS plays a pivotal role in improving students' achievement in various subjects like Mathematics, Biology among others. Besides, the skills that students develop while cooperating with peers are superior to those that are developed from conventional strategy or working independently. Research by Prieto-Saborit et al. (2022) in Spain, showed that students' achievement in mathematics was high when they were taught using cooperative teaching strategy. The study noted that CTS enhanced achievement because it involved interpersonal work and most students felt more confortable solving mathematical problems in small groups rather than the whole class.

Research by Evans (2018) in USA established whether CTS enhanced social studies achievement in high schools. A total of 46 10^{th} grade students enrolled in high school social studies classes were involved in the study. The study noted that there was significant improvement in the academic achievement of students who were taught using the cooperative teaching strategy. Although the study shows that the teaching strategy positively impacts on students' achievement in social studies, it did not indicate whether similar success would be achieved in a technical subject like agriculture. Further, the study did not examine gender differences in achievement and motivation. This knowledge gap justifies the current study.

Ullah et al. (2018) analyzed the impact of peer tutoring on high school students' achievement in biology using a sample of 40 learners. The results indicated the mean score obtained by the experimental group was higher than that of the control group. that the average mean score of the experimental group was better than that of the control group. This is an indication that peer tutoring strategy and engagement of students in group discussions can improve students' academic achievement. Although this study provides an invaluable insight about the benefits of peers tutoring, the sample was too small and the outcome may not be generalized to the area of study.In addition, the study investigated the effect of cooperative teaching strategy on students'

achievement in biology not agriculture. This therefore, creates a need for a similar study in Kirinyaga-East Sub-County which focuses on achievement in agriculture and also factors in the aspect of gender.

Jirba et al. (2018) carried out a study in Makurdi local authority, Benue State, Nigeria which invesgitated the influence of peer collaboration learning strategy on pupils achievement in basic science. The study sample comprised of 128 pupils from 6 basic school levels. The study employed the quasi-experimental research design with pre and posttest. The study results showed that cooperative teaching strategy improved pupils' academic achievement in basic sciences better than the demonstration strategy. The difference in the mean scores of the two groups was also statistically significant in favour of pupils exposed peer collaboration strategy. This study was conducted in primary schools, its findings cannot be used to address issues related to secondary school agriculture. This called for the current study which examined the effect of CTS at high school level using a larger sample of 186 Form two agriculture students.

In Ethiopia, Eshetu et al. (2017), examined the impact of CTS on students achievement in physics. Two groups of students each from levels 9 and 10 were randomly picked from Robe Galema high school. The findings revealed that experimentals groups in each grade outperformed their peers who were taught using conventional methods. The findings also showed that CTS was effective in boosting achivement of low performares. Although the study showed the effectiveness of this teaching strategy, it was focused on physics students and further investigations were necessary to agriculture students. The study only dealt with cooperative teaching. It used two groups of students who were randomly sampled without clearly indicating how the subjects were assigned to groups. The idea of gender difference was not shown. Which prompted for a study to fill the said knowledge gap.

In Kenya, Waiganjo et al. (2014) investigated the impact of cooperative teaching strategy on students academic achievement in agriculture among high schools in Nakuru Sub-County. A total of 154 form one students were involved in the study. The study results showed better academic achievement in agriculture for students where

cooperative teaching strategy was used. The use of cooperative teaching strategy enhanced learning of agriculture subject and the stakeholders endorsed its utilization in teaching high school agriculture subject. The study only focused on form one students who could be having less knowledge of the subject matter. More so, the study failed to address the aspect of gender difference in academic achievement.

2.4.2 Gender Difference on Students' Academic Achievement in Agriculture

The study of gender differences in academic achievement continues to generate immense attention among educational researches. According to Jackman et al. (2019), female students tend to do better academically than their male counterparts, and that the behaviour of male students impact their academic achievement. However, research also indicates that gender bias is common in learning environments (Sharma & Parika, 2020). As a result, female students are often overshadowed by their male counterparts particularly in group learning activities as male students are likely to dominate leadership roles, leaving the girls to assume passive roles.

While early research on gender in academic achievement was more concerned with whether the differences in outcomes were caused by biological factors, more recent studies have pointed to the greater effect being within gender roles than biological factors (Buchmann & Edmunds, 2018). Studies have also shown that some strategies of teaching can influence students' academic achievement. A study in Spain by Canabate et al. (2021) examined the effect of cooperative teaching in reducing gender equality and differences in students with immigrant backgrounds. The findings indicated that promotive interaction and positive interdependence helped tackle gender disparity and inequality. Both dimensions of cooperative teaching strategy were found to enhance relationships and social competencies of both boys and girls. The study was however based on general educational achievement, the sample size was also not captured. The study too only focused on cooperative teaching strategy without capturing the idea of a conventional teaching strategy.

Collaborative teaching strategies such as cooperative can be one of the effective ways in addressing gender differences in educational achievement. A study by Baena-Morales (2020) sought to establish differences in perceptions in students after being

exposed to cooperative teaching strategy. The study involved 177 students from Alicante University. The study hypothesized that cooperative teaching strategy would promote social competencies in female students. The findings showed that male students preferred groups to be structured based on activities, while female students preferred them to be stable throughout the learning process and be organized by academic criteria. Overall, the findings indicated that perceptions on usefulness of cooperative teaching strategy of the male students was similar to that of the females. The study however was targeted at university students and focused on their achievement in physical and primary education courses. The study sample size of 177 students was small as compared to the current sample size of 186 form two agriculture students. The level of students was too left out while the current study was very specific on form two agriculture students.

Yaduvanshi and Singh (2018) investigate the effect of CTS and gender on biology learning outcomes in India. The findings revealed that the females posted higher means scores than the male However, gender did not affect achievement of students exposed to cooperative teaching strategy. Even though the findings of the study indicated that genderhad no impact on achievement, they may not be applicable to this study. This is so because the achievement was in biology, not agriculture, it did not indicate the gender comparison of the participating schools nor the research design adopted during the inquiry.

In Nigeria, Akhigbe and Adeyemi (2020), investigated the effect of gender-responsive CTS on science achievement. A sample of 218 students drawn from both mied and single sex sxhools participated in the study. The results indicated statistically significant gender differences in achievement. The study did not show the level at which the students were. The study only dealt with cooperative teaching strategies while the current study was comparing cooperative and convectional teaching strategies. Further the study assessed students' achievement in general science as compared to a technical subject like agriculture creating the knowledge gap which the present study attempted to fill.

Paschal et al. (2020, carried out a study in Tanzania that investigated the role of CTS on attainment of inclusive education in secondary schools. This involved examining students' grades in various subjects including agriculture. The findings indicated that strategies which improving cooperative teaching strategy, such as enough classrooms, providing male and female students equal opportunities to learn all subjects including agriculture, sciences and languages reduces gender inequalities. The study however failed to specifically whether gender of students exposed to CTS affected their achievement . The sample size too was not indicated. A gap that the present study fully addressed.

In Kenya, Waiganjo (2017) investigated the effects of gender on on academic achievement of students exposed to CTS. The study sampled of 154 students were from public schools in Bahati sub county in Nakuru County. The results indicated that the girld who were exposed to CTS recorded a mean score of 49.9 per cent compared to 38.6 per cent for boys who had received instructions through conventional teaching strategy. While the findings showed boys to have improved more in their academic achievement in agriculture, overall, girls were found to have attained higher mean scores than their male counterparts. It was interesting to find out whether similar results can be replicated in Kirinyaga East Sub-County. The study also used a smaller sample of only 154 students while the current one used a large sample size of 186 form two agriculture students. More so, the level of students was not indicated and even the method of sampling.

In a related study, Chebii et al. (2018) investigated the effect of CTS on on students achievement in chemistry in Baringo county. The study also assessed whether gender of students exposed to CTS affected their achievement. The results indicated that an insignificant difference between female and male students exposed to CTS. This study was focused on students'chemistry achievement. The sample size was not indicated and the sampling procedures. Therefore, creating a knowledge gap which the present study focused to address.

2.4.3 Motivation to Learn Agriculture

Derived from the term motive, motivation is illustrated as a process of stimulating an individual to action. It is a key element that offer inspiration, guidance and maintains constructive attitudes towards shared goals (Hancock**,** 2004). Motivation is an essential component for the learning and overall achievement of a student both outside and within the learning environment (Salmi & Thuneberg, 2020). Although motivation can also be influenced by students' character traits, the teaching strategy employed by teachers also plays a critical role in motivating students to learn (Tran, 2019). Research has shown that teaching strategies such as cooperative can increase students' motivation to learn (Slavin, 2011). Cooperative teaching strategy encourages students to learn by developing relational skills and a good mindset while solving tasks collaboratively besided enhancing their academic achievement (Chen, 2018). Moreover, CTS enhances students' motivation by providing them with control over their learning experiences as compared to a conventional one.

Tran (2019) investigated the effect of cooperative teaching strategy on achievement in psychology in Vietnam. The findings indicated that students were motivated and enjoyed learning through collaborative strategy. The results also showed that students' academic achievement improved after exposure to the treatment. However, the study was conducted in a developed country involving students from the tertiary level. The focus of the study was to examine motivation to learn psychology, not agriculture as the current one. Moreover, the study also sampled only 72 students and their education level was not captured. It also focused only on cooperative teaching strategy while the present study was comparing the result from cooperative and conventional teaching strategies.

In Saudi Arabia, Al-Mubireek (2019) determined the effect of CTS on students academic achievement in English. The study involved a sample of 60 students. The results revealed that students taught using CTS were more motivated and out performed their counterparts taught using conventional methods. The results also revealed that the difference in the mean scores of the two groups was statistically significant in favour of the treatment group. The study recommended cooperative teaching strategy to be implemented in all schools to improve students' academic

achievement in mathematics. However, this study utilized a small sample of only 60 students. Also, it used only cooperative teaching strategy without considering the effect of the conventional teaching strategy. The study subject was English while the present study focused in agriculture. Therefore, further investigations were necessary to determine students' differences in motivation to learn agriculture subject as opposed to English subject, which was the purview of the present study.

In Nigeria, Olatunde and Ogunode (2020), explored effective teaching strategies in science education. The study sampled 330 undergraduate and college students in science education. The findings indicated that undergraduate students liked and were motivated to learn when different learning and teaching strategies were used in Science Education. The study generalized the scope of teaching strategy and it is difficult to determine which was the best teaching strategy concerning students' motivation. More so, it only dealt with general science education. The current study aimed at establishing the difference in motivation to learn agriculture between students exposed to CTS and those taught using conventional methods in secondary schools.

In Rwanda, Byusa et al. (2020), investigated the benefits of utilizing cooperative teaching strategy in teaching chemistry subjects among learners. The study involved 125 respondents and the findings indicated that teaching through cooperative strategy to some extent motivated students to learn and enhanced their academic achievement. However, the study and a small sample size of 125 students. It did not show the differences in motivation to learn between girls and boys. And it only focused on cooperative teaching strategy in chemistry subjects. It was therefore important to conduct another study to fill the said knowledge gaps.

Nyabiosi et al. (2017) examined the effects of CTS on high school students' motivation to learn Kiswahili subject in Kisii sub-county. The study involved 4 public schools from which a sample of 160 forn two students were drawn. The findings revealed that use of CTS improved students motivation to learn Kiswahili subject. However, the study did not expressively compare cooperative teaching strategy with

the conventional teaching strategy and how the latter affects students motivation to learn Kiswahili. The current study was meant to fill this knowledge gap.

2.4.4 Gender Difference on Students' Motivation to Learn Agriculture

While there are some exceptions, research indicates that girls and boys differ in conventional stereotypes thus influencing the dissimilarity of behaviour for both genders in the learning environment (Koineg, 2018). According to Nduagbo (2020) the difference in class academic achievement between boys and girls is attributed to specific physical behaviour styles of social interactions, choices, academic motivation and the type of teaching strategy teachers employ in content delivery.

In Israel, Daher et al. (2021) examine students motivation to learn science subjects by gender. The study adopted a moderation model and targeted students from both primary and secondary schools. The result indicated gendet was not a significant predictor of students motivation to learn sciences, which included agriculture. It was suggested that the teaching strategy ought to be broad to fit both genders in the learning of science and agriculture. The study used the moderation model while the current study focused on Solomon Four Group-Design. The study too failed to highlight the comparison between cooperative and convectional teaching strategies towards gender differences in motivation. However, a need for more research to fill these knowledge gaps.

In Canada, Seskus **(**2018) notes that even though a lot of attention had been directed towards education of the youth, only a few studies have examined their experiences in agriculture by gender. The study however found that there was a growing visibility of female students in agriculture. The study found that nearly 60 per cent of Canadian students in agriculture were female, implying that the number of female students enrolling in agriculture has been on the rise. The study however was based on gender and motivation to learn agriculture in the rural community and not in a secondary school setting.

According to Farah et al. (2021), female students tend to avoid agriculture at higher education in Pakistan, as it is perceived to be hard. Mehmood et al. (2018) noted the

number of female enrolled in all disciplines have been rising substantially, except in agriculture. These findings are however based on statistics on students' motivation to learn agriculture in higher education institutions. More so, these studies did not address aspects of the instructional strategy used in teaching. In addition, the studies did not compare tudents motivation by gender. The said knowledge gaps called for the current study to bridge them.

Darko's **(**2016) study in Ghana explored the effect of gender towards students' motive to agriculture in senior high schools. The study found that gender did not affect students' interest in learning agricultureIt also found that the difference in motivation to learn agriculture between the male and female students was not significant. The study did not specify or even compare the instructional strategy used in content delivery. In addition, even though samples were drawn from senior high school, those institutions used different education systems and the study failed to indicate the exact level of students who participated in the study. Further, the study was conducted in West Africa and its outcomes could not be generalised for the area of the present study given the cross-cultural differences.

In Botswana, Bulala and Malima (2019), investigated the effect of gender on achievement in agriculture among primary school learners. The study found that interest to learn agriculture among the girls was higher than that of the boys. It also established that the difference interest to learn agriculture between the two groups was significant. However, factors that led to the differences were not expressly revealed. Further, the study was carried out in primary schools, hence the need for the current one which was carried out in secondary schools.

In Tharaka Nithi county, Kenya, Muchiri (2018) investigated students motivation to learn agriculture by gender. The study sampled 327 male and female form one students from selected schools and used Agriculture Motivational Questionnaire. The findings revealed that the mean score of the males was significantly higher that that of the females. This means that male students were more motivated to learn agriculture compared to their female counterparts. The study however sampled form one students, whereas the present study sampled form two students, who are more mature

and exposed to learning and testing. The study only focused on motivation while the present study addressed both motivation and academic achievement.

2.5 Theoretical Framework

Two theories, namely, the Social Interdependence and Collaborative learning guided this study.

2.5.1 Social Interdependence Theory

This is a psychological theory from the Gestalt School that is traced to the work of Kurt Koffka in the early 1900s. Koffa (1935 considered groups as dynamic wholes with varied interdependents among the individual members.. According to Smith et al. (2007), interdependence is the essence of the group, having been generated through the common goals of the individual members. He further proposed that the outcomes of a groups' interdependence make the group a dynamic whole.

According to Butera and Buchs (2019), social interdependence occurs through sharing of common goals by individual members of a group. In Social interdependence theory, interpersonal relationships are expressed through social interdependence, exemplifying the process through which individuals working together in groups influence one another's abilities towards the attainment of shared goals (Tran, 2019). Social interdependence theory is premised on the understanding that it is how goals are structured that dictates the mode of interactions among the individuals, which subsequently shapes and produces the outcomes. Smilarly in CTS, students are given tasks and work in small heterogenous groups that are structured in such each member learns (Donovan et al., 2018).

This theory claims that there are two forms of social interdependence. The two are possitive or coorperative interdependence and negative or competitive interdependence . The theory assumes that positive interdependence occurs through positive relationships among individual members' aspirations to attain their goals (Garrote et al., 2017). The theory recognizes that positive interdependence occurs on individuals' understanding that they cannot attain their goals unless the individual students they are interacting with achieve theirs.

Ryzin and Roseth (2018), affirm that positive interdependence has led to positive changes in students towards academic achievement through peer support, interpersonal interraction and liking others' views. Negative interdependence on the other hand develops from negative or conflicting relationships among individual members' aspirations to achieve their individual goals. In essence, negative interdependence occurs if individual members feel that their goals can be achieved only if the persons they are interacting with competitively fail to achieve theirs. It is proved that cooperation or positive interdependence takes place if people work together to achieve their shared goals (Baloche & Brody, 2017). On the contrary, competition sets in if people work against each other. Each of the forms of social interdependence depends on the structuring of the situation at hand (Butera & Buchs, 2019).

If goals are structured competitively, individuals become competitive and individualistic and pursue individual goals. If goals are structured cooperatively, individual members work together cooperatively to achieve their shared goals (Tran, 2019). Social interdependence theory underpins the principles of cooperative teaching in the sense that teamwork is more productive than working alone. Tran (2019) also added that students are expected to work together in groups through interdependence and cooperation. The theory supports the fact that having students of different levels of achievement and studying cooperatively in groups and integrating instructional models that promote positive interdependence can be helpful for learning experiences (Butera & Buchs, 2019). Thus, students who receive their instructions through cooperative teaching are expected to achieve their shared goals in agriculture among others.

The implication of this theory in the teaching process is that which makes learning student-centred rather than teacher-centred. It helps the students to socialise with each other to gain experience from others when learning agriculture. It goes along with activity theory in the sense that students become more active during the learning process. This helps the students to have high understanding, motivation, lower anxiety and equally participate in agriculture lessons. Social interdependence theory supports

cooperative teaching in that it takes the main aim of achieving a specific goal by each group member inside the classroom that makes every individual strong in the skills or the lesson which they study.

2.5.2 Collaborative Learning Theory

Collaborative learning theory by Vygotsky (1962) is linked to the philosophies of Soviet psychologist, Lev Vygotsky published in a work titles Zone of Proximal Development. This work by Vygotsky (1062) underscored the importance of social relations, interactions and communications as the process of learning achievement. The collaborative theory of learning propagates the idea of students' ability to learn from each other through close interactions aimed at solving problems, being inventive, completing tasks and sharing ideas. According to Zabolotna et al. (2023), students' knowledge is got through active construction of ideas with the help of others in the group. The learning theory entails interactive learning among peers to foster deeper thinking in the learning environment (Sounders & Wong, 2020). More so, students' ability is developed through interaction with others.

Tran (2019) urged students working together in groups or pairs get to tap into each other's abilities, foster deeper thinking, build self-esteem and improve interpersonal skills. Vygotsky (1962) theorised that interactive classroom processes such as discussions, feedback and collaboration with peers provide students with opportunities to fully exploit their learning abilities. The importance of interaction and collaboration among peers as well as teachers who play a key role as experts in structuring goals and learning activities that maximise students' learning potential (Le et al., 2019).

Vygotsky further suggests that culture is an important and fundamental element in shaping the attainment of knowledge. The theory recognizes that individuals gain knowledge through a cultural perspective by cooperating and bench marking with others as well as conforming to the standards, abilities and skills as dictated by their culture (Garrotte et al., 2017). Vygotsky (1962) believes that collaboration and cooperation provide learners with a certain level of control, which is a great factor in motivating students to do and achieve more in learning (Davidson & Major, 2014).

Such motivated and empowered students are expected to achieve more in the classroom including achieving better in a subject like agriculture.

Vygotsky **(**1978) suggested social interactions as a powerful tool for language development. He perceived language as one of the greatest tools that individuals can use to communicate with those around them and the outside world. In a learning environment, he perceived that language plays a key role in shaping cultural activities such as reading and writing as well as fostering good reasoning and thinking. The theory recognizes the need for teachers to promote meaningful interactions among the students by encouraging purposeful and meaningful discussions that improves the ideas and skills of each learner for greater understanding (Barkley et al., 2014). According to Leeuwen & Janssen (2019), teachers' guidance for group work which includes prompting, modelling and praising enhances the success of group processing.

Essentially, the theory recognises that learning is a continuous process that cannot be detached from social context. Further, there is a need for teaching strategies that encourage the distribution of knowledge and motivate students to achieve more through collaboratively and cooperatively working with peers, sharing ideas and performing towards achieving shared goals (Rudnitsky et al., 2017). The theory was deemed appropriate for the study as it supports the idea of social relations, positive interactions and cooperation among students toward greater achievement in learning **(**Zambrano et al., 2019). The theory is also suitable for the study as it recognises that through collaboration and cooperation among peers, students develop some control in learning and get to learn from others, thus motivating them to do more towards the shared goals (Tran, 2019).

Additionally, the implication of this theory in the study is that it is a promoting key to student skills such as critical thinking and communication. Students find collaborative work highly motivating in academic fields. When students are challenged by others, this improves their classroom experience and the relationship they form with fellow students. Therefore, collaborative strategy is realizing that no student is an island and that we all have a lot to learn from each other by working together.

2.6 Conceptual Framework

A conceptual framework illustrates in diagrammatic form the interactions, associations or relationships among the variables of a research. The conceptual framework of this study is displayed in Figure 1.

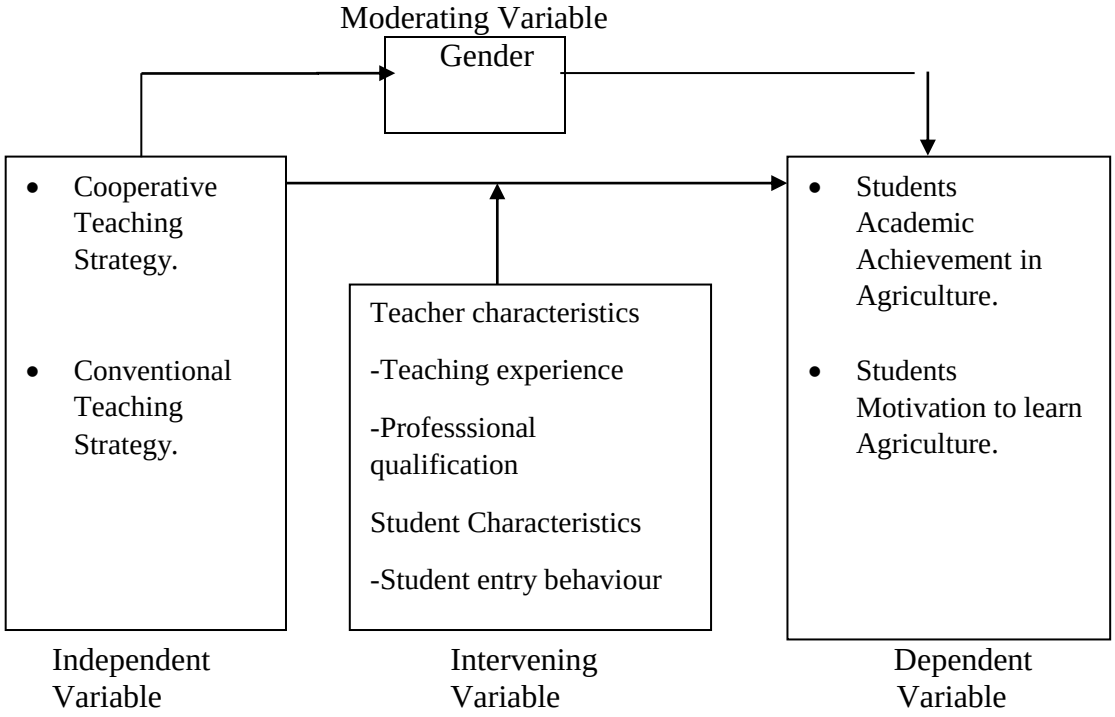

Figure 1: Conceptual Framework showing the Interaction between Cooperative Teaching Strategy, Conventional Teaching Strategy, Achievement and Motivation.

The study's independent variables were teaching strategies which comprised of cooperative teaching and conventional teaching strategy. The dependent variables were achievement and motivation to learn agriculture. The intervening variables were teachers' and students' characteristics while gender was the moderating variable. The study presupposes that conventional teaching and cooperative teaching strategies as the study's independent variable that influence academic achievement and motivation to learn agriculture. Gender may have an influence on achievement and motivation, as both boys and girls may exhibit different achievement and motivation levels when exposed to different teaching strategies. Teacher characteristics, such as teaching experience and professional qualification, may affect the dependent variables. To address this in the study, only trained agriculture teachers with atleast a Diploma and three years of teaching experience were involved in the study. Students'

characteristics, such as entry behavior may influence motivation and academic achievements in agriculture. This was controlled by targets form two students in the 4 county co-education secondary schools. These ensured homogeneity among the groups.

CHAPTER THREE
METHODOLOGY

3.1 Location of the Study

The study was carried out in Kirinyaga East sub-county, Kenya. Kirinyaga East Sub-County is in Kirinyaga County which is one of the 47 counties in Kenya. Kirinyaga County is in the central part of Kenya bordering Mount Kenya. The county lies between 1,158 and 5,380 metres above sea level in the south and at the peak of Mt. Kenya respectively. Kirinyaga County lies on the following coordinates, 37’20’0 E, 37’30’0 and 0’400’S. Kirinyaga County borders with Embu and Nyeri County. The Sub-County has variety of schools including; Sub-County, County, extra-County and

national schools. These schools are mixed and single gender. The location was chosen because students achievement in agriculture in national examinations in the Sub-County has been unsatisfactory (KNEC, 2022).

3.2 Research Design

The study utilized quasi-experimental research design specifically Solomon Four Group-Design. Quasi-experimental does not rely on random assignment of subjects to either control or treatment conditions. Instead, subjects are assigned to groups based on non-random criteria (Zubair, 2023). The design aimed to establish a cause-and-effect relationship between independent and dependent variables. Quasi-experimental design was applicable since it allowed the use of already constituted classes. In Quasiexperimental design the research participants are not randomly assigned to experimental and control groups. The researcher works with the existing intact classes.

Quasi-experimental design helped the researcher to have a complete control over the variables and also check the effects of pre-test on the results (Campbell, 1979). Solomon Four Group-Design purposes on achieving four main goals namely; to asses the effect of pre-test relative to non pre-test, to evaluate the intervention between pre-test and treatment condition, to asses the effect of experimental treatment relative to control condition and to asses the uniformity of the groups before administration of treatment (Zubair, 2023). The design also helped the researcher to control threats to external validity such as pre-test sensitization by ensuring that the pre-test did not influence the outcome of the post-test unless in the presence of the treatment. According to Shuttleworth (2009) Solomon Four Group-Design involves two experimental groups and two control groups.

Figure 2: Solomon Four Group-Design.

Groups	Pre-test	Treatment	Post-test
Experimental Group (E1)	01	X	02
Control Group (C1)	03	-	04
Experimental Group (E2)	-	X	05
Control Group (C2)	-	-	06

Solomon Four-Group Design

Where;

01 and 03:	Pre-test
02, 04, 05 and 06:	Post-test
X:	Treatment

Experimental group (E1) was group (1) which received pre-test (01), treatment (X) and post-test (02). Control group (C1) was group (2) which received pre-test (03) and post-test (04). Experimental group (E2) was group (3) which received treatment (X) and post-test (05). Control group (C2) was group (4) which received only post-test (06). Students in group one and three were exposed to cooperative teaching while those in group two and four were exposed to conventional teaching. In the treatment conditions, one group was pre-tested (E1) and the other one was not (E2). In the control conditions, one group was pre-tested (C1) and the other one was not (C2).

3.3 Target Population

The study targeted co-educational secondary schools in Kirinyaga East Sub-County. The study location had 37 secondary schools. The target population was 3570 form two students. The accessible population was 186 form two students in co-educational secondary schools. Co-educational secondary schools were chosen to ensure that male and female students were involved in the study since gender was part of it. The form twos were selected because the study focused on the topic, Soil fertility II (Inorganic fertilizers), which is taught in form two.

3.4 Sample Size and Sampling Procedure

A sample size is a subset of the total population that is used to give the general insights into the target population (Kothari**,** 2004). Kirinyaga East Sub-County has a total of 37 secondary schools of which 26 are co-educational and 11 are non-coeducational. Out of the 26 co-educational secondary schools, 15 are county secondary schools. Purposive sampling was employed when selecting county co-educational secondary schools to ensure that both gender is represented. Simple random sampling was used to select four co-educational secondary schools. The

number of students per group was, E1=45, E2=48, C1=46 and C2=47. Following the Solomon Four Group-Design, four groups were required, therefore, each school constituted a group. Simple random sampling was employed when assigning the selected schools to either control or experimental group.

A sample size of 186 students participated in the study. This number was considered adequate for the study because according to Mugenda and Mugenda (2003) the required sample size per group is at least 30 cases for experimental research. In instances where a school had more than one stream taking agriculture, all the streams were taught using the same strategy but only one stream was considered for analysis.

3.5 Research Instruments

The researcher used two research instruments to collect data. Agriculture Motivation Questionnaire (AMQ) to measure students' motivation to learn agriculture and Agriculture Achievement Test (AAT) to measure students' academic achievement in agriculture.

3.5.1 Agriculture Motivation Questionnaire (AMQ)

Agriculture motivation questionnaire was developed to measure students' motivation to learn agriculture in secondary schools. The questionnaire comprised of 25 items. The items were scored through five levels of the Likert scale, ranging from 5. Strongly Agree = SA, 4. Agree = A, 3. Undecided = U, 2. Disagree = D and 1. Strongly Disagree SD. The responses were used to obtain information on students' motivation towards Agriculture. The AMQ was developed from Science Motivation Questionnaire (SMQ) designed by Glynn et al. (2009). The items were modified to suit agriculture subject.

3.5.2 Agriculture Achievement Test (AAT)

The AAT comprised of short answer and structured questions. The test had seven items with a total of 30 marks and was done in forty-five minutes. The objective of the test was to access students understanding of agriculture concept before and after treatment. A table of specification was used to develop test items to ensure that all items were adequately balanced in terms of knowledge and skills meant to be

assessed. Items were developed from what the students had learnt during the study period. Soil Fertility II (Inorganic fertilizers) formed the study topic.

3.6 Pilot Study

Pilot study was necessary in identify potential confounding variables that were not previously known and also assessing whether the research protocal is realistic and workable. It also helped to evaluate the strength of relationships among key variables to aid in the calculation of sample size (Polit & Beck, 2017). Piloting was done in Kirinyaga-Central Sub-County, as the Sub-County has similar characteristics with Kirinyaga East Sub-County. According to whitehead *et al (*2016*)* the number of participants used for the pilot study should be 10 % of the sample size. Therefore forty five form two students were involved in the study. Results from the pilot study were used to estimate the reliability of the instruments.

3.6.1 Validity of the Study

Validity is the degree of accuracy achieved by the instruments used within a study (Huck, 2008). The face and content validity of the AAT and AMQ were checked by the supervisors. Taherdoost's (2016) contends that validation should be done by a panel of experts since it involves theoretical assessment, rating suitability of items and evaluating their fitness in defining a construct. The experts examined the instruments to ensure that the items in them addressed the specific objectives of the study, their format, layout and language was appropriate. The recommendations of the experts were used to improve the instruments before they were utilized to gather data.

3.6.2 Reliability of the Study

Reliability tests ensures that the methods used to collect data yields the same results over repeated trials (Mohajan, 2020). The reliability of AAT was estimated using the Kuder Richardson KR 21 formula while that of AMQ was estimated using the Cronbachs' alpha formula. Kuder Richardson 21 was chosen because it is recommended for estimating the reliability of instruments constructed using items that have varying difficulties, are scored as either right or wrong, or whose means can be calculated (Kara & Celikler, 2015). The Cronbachs' alpha method was deemed appropriate because it is ideal for estimating the reliability of instruments constructed

using close-ended Likert-type items (Quansha, 2017). The AAT and AMQ yielded reliability coefficients of 0.742 and 0.811 respectively. They were deemed reliable as their coefficients were above the 0.70 recommended by (Taber, 2018).

3.7 Data Collection Procedures

Data collection was done in first term in the selected co-educational secondary schools. The researcher proceeded to the four co-educational secondary schools to seek permission from the principals and obtain consent from the agriculture teachers. With the aforementioned authorization, the researcher then booked appointments and scheduled training sessions for agriculture teachers and administration of tests and questionnaires to the participants.

Agriculture teachers in the experimental groups were trained for one day on the use of cooperative teaching strategy. The pre-test was administered to two groups, experimental group (E1) and control group (C1) at the start of the programme. Students in experimental groups E1 and E2 were taught using cooperative teaching strategy while those in control groups C1 and C2 were taught using conventional teaching strategy. Post-test was administered to all groups at end of the program.

3.8 Ethical Consideration

The researcher was approved to carry out the study through a letter from the graduate school of Chuka University and a clearance letter from the university's Ethic committee. These documents were then used to obtain a research permit from the National Commission for Science, Technology, and Innovation (NACOSTI). The researcher further sought authorization from the Ministry of Education through the Kirinyaga East Sub-County Education Office, and the office of the Sub-County commissioner.

All the work reported in this study conformed to the laws governing intellectual property, ethical standards and anti-plagiarism. Any texts originating from the works of other authors were duly acknowledged per APA 7th edition referencing guidelines. The researcher sought permission from the school principals before asking the participants to sign an informed consent form. The participants were assured of the

right to privacy and confidentiality. To achieve this, all participants were informed that no part of their information will be shared with others. Participants were also advised not to write their names on the study materials. Consent for students to participate in the study was sought from their teachers. Participation in the study was voluntary and free from any form of coercion. Participants were informed that no form of compensation will be offered as a direct benefit for taking part in the study.

3.9 Data Analysis

The collected data was checked for errors and coded. Both descriptive and inferential statistics were employed in data analysis. Descriptive statistics included mean, percentage and standard deviations which were used in summarizing the data. Analysis of variance (ANOVA), t-test, H-test and U-test were used to check for significant differences between control and experimental groups. ANOVA and H-test were used to test for differences between four groups while t-test and U-test were used to check for differences between two groups. A data file was prepared using the Statistical Package for Social Science (SPSS) version 26 and the coded data keyed into it and computed. Hypotheses were tested at the 0.05 significance level using the t-test, Mann Whitney (U-test), Kruskal Wallis (H-test) and Analysis of Variance (ANOVA) techniques. Before testing the hypotheses, data was screened to ensure that the parametric assumptions such as normality and equality of variance were not violated. A summary of data analysis is presented in Table 3.

Table 3: Summary of Data Analysis

Hypothesis	Independent Variable	Dependent Variable	Statistical Test
H_{01}: There is no statistical significant difference in achievement in agriculture among students exposed to cooperative teaching strategy and those exposed to conventional teaching strategy in secondary schools in Kirinyaga East Sub-county, Kenya.	Cooperative teaching Strategy Conventional teaching strategy	Achievement	ANOVA, t-test
H_{02}: There is no statistical significant difference in motivation to learn agriculture among students exposed to cooperative teaching strategy and those exposed to conventional teaching strategy in secondary schools in Kirinyaga East Sub-County, Kenya.	Cooperative teaching Strategy Conventional teaching Strategy	Motivation	H-test, U-test
H_{03}: There is no statistical significance gender difference in academic achievement in agriculture among students exposed to cooperative teaching strategy in secondary schools in Kirinyaga East Sub-County, Kenya.	Gender	Achievement	t-test
H_{04}: There is no statistical significance gender difference in motivation to learn agriculture among students exposed to cooperative teaching strategy in Secondary schools in kirinyaga East sub-county, Kenya.	Gender	Motivation	U-test

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Students' Demographic Information

This section presents the demographic information about the students who participated in the study. This information is crucial for understanding the characteristics of the respondents and for comparative analysis. The study was conducted in Kirinyaga East Sub-County, Kenya, specifically in co-educational public secondary schools. The distribution of participants by gender is presented in Table 4.

Table 4: Distribution of Participants by Gender

Gender	N	Percentage (%)
Male	104	55.9
Female	82	44.1
Total	186	100.0

The information in Table 4 shows the distribution of students who participated in the study. Male and female students were, 104 (55.5%) and 82 (44.1%) respectively. A total of 186 Form Two students participated in the study. Male students were more than the female students with a difference of 22 students.

4.2 Effect of Cooperative Teaching Strategy on Students' Academic Achievement in Agriculture

Objective one of the study sought to investigate the effect of CTS on students' achievement in Agriculture. In this study, achievement refers to what the student has fully internalized during the learning process, as reflected by the marks attained on the Agriculture Achievement Test (AAT). To assess the students' knowledge in Agriculture before the treatment, a pre-test was administered to Experimental group (E1) and Control group (C1). The pre-test was conducted before the treatment to determine if the students chosen for the study had comparable characteristics.

4.2.1 Agriculture Achievement Test (AAT) Pre-test Mean Scores

The Solomon Four quasi-experimental group-design which was adopted in this study assumes that the sample groups are homogeneous at the point of entry (Zubair, 2023). Pre-test analysis enables a researcher to ascertain whether this assumption is violated.

The pre-test analysis involved Experimental group (E1) and Control group (C1). Results are presented in Table 5.

Table 5: AAT Pre-test Mean Scores for E1 and C1

	Group	N	Mean	Standard Deviation (SD)
Teaching Strategy	E1	45	4.47	2.55
	C1	46	4.37	2.53
Gender	Male	48	4.54	2.53
	Female	43	4.28	2.87

The results in Table 5 above shows that the mean score of E1 (M = 4.47, SD = 2.55) was higher than that (M = 4.37, SD = 2.53) of C1. With regard to gender, male and female students attained a mean of (M = 4.54, SD = 2.53) and (M = 4.28, SD = 2.87) respectively.

The experimental group (E1) had a slightly higher mean score (4.47) compared to the Control group (C1) with a mean score of (4.37). However, the difference is small (0.10 points), suggesting that both groups had similar levels of knowledge in Agriculture before the teaching strategy was implemented. Male students had a higher mean score (4.54) compared to female students (4.28). The standard deviation for female students (2.87) is higher than for male students (2.53), indicating more variability in scores among female students.

The pre-test scores show that both the Experimental and Control groups started with similar levels of achievement in Agriculture. This is important as it supports the assumption of group homogeneity at the point of entry in the Solomon Four quasi-experimental design. The small difference in mean scores (0.10 points) between (E1 and C1) suggests that any subsequent differences in post-test scores can be attributed to the teaching strategy rather than initial differences in knowledge.

The pre-test mean scores for male students were slightly higher than for female students. The higher standard deviation among female students indicates greater variability in pre-test scores within this group compared to male students. The findings suggest that any difference observed in post-test scores between the Experimental and Control groups can be attributed to the teaching strategy rather than

initial differences in knowledge. The variability in pre-test scores among female students might be a factor to consider in the analysis of the study results. An additional analysis using t-test was conducted to test whether the results were statistically significance. Results are presented in Table 6.

Table 6: t-test of Pre-test Mean Scores on AAT for E1 and C1

Scale	Group	N	Mean	SD	df	t-value	p-value
Teaching Strategy	E1	45	4.47	2.55	89	0.189	0.856
	C1	46	4.37	2.53			
Gender	Male	48	4.54	2.20	89	0.492	0.624
	Female	43	4.28	2.87			

The t-test results in Table 6 show that there is no statistically significant difference in the pre-test mean scores between the experimental group (E1) and Control group (C1). t-value = 0.189 indicates a very small difference between the means of E1 and C1. P-value = 0.856 ($p>0.05$) is greater than the typical significance level of 0.05, indicating that the difference observed is not statistically significant.

On the gender, the t-test results show that there is no statistically significant difference in the pre-test mean scores between male and female students. t-value = 0.492 indicates a small difference between the means of male and female students. p-value = 0.624, p-value ($p>0.05$) is greater than 0.05, indicating that the observed difference is not statistically significant.

The non-significant t-value = 0.189 and p-value = 0.856, suggest that the pre-test mean scores between the Experimental and Control groups are similar. This supports the assumption of group homogeneity at the beginning of the study, which is necessary for the validity of the Solomon Four quasi-experimental design. Similarly, the non-significant t-value (0.492) and p-value (0.624), is more than the 0.05 alpha level. This indicate that there is no significant difference in the pre-test mean scores between male and female students. This suggests that both groups started with comparable levels of knowledge in Agriculture. The findings from Table 6 indicate that any difference in post-test scores between the Experimental and Control groups or between male and female students can be attributed to the teaching strategy or other variables, rather than initial differences in knowledge.

To assess the effect of CTS on students' achievement in Agriculture a post-test results analysis for both groups, Experimental group (E1) and Control group (C1) was done. The results are presented in Table 7.

Table 7: Post-test Mean Scores on AAT for E1 and C1

Groups	N	Mean Score	SD
E1	45	11.87	3.94
C1	46	6.04	2.71

The post-test results in Table 7 shows a higher difference in mean scores between Experimental group (E1) and Control group (C1). Experimental group (E1) attained a mean score of 11.87 with a standard deviation of 3.94 while Control group (C1) got a mean score of 6.04 with a standard deviation of 2.71.

The findings shows that the mean score for the Experimental group (E1) after implementing CTS (11.87) is substantially higher than the mean score for the Control group (C1) (6.04). The large difference in mean scores between E1 and C1 suggests that CTS had a significant positive impact on students' achievement in Agriculture.

4.2.2 Mean Gain for E1 and C1

Analysis of gain was conducted to give an insight on the relative effects of treatment on groups that were pre-tested. It gives an indication of changes (increase or decrease) in groups after undergoing treatment and are determined using their pre-test and post-test scores. The achievement in agriculture mean gains of Experimental group (E1) and Control group (C1) are presented in Table 8.

Table 8: AAT Mean Gain for E1 and C1

Group	N	Pre-test	SD	Post-test	SD	Mean Gain
E1	45	4.47	2.55	11.87	3.94	7.40
C1	46	4.37	2.53	6.04	2.71	1.67

Table 8 indicates the mean gain results for Experimental group (E1) and Control group (C1). The mean gain in scores is calculated by subtracting the pre-test mean from the post-test mean. In E1, the mean gain is 7.40 points (11.87 – 4.47) while in C1, the mean gain is 1.67 points (6.04 – 4.37). The Experimental group (E1), which

received Cooperative Teaching Strategies (CTS), shows a much larger mean gain (7.40 points) compared to the Control group (C1) which had a mean gain of (1.67 points). The substantial difference in mean gains between E1 and C1 indicates that CTS had a positive impact on students' achievement in Agriculture. Students in Experimental group (E1) made a much greater improvement in their post-test scores compared to those in Control group (C1). The standard deviations for both groups in the post-test (3.94 for E1 and 2. 71 for C1) indicate the variability in students' scores within each group.

To confirm if this difference is statistically significant, further t-test analysis was conducted. This was to determine whether the difference between the mean gain of Experimental group (E1) and Control group (C1) was statistically significant. The results are presented in Table 9.

Table 9: t-test of Mean Gain on AAT for E1 and C1

Group	N	Mean Gain	SD	df	t-value	p-value
E1	45	7.40	4.41	89	6.741	0.000
C1	46	1.67	3.67			

The t-test results on Table 9 shows a statistically significant difference between the mean gain of Experimental group (E1) and Control group (C1). t-value: 6.741 and P-value = 0.000. P-value ($p<0.05$) is less than the typical significance level of 0.05, indicating that the difference observed is statistically significance.

The significant t-value (6.741) and p-value (0.000) indicates that there is a statistically significant difference in Agriculture Achievement Test (AAT) between E1 and C1. This difference was attributed by the teaching strategy which was given to Experimental group (E1). This ascertain that Cooperative Teaching Strategy is a better strategy in improving students academic achievement.

4.2.3 Post-test Mean Scores for Experimental and Control Groups

At the end of the programme all groups, Experimental group (E1), Experimental group (E2), Control group (C1) and Control group (C2) were given Agriculture

Achievement Test (AAT) post-test. This was to check whether there was a change after E1 and E2 were exposed to CTS. The mean scores are presented in Table 10.

Table 10: AAT Post-test Mean Scores for all Groups

Group	N	Mean Scores	SD
E1	45	11.87	3.94
E2	48	11.27	4.77
C1	46	6.04	2.71
C2	47	6.28	3.35

Table 10 shows the mean scores and standard deviations of the Experimental groups (E1 and E2) and Control groups (C1 and C2). The mean scores and standard deviations for Experimental groups are, E1 (M = 11.87, SD = 3.94) and E2 (M = 11.27, SD = 4.77), mean scores for Control groups are, C1 (M = 6.04, SD = 2.71) and C2 (M = 6.28, SD = 3.35). The mean scores for Experimental groups (E1 and E2) are greatly higher than those of the Control groups (C1 and C2). The Experimental groups (E1 and E2) were exposed to CTS while Control groups (C1 and C2) were not. Therefore, the difference in students' academic achievement in agriculture is attributed to the teaching strategy employed by teachers in the Experimental groups (E1 and E2). These results suggest that CTS is more effective in improving students academic achievement in agriculture.

Additional analysis using ANOVA was conducted to test whether the mean differences were statistically significance. The ANOVA test was used to determine whether there were significant differences among groups E1, C1, E2 and C2. The results of the test are presented in Table 11.

Table 11: ANOVA of AAT Post-test Mean Scores for all Groups

Scale	Sum of Squares	Df	Mean Square	F-ratio	p-value
Between Groups	1364.369	3	454.790	31.810	0.000
Within Groups	2601.996	182	14.297		
Total	3966.366	185			

Table 11 shows that the results of ANOVA test are statistically significant. $F_{3, 182}=31.810$, $p<0.05$). P-value of 0.000 is less than 0.05. This is evidence that there was a significant difference between the mean scores among the four groups. The

ANOVA test results only shows that there was statistically significant differences among the groups, but does not indicate where the differences are (Pallant, 2016). Further analysis using Least Significant Difference (LSD) procedure was done to identify where the differences were. The LSD test results are presented in Table 12.

Table 12: LSD of AAT Post-test Mean Scores between Pair Groups

Pair Groups	Mean Difference	SE	p-value
E1 and E2	0.60	0.78	0.449
E1 and C1	5.82*	0.79	0.000
E1 and C2	5.59*	0.79	0.000
E2 and C1	5.23*	0.78	0.000
E2 and C2	4.99*	0.78	0.000
C1 and C2	-0.23	0.78	0.767

The results in Table 12 shows that there was statistically significant differences between pairs E1 and C1 ($p = 0.000$), E1 and C2 ($p = 0.000$), E2 and C1 ($p = 0.000$) and E2 and C2 ($p = 0.000$). However, the differences between pairs E1 and E2 and C1 and C2 were statistically insignificant. On that ground, H_{01} was rejected, which stated that there is no statistical significant difference in achievement in agriculture among students exposed to CTS and those taught using conventional teaching strategy. This implies a statistically significance difference in academic achievement when students were exposed to CTS.

Further analysis was conducted by examining whether there was a difference in post-test mean scores between the experimental and control groups. The purpose of this analysis was to confirm if significant differences existed between the experimental and control groups. This involved combining the experimental groups (E1 and E2), and comparing their mean scores with that of Control groups (C1 and C2) combined. The t-test was used during the comparison. Results are presented in Table 13.

Table 13: t-test of AAT Post-test Mean Scores for all Groups

Group	N	Mean	SD	df	t-value	p-value
Experimental	93	11.56	4.38	184	9.770	0.000
Control	93	6.16	3.04			

The t-test results shows a statistically significant difference in mean scores between experimental groups (E1 and E2) and Control groups (C1 and C2). t-value 9.770 shows a greater difference in mean scores and p-value =0.000. p-value ($p<0.05$) was less than the typical significance level of 0.05. The results indicate that the differences between these groups are statistically significant in favor of the experimental groups. These findings imply that CTS is more effective in improving students' achievement in agriculture than conventional teaching strategy.

The gain analysis, ANOVA and t-test results showed statistically significant difference in agriculture achievement in favor of the experimental groups. They support the findings of a study by Prieto-Saborit et al. (2022) which demonstrated that CTS boosted students' achievement in mathematics. Achievement was enhanced because solving mathematical problems involved interpersonal work and students felt more comfortable clarifying their thought in small group discussions than the whole class. Ullah et al. (2018), also noted significant improvement in high school students' performance in biology when students were exposed to CTS. The scholars noted that the peer tutoring and engagement of students in group discussions improve their academic achievement.

These results are also in tandem with those of a study in Ethiopia by Eshetu et al. (2017). The results of the study revealed that students exposed to CTS performed better in physics than their peers who were taught using conventional strategy. The results of the study also revealed that CTS was effective in raising academic achievement of low performers. Waiganjo et al. (2014) established that use of cooperative teaching strategy enhanced learning of agriculture subject. The enhanced performance was attributed to the interactive nature of CTS which enables students to take a more active role in the learning process.

These findings indicate that use of CTS enhances students' achievements in agriculture. Moges (2019) noted that teachers and students prefer CTS to lecture method because use of small teams provides learners with opportunities to work together and take advantage of their own and each other's learning. The strategy thus has the potential to boost academic achievement in agriculture in secondary schools

that have been posting poor grades such as those in Kirinyaga East Sub-County. Agriculture teachers should consider blending CTS with other teaching strategies in their endeavor to enhance achievement in the subject.

4.3 Effect of CTS on Students' Motivation Towards' Agriculture

Objective two sought to investigate the effect of Cooperative Teaching Strategy (CTS) on students' motivation to learn agriculture. In this study, motivation refers to the willingness and desire of a student to learn, as reflected by the student choice, effort, persistence and level of achievement in a subject after exposure to a certain teaching strategy. To asses the students' motivation towards' Agriculture, an Agriculture motivationa Questionnaire (AMQ) was administered. Students' motivation to learn Agriculture was measured using a set of 25 closed-ended items in the questionnaire. The respondents indicated the extent of agreement to the items based on a 5 points scale. The scale was; Strongly Disagree (1), Disagree (2), Undecided (3), Agree (4) and Strongly Agree (5). The responses to the items were scored their means computed and transformed into motivation to learn Agriculture overall mean score for the study groups. AMQ was first administered to Experimental group (E1) and Control group (C1). The pre-test was conducted before the treatment to determine if the students chosen for the study had comparable features.

4.3.1. Pre-test Results on Students' Motivation towards Agriculture

The Solomon Four quasi-experimental group research design which was adopted in this study assumes that the sample groups are homogeneous at the point of entry (Zubair, 2023). Pre-test analysis enables the researcher to ascertain whether this assumption is violated. The pre-test analysis involved Experimental group (E1) and Control group (C1). The results are presented in Table 14.

Table 14: Pre-test Results on AMQ for E1 and C1

Scale	Group	N	Mean Rank
Teaching Strategy	E1	45	45.79
	C1	46	46.21
Gender	Male	48	49.72
	Female	43	41.85

The results in Table 14 above shows that the Mean Rank of E1 (M = 45.79), was lower than that of C1 (M = 46.21). With regard to gender, male and female students attained a Mean Rank of (M = 49.72) and (M = 41.85), respectively.

The experimental group (E1) had a slightly lower Mean Rank (45.79) compared to the Control group (C1) with a Mean Rank of 46.21). However, the difference is small (0.42 points), suggesting that both groups had similar levels of motivation before the teaching strategy was implemented. With regard to gender, male students had a higher Mean Rank (49.72) compared to female students (41.85). A difference of (7.87 points)

The pre-test Mean Rank shows that both the Experimental group (E1) and Control groups (C1) started with similar levels of motivation to learn Agriculture. This is important as it supports the assumption of groups homogeneity at the point of entry in the Solomon Four quasi-experimental design. The difference in Mean Rank for (E1 and C1) was (0.42 points) while that of male and female students was (7.87 points) suggests that any subsequent differences in post-test scores can be attributed to the teaching strategy or other variables rather than initial differences in knowledge.

To check whether the difference in the Mean was statistically significant, further analysis was conducted using Mann-Whitney U-test. The results are presented in Table 15.

Table 15: U-test of AMQ Pre-test Results for E1 and C1

Scale	Group	N	Mean Rank	U-value	P-value
Teaching Strategy	E1	45	45.79	1025.500	0.940
	C1	46	46.21		
Gender	Male	48	49.72	853.500	0.156
	Female	43	41.85		

The U-test results in Table 15 show that there is no statistically significant difference in the pre-test Mean Rank between the experimental group (E1) and Control group (C1). U-value =1025.500 and p-value = .940. P-value ($p>0.05$) is greater than the typical significance level of .05. The results suggest that the pre-test Mean Rank between the Experimental and Control groups are similar. This supports the

assumption of groups being homogeneous at the beginning of the study, which is necessary for the validity of the Solomon Four quasi-experimental design.

On the side of gender, the non-significant U-value = 853.500 and p-value =0.156). p-value ($p>0.05$) is greater than the significance level of .05, indicate that there is no significant difference in the pre-test Mean Rank between male and female students. This suggests that both groups started with comparable levels of knowledge in motivation to learn Agriculture. Hence suitable for the study. The findings from Table 15 indicate that any difference in post-test scores between the Experimental and Control groups or between male and female students can be attributed to the teaching strategy or other variables, rather than initial differences in knowledge.

4.3.2 Post-test Mean for E1 and C1

To assess the effect of CTS on students' motivation to learn Agriculture a post-test was conducted. Results for both groups, Experimental group (E1) and Control group (C1) were analysed and presented in Table 16.

Table 16: Post-test Mean Rank for E1 and C1

Group	N	Mean Rank
E1	45	86.18
C1	46	94.27

Table 16 above presents post-test results for Experimental group (E1) and Control group (C1). C1 attained a higher Mean Rank of 94.27 than E1 which had 86.18. The difference in the Mean Rank between the two groups was (8.09 points). This imply that the two groups indicated some improvement in motivation irrespective of teaching strategy employed.

4.3.3 Mean Gain for E1 and C1

Analysis of gain was conducted to give an insight on the relative effects of treatment on groups that were pre-tested. It gives an indication of changes (increase or decrease) in groups after undergoing treatment and are determined using the pre-test and post-test scores. The students motivation to learn agriculture mean gains of Experimental group (E1) and Control group (C1) are presented in Table 17.

Table 17: AMQ Mean Gain for E1 and C1

Group	Pre-test Mean	Post-test Mean	Mean Gain
E1 (n=45)	45.79	86.18	40.39
C1 (n=46)	46.21	94.27	48.06

Table 17 indicates the mean gain results for Experimental group (E1) and Control group (C1). The mean gain is the difference in pre-test mean and the post-test mean. In E1, the mean gain is 40.39 points (86.18 – 45.79) while in C1, the mean gain is 48.06 points (94.27 – 46.21). The difference between the Experimental group (E1), which received treatment and the Control group (C1) which did not receive the treatment was 7.67 points (48.06 – 40.39). Basically the two groups showed an improvement in the post-test results irrespective of the teaching strategy employed. This therefore, suggest that, there other variables like time factor, school environment among others which affect students motivation to learn.

To ascertain if the difference was statistically significance, the Mann-Whitney U-test was conducted to find out if the difference between the Rank gain of E1 and C1 was statistically significant. Results are presented in Table 18.

Table 18: U-test of AMQ Post-test Results for E1 and C1

Group	N	Mean Rank	U-value	p-value
E1	45	86.18	1013.500	0.864
C1	46	94.27		

Table 18 presents U-test results for Experimental group (E1) and Control group (C1), the results shows insignificant statistical difference in the Mean Rank. U-value = 1013.500 and p-value = 0.864. p-value ($p>0.05$) is greater than the typical significance level of 0.05. It imply that, there was an improvement in students' motivation to learn agriculture, irrespective of whether the learner was exposed to CTS or Convectional teaching strategy.

4.3.4 Post-test Results on Motivation for Experimental and Control groups

At the end of the programme, the four groups Experimental group (E1), Experimental group (E2), Control group (C1) and Control group (C2) were given a AMQ post-test

inorder to asses the effect of CTS on students' motivation to learn agriculture. The results were computed and analysed as presented in Table 19.

Table 19: AMQ Post-test Results on Students' Motivation for all Groups

Students Groups	N	Mean Rank
E1	45	86.18
E2	48	104.86
C1	46	94.27
C2	47	88.15
Total	186	

Table 19 shows the difference between the Mean Rank of post-test results on motivation to learn agriculture. E1 (M = 86.18), E2 (M = 104.86), C1 (M = 94.27) and C2 (M = 88.15). Experimental group (E2) attained the highest Mean of 104.86 while Experimental group (E1) attained the lowest Mean of 86.18. Control group (C1) attained a higher Mean Rank of 94.27 than Control group (C2) 88.15. Experimental group (E2) which was exposed to CTS outperformed other groups. This implies that, CTS contribute to students motivation to learn agriculture though the improvement index can not be generalized for all groups.

In order to find out whether the differences were ststistically significant, additional analysis of post-test results that involved all the four groups, E1, C1, E2 and C2 was done. Students' motivation to learn agriculture post-test Mean Rank were computed and compared by teaching strategy. The comparison was conducted using the Kruskal Wallis H-test. The results of the test are shown in Table 20.

Table 20: H-test of AMQ Post-test Results on Students' Motivation for all Groups

Student Groups	N	Mean Rank	Df	H-value	p-value
E1	45	86.18	3	3.448	0.328
E2	48	104.86			
C1	46	94.27			
C2	47	88.15			
Total	186				

The results show that the difference between the Mean Ranks of E1 (M = 86.18). E2 (M = 104.86), C1 (M = 94. 27) and C2 (M = 88.15) were statistically insignificant, H-value = 3.448 and p-value =0.328. P-value ($p>0.05$) is greater than the significant

level of 0.05, implying that the post-test results were statistically insignificant. These results imply that improvement in students' motivation to learn agriculture is not dependent on whether the students were exposed to CTS or taught using conventional teaching strategy. This may imply that students motivation is affected by other variables and not teaching strategy alone. Further analysis using the Post Hoc (multiple comparisons) was not conducted given that the differences were not statistically significant. Therefore, these results support Ho_2 which state that, there is no statistical significant difference in motivation to learn agriculture among students exposed to cooperative teaching strategy and those exposed to conventional teaching strategy. The hypothesis was thus accepted.

The Kruskal Wallis H-test results showed that the differences in motivation to learn agriculture among groups C1, E1, C2 and E2 was statistically insignificant. Further analysis was done to confirm this observation by categorising the groups as Experimental groups (E1 and E2 combined) and Control groups (C1 and C2 combined) and comparing them. The comparison was carried out using the Mann-Whitney U-test. The results are presented in Table 21.

Table 21: U-test of AMQ Post-test Results on Students' Motivation for all Groups

Group	N	Mean	U-value	p-value
Experimental	93	95.82	4108.500	0.556
Control	93	91.18		

The Mann-Whitney U-test results reveal that the Experimental groups (E1 and E2) posted a higher mean rank of (M = 95.82) than (M = 91.18) of the control groups (C1 and C2). However, the difference between the Mean Rank was not statistically significant, U-value = 4108.500, p-value = 0.556. p-value ($p>0.05$) is greater than the significant level of 0.05. These findings imply that CTS and conventional teaching strategies had almost the same level in terms of students motivation towards agriculture.

The results of Kruskal Wallis H-test showed an insignificant difference in students' motivation to learn agriculture among groups E1, E2, C1 and C2. These findings are in tandem with Argaw et al. (2017) contention that cooperative teaching is effective

only if students are organized and facilitated to work in groups, consulting and sharing experiences that arouse interest in learning and enhance their liking and value of a subject. Argaw et al. argue that experiences which enhance motivation may not be realized if cooperative teaching is not implemented well. The results are also in agreement with Ngatia's (2019) assertion that changing students' motivation is a process that require time. Motivation to learn may not change much if learners are exposed to treatment for only a short period of time as was the case in this research.

These findings contradict those of a study conducted in Spain by Alcala et al. (2019) which examined the effects of cooperative learning on physical education at primary and secondary education stages. It was observed that motivation of groups exposed to treatment increased significantly at post-test compared to their counterparts in the control groups. A study in India by Moges (2019) also indicated that instructors and students had positive attitudes towards cooperative learning and prefer it to the lecture method. Adoption of the approach motivated students through use of small teams which provided learners with opportunities to work together and take advantage of their own and each other's learning experiences.

These findings showed an insignificant difference in motivation to learn agriculture by teaching strategy. This implies that improvements in students' motivation to learn agriculture is not only affected by teaching strategy. This means that there may be other variables like time factor which influence students choice of Agriculture and motivates them to learn the subject. Teachers should be cognizant of this in their endeavour to enhance students' motivation to learn and enrolment in Agriculture.

4.4 Effect of CTS on Students' Achievement by Gender

The third objective sought to compare the difference in students' academic achievement in Agriculture by gender when exposed to cooperative teaching strategy. To achieve this, the researcher administered Agriculture Achievement Test (AAT) to the students before and after exposure to the treatment. The pre-test and post-test mean scores of experimental groups (E1 and E2) were used during the comparison.

4.4.1 Pre-test Mean Scores by Gender

A pre-test was done to experimental group (E1) before the students were exposed to the treatment. This was to check whether the two categories of students had comparable characteristics in the beginning. The results are presented in Table 22.

Table 22: AAT Pre-test Mean Scores by Gender for E1

Group	Gender	N	Mean Score	SD
experimental	Male	23	5.39	2.21
Pre-test	Female	22	3.50	2.58

Table 22 presents pre-test mean scores for experimental group (E1) based on gender. The means are for both male and female students in Experimental group (E1). Mean score of male students was 5.39 with a standard deviation of 2.21 while female students attained a mean of 3.50 with a standard deviation of 2.58. The male students had a higher mean score than the female students. To ascertain if the difference was statistically significant a t-test was conducted for further analysis. The results are presented in Table 23.

Table 23: t-test of AAT Pre-test Results by Gender for E1

Group	Gender	N	Mean	SD	df	t-value	p-value
Experimental	Male	23	5.39	2.21	43	2.646	0.563
Pre-test	Female	22	3.50	2.58			

The t-test results in Table 23 shows that there is no statistical significant difference in the pre-test mean scores between the male and female students in experimental group (E1) at the start of the study. t-value = 2.646, p-value = 0.563. P-value, ($p>0.05$) is greater than the typical significance level of 0.05, indicating that the difference observed is not statistically significant.

The non-significant t-value (2.646) and p-value (0.563), suggest that the pre-test mean scores between the male and female students in Experimental group (E1) are similar. The greater standard deviation in female students shows a higher viability within the group at point of entry. This supports the assumption of group being homogenous at the beginning of the study, which is necessary for the validity of the Solomon Four quasi-experimental design. This suggests that both groups started with comparable

levels of knowledge in Agriculture. The findings from Table 23 indicate that any difference in post-test scores between the male and female students will be attributed to the teaching strategy or other variables, rather than initial differences in knowledge.

4.4.2 Post-test Mean Scores by Gender

To ascertain whether there was an impact in students' academic achievement after the treatment, the researcher administered a post-test to the Experimental groups (E1 and E2). The results were computed and analysed as presented in Table 24.

Table 24: AAT Post-test Mean Scores by Gender for E1 and E2

Group	N	Mean Scores	SD
Male	55	12.45	4.00
Female	38	10.57	4.61

Table 24 above shows the post-test mean scores of the Experimental groups (E1 and E2) by gender. The mean scores for the male students was, (M = 12.45, SD = 4.00) while that of the female students was, (M = 10.57, SD = 4.61). The male students attained a higher post-test mean scores as compared to their female counterparts. To confirm whether the difference was statistically significance, a t-test was conducted. Results are presented in Table 25.

Table 25: t-test of AAT Post-test Mean Scores by Gender for E1 and E2

Gender	N	Mean Score	SD	df	t-value	p-value
Male	55	12.45	4.00	91	2.107	0.038
Female	38	10.57	4.61			

The results in Table 25, indicate a statistically significant difference between the mean scores of male and female students. The mean scores are higher in favor of the male students. t-value = 2.107 and p-value = 0.038. p-value ($p<0.05$) is less than 0.05 the significance level. When both male and female students are exposed to Cooperative Teaching Strategy, the post-test results for male students were higher than those of their female counterparts. This impies that, male students benefited more from the treatment than the female students which resulted in their greater achievement. On that basis, Ho3 was rejected, which stated that, there is no statistical significant gender difference in achievement in agriculture among students exposed to

CTS. These results imply that when students are exposed to CTS, the improvement in academic achievement of males is higher than that of the female students.

These findings are in tandem with those of a study by Prieto-Saborit. (2021) which established the mathematics grades of male students in a cooperative learning setting was higher than that of the female students. This observation could have been attributed by tendency of male students to dominate learning activities in settings that involve small groups. It should be noted that this is not how the cooperative teaching strategy should be implemented. All students should be given equal opportunities when they are engaged in learning activities (Waiganjo et al., 2014). Fortin et al. (2013) study also showed that female students perform better academically than male students in the industrialized countries. Otiende et al. (2021) study also revealed that cooperative strategy enhanced students' abilities in Physics.

The study findings do not support those of Ikegbusi and Okeke (2022) conducted among secondary school students in Nigeria. The study established that cooperative teaching enhanced students' achievement in physics. The strategy enhanced achievement because collaborative inquiry leads to greater confidence and reasoning gains for both low and high ability students. The results of a study by Puiggalí et al. (2023) also revealed that both male and female students obtained grades that were comparable when exposed to cooperative teaching approach. Waiganjo's (2017) study indicated that there was no significant gender difference in academic achievement among agriculture students when cooperative teaching is used. The insignificant gender difference was attributed to cooperative teaching, which provides students with opportunities to tutor one another, which leads to better mastery of concepts than in individual learning.

Even though these results show a significant difference by gender, CTS has the potential to enhance achievement in agriculture. Cooperative teaching enhances achievement because it enables learners to take a more active role in the learning process and responsibility for their work. Cooperative teaching strategy has been found to be highly effective because it makes learning enjoyable and promotes

students' development of cognitive skills. It has also the potential to level out gender differences in achievement in agriculture if well implemented.

4.5 Effects of CTS on Students' Motivation by Gender

The fourth Objective sought to find out whether there was a significant difference by gender in motivation to learn agriculture when students are exposed to CTS**.** The comparison was conducted using motivation to learn agriculture post-test mean scores of Experimental group (E1 and E2) combined. To achieve this the Agriculture Motivation Questionnaire was administered to the students. The comparison was conducted using motivation to learn agriculture pre-test mean scores of experimental group E1 and post-test for experimental groups (E1 and E2) combined.

4.5.1 Pre-test Results on Students' Motivation by Gender

To asses students' motivation to learn agriculture at the point of entry, a pre-test was administered to Experimental group (E1). This was deemed necessary as it enabled the researcher to find out whether motivation to learn agriculture for both male and female students was comparable at the point of entry. The pre-test results are presented in Table 26.

Table 26: AMQ Pre-test Results on Students' Motivation by Gender for E1

Gender of students	N	MeanRank
Male	23	21.91
Female	22	24.14

The Table 26 above presents the pre-test results on motivation for Experimental group (E1) by gender of students. The Mean Rank for male and female students are 21.91 and 24.14, respectively. The Mean Rank for female students was higher than that of male students at the point of entry. To ascertain whether the difference was statistically significant, a Mann-Witney U-test was conducted. The results are presented in Table 27.

Table 27: U-test of AMQ Pre-test Results on Students' Motivation by Gender for E1

Gender of students	N	Mean Rank	U-value	P-value
Male	23	21.91	228.000	0.570
Female	22	24.14		

The Mann-Witney U-test results indicate a non-significant difference between the Mean Rank of the male and female students. u-value = 228.000 and p-value: = 0.570. p-value ($p>0.05$) is greater than the significance level of 0.05, indicating that the difference noted was statistically insignificant.

The non-significant u-value (228.000) and p-value (0.570) suggest that the pre-test Mean Rank between the male and female students are similar. This supports the assumption of group homogeneity at the start of the study, which is necessary for the validity of the Solomon Four quasi-experimental design. This suggests that both groups started with comparable levels of motivation in Agriculture. The findings from Table 26 indicate that any difference in post-test scores between the male and female students can be attributed to the teaching strategy or other variables, rather than initial differences in knowledge.

4.5.2 Post-test Results on Students' Motivation for E1 and E2 by Gender

At the end of the programme, Experimental group (E1) and Experimental group (E2) were given a AMQ post-test. This was to ascertain if there was an impact after exposure to CTS. The results for students' motivation to learn Agriculture was computed and analysed. This involved comparing motivation to learn Agriculture post-test Mean of students exposed to CTS by gender. Table 28 presents the results of the comparison that was conducted for post-test.

Table 28: AMQ Post-test Results on Students' Motivation by Gender for E1 and E2

Gender of Students	N	Mean Rank
Male	55	50.58
Female	38	41.82

Results on Table 28 shows that the Mean Rank (M = 50.58) of the male students was higher than that (M = 41.82) of the female students. This implies that after exposure to CTS, male students were more motivated than female students. To check if the difference was statistically significance U-test was conducted. The results are presented in Table 29.

Table 29: U-test of AMQ Post-test Results on Students' Motivation by Gender for E1 and E2

Gender of Students	N	Mean Rank	U-value	P-value
Male	55	50.58	848.000	0.123
Female	38	41.82		

Results on Table 29 shows that the difference between the Mean Ranks for male and female students was statistically insignificant. U-value = 848.000 and p-value = 0.123. p-value ($p>0.05$) is greater than the typical significance level of 0.05, this implies that the noted difference was not statistically significant. These findings are an indication that exposure to CTS levels out gender difference in students' motivation to learn Agriculture. On that basis, Ho4 is accepted which stated that, there is no statistical significant gender difference in motivation to learn Agriculture among students exposed to CTS.

The Mann-Whitney U-test results showed an insignificant difference in motivation to learn agriculture between male and female students exposed to CTS. These findings concur with those of a study by Ngatia **(**2019) which showed insignificant gender difference in motivation to learn physics of students exposed to treatment. Ngatia demonstrated that exposure to treatment enhanced student motivation to learn physics in both boys and girls. These results are in tandem with those of a study in Ghana by Darko **(**2016) which observed that gender did not have any effect on students' interest in learning agriculture. The results are also consistent with those of Mwangi et al. (2001) which noted insignificant gender differences in motivation to learn when interest, behaviour, attitude and curiosity of students in a subject are shaped at an early age and sustained to adulthood. Moreso, these findings support those of Muchiri (2018) which revealed that male students had significantly higher mean scores on motivation than female students. The study concluded that male students were more motivated to learn Agriculture than their female counterparts. Following the findings it means that, CTS has an equal effect on motivation to learn Agriculture in both boys and girls. The teaching approach can thus be blended with others and used by Agriculture teachers to level out gender differences in motivation to learn the subject in situations where such disparities exist. It can also be used to motivate female students to enroll in Agriculture given that women's participation in many fields of learning had risen substantially except in Agriculture (Mehmood et al., 2018).

CHAPTER FIVE
SUMMARY, CONCLUSION AND RECOMMENDATIONS

Summary of Findings

The first objective of this inqury sought to determine the effects of CTS on students' achievement in agriculture. The pre-test analysis confirmed that agriculture achievement of Experimental (E1) and Control (C1) groups were similar at the point of entry. Gender analysis indicated higher pre-test scores among males. Post-test implementation showed that, E1 significantly outperformed C1 (M = 11.87 vs. M = 6.04, p = 0.001), validating CTS's more effective in teaching agriculture. Mean gain analysis showed E1 gained 7.40 points compared to C1 1.67 (p = 0.001), affirming CTS's impact on academic improvement. ANOVA and subsequent LSD tests confirmed significant differences among groups (p < 0.001), emphasizing CTS is more effective than conventional methods. Combined group analysis (E1+E2 vs. C1+C2), t-test also showed significant post-test score differences (p = 0.001), underscoring CTS effectiveness in enhancing Agriculture achievement.

Objective two examined the effect of CTS on students motivation to learn agriculture. The pre-test analysis showed that the motivation to learn agriculture mean score of E1 (M = 45.79) and C1 (M = 46.21) were almost at the same level. The groups were thus homogeneous at the beginning of the programme. With regard to gender, male (M = 49.72) students had a higher mean score than that of their female (M = 41.85) counterparts. The U-test indicated statistically insignificant difference in all groups confirming that all groups had comparable characteristics, therefore, suitable for the study. Gain analysis showed that C1 attained a higher mean than E1 with a difference of (8.09 points). Post-test results after implementing CTS showed that the two groups had some improvement though C1 outperformed E1, p-value 0.864 indicated statistically insignificant difference among the groups. H-test showed insignificant difference among the groups (p = 0.328). Confirming that there other variables like time, school environment among others which may influence motivation and not teaching strategy alone. Combined groups (E1 and E2) vs (C1 and C2) showed significant difference in mean in fovour of Experimental groups. Basically students motivation to learn agriculture may be influenced by other factors like time.

The third objective compared academic achievement in agriculture of students exposed to CTS by gender. The pre-test mean scores for the male and female students were M = 5.39 and M = 3.50 respectively. The results of the t-test comparing the two means was t = 2.646, and p-value 0.563. These results showed that the difference between the mean of male and female students was statistically insignificant. They confirm that the two groups of students homogeneous at the start of the programme. The post-test results after exposure to CTS showed that male students outperformed there female counterpart with a mean of 12.45 and 10.57 respectively. The t-test was 2.107, p-value (0.038) was lower than 0.05 confirming that the results were statistically significant. This therefore showed that male students gained a lot from CTS than female students.

Objective four established whether there was gender difference in motivation to learn agriculture of students exposed to CTS. The pre-test resuts show that the the mean score of female (M = 24.14) students was higher than that of their male (M = 21.91) counterparts. U-test on the same results confirmed that the difference was statistically insignificant, p-value 0.570. Thus supporting the assumption of group homogeneity at the start. The post-test results reveal after exposure to CTS, male (M = 50.58). students obtained a higher mean score than their female (M = 41.82) counterparts. The results of the U-test indicated that difference between the two means was statistically insignificant, p-value = 0.123. This implies that gender does not affect motivation to learn agriculture of students exposed to CTS.

5.2 Conclusion of the Study

This inquiry made the following conclusions based on the findings:

CTS is more effective in improving students academic achievement in agriculture compared to conventional teaching methods. Cooperative teaching strategy enhances achievement because peer tutoring and engagement of students in group discussions improve their academic achievement. The effectiveness of CTS in enhancing motivation to learn agriculture is similar to that of conventional teaching methods. Improvement in motivation to learn agriculture of the male students is higher than that of the female students when students are exposed to CTS.

Improvement in motivation to learn agriculture of male students is similar to that of their female colleagues when students are exposed to CTS. The teaching strategy can thus be used with other methods by agriculture teachers to level out gender minimise gender disparity in students motivation to learn agriculture.

5.3 Recommendations of the Study

The following recommendations were made, based on the conclusions:

i. Agriculture teachers to integrate digital collaborative tools with CTS in agricultural education to enhance students engagement, feedback and enrich learning experiences that will prepare students for modern agricultural challenges in the society.
ii. Agriculture teachers should be encouraged to adopt cooperative teaching strategy in their teaching as it has the potential to enhance students' achievement in agriculture.
iii. It was observed that motivation to learn agriculture of the male students was comparable to that of the female students. The strategy can therefore, be blended with others and used by agriculture teachers to level out gender difference in motivation to learn the subject.

5.4 Suggestions for further Research

The research has generated findings which contribute significantly to education knowledge and practices. However, there were issues that emerged which require further investigation. The issues are:

i. The study covered only Soil Fertility II, it would be interesting to find out if students' exposure to CTS would also enhance their achievement in other agriculture topics, hence the need for further studies.
ii. A number of studies indicate that CTS enhances motivation to learn, this is contrary to the results of this study. This observation could perhaps be due to teachers' unpreparedness to use the teaching strategy. This calls for a study which examines agriculture teachers' preparedness to incorporate CTS in teaching the subject.

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APPENDICES

Appendix I: Training Manual for Agriculture Teachers

Introduction.

In order to achieve vision 2030 in kenya, academic excellent is a critical factor. This is geared towards the learnt and retained skills in students which they apply in there daily endeavors. In enhancing a greater academic achievement in students there is a need to adopt a student centered strategy such as cooperative teaching in content deliverly. Cooperative teaching is a strategy where students of mixed levels of ability are organised into groups and rewarded according to the groups' success. Every member is encouraged to fully contribute towards the set goal. In this strategy the instructor gives a task to the students in there small groups. The students brain storm amongst themselves as they find solutions to the given task. The instructor moves round the classroom giving guidance, facilitating and intervening to the challenging task where needs be.

Steps in Implementing Cooperetive Teaching Strategy

i. **Pre-instructional planning**, prior planning helps to establish the specific cooperative teaching technique to be used and lays the foundation for effective group work. The instructor should plan out how groups will be formed and structure how the members will interact with each other.
ii. **Introduce the activity to the students**, students need to get their matching orders. Explain the academic task to them and what the criteria are for success. Then structure the cooperative aspects of their work with special attention to the components of positive interdependence and individual accountability. Set up time limits and allow for clarifying questions.
iii. **Monitor and intervene**, in this the instructor let the groups run while the instructor moves through the classroom to collect observation data, see whether the students understand the assignment, give immediate feedbackand praise for working together. If a group is having a challenge in solving the task given, the instructor can help them get on the right track.
iv. **Process,** group processing involves asking the group to rate their own achievement and set goals for themselves to improve their cooperative work.
v. **Assessment**, some informal assessment is already done while the instructor is monitoring the groups during the learning process. However, an over all assessment should be done at the end of the learning process.

Appendix II: Implementation Schedule

WK	LS	Topic/ Sub-topic	Objectives	Learning/ activities	Teaching/ Resources	Ref	Rmks
			By the end of the lesson the learner should be able to:				
1	1,2	Inorganic fertilizers/ Macro-nutrients	To identify plants macro-nutrients. To classify macro-nutrients as fertilizers and liming elements.	Discussion of examples of the role of nitrogen and the deficiency symptoms	Yellowish-green / brown leaves. Curled leaves,	KLB BK11 PG 1-2	
	3	Inorganic fertilizers/ Magnessiun, boron	To identify role of magnesium in plants. To state symptoms of magnesium deficiency in plants. To identify role of boron in plants.	Discussion of examples of the roles of magnesium, boron and deficiency symptoms.	Thin stems with reduced nodulation Tomatoes with blossom end rot,	KLB BK11 PG 3	
	4	Inorganic fertilizers/ Sulphur. Carbon, Hydrogen & Oxygen.	To identify the role of sulphur and state it deficiency symptoms in plants. Describe two roles of carbon and oxygen in crops.	Discussion examples of the roles of sulphur and the deficiency symptoms of sulphur in crops.	Crop leaves	KLB BK11 PG 4-5	
2	1,2	Inorganic fertilizers/ Classification of Fertilizers. Straight and compound fertilizers.	To identify criteria used to classify inorganic fertilizers. To distinguish between straight and compound fertilizers.	Detailed discussion. Teacher presents the fertilizers and helps students to identify them	Chart: Macro-nutrients, micro-nutrients,	KLB BK11 PG 5	

	3	Inorganic fertilizers/ Nitrogenous fertilizers	To identify characteristics of nitrogenous fertilizers. To give four classification of nitrogenous fertilizers.	Discussion: on characteristics of nitrogenous fertilizers. Giving examples of nitrogenous fertilizers.	(NH4)2 SO4 ASN	KLB BK11 PG 6	
	4	Inorganic fertilizers/ Phosphatic fertilizers	To state three characteristics of phosphatic fertilizers. To give two examples of phosphatic fertilizers.	Group experiment: Dissolving SSP in water Discuss further properties of SSP, DSP,	SSP DSP TSP	KLB BK11 PG 7	
3	1& 2	Inorganic fertilizers/ Potassic fertilizers. Fertilizer Application.	To state two characteristics of potassium fertilizers. To give two examples of potassium. To describe methods of fertilizer application.	Group experiments: Solubility in water, litmus tests. Teacher elicits responses on methods of fertilizer application.	KCl K2 SO4	KLB BK11 PG 8-9	
	3	Inorganic fertilizers/ Fertilizer Rates.	To calculate fertilizer ratio. To find the amount of fertilizer required per unit area.	Problem solving and explanations. Worked examples. Supervised practice.	charts	KLB BK11 PG 9	
	4	Inorganic fertilizers/ Fertilizer Rates.	To calculate fertilizer ratio. To find the amount of fertilizer required per unit area of land.	Problem solving and explanations. Worked examples. Supervised practice.	Charts	KLB BK11 PG 10	
4	1& 2	Inorganic fer tilizers/ Carbon cycle and Soil Sampling.	To explain three ways in which carbon is returned. To state two methods of	Assignment method / Group discussion. Expositions & Detailed	Charts: Carbon cycle. Charts on soil sampling	KLB BK11 PG11-12	

			soil sampling	discussion.	methods.		
	3	Inorganic fertilizers/ Soil Sampling	To define soil sampling. To state three Reasons for soil sampling	Group discussion on importance of soil sampling.	Litmus paper, indicators, pH colour chart.	KLB BK11 PG12-13	
	4	Inorganic fertilizers/ Soil Testing	To explain three importance of soil testing. To explain two effect of soil pH on crops.	Demonstrtion of importance of soil testing. Determining soil pH.	Litmus paper, indicators, pH colour chart.	KLB BK11 PG14-15	

Appendix III: Agriculture Motivation Questionnaire (AMQ)

Class:……Gender:……..

INSTRUCTIONS

The following statements are about secondary school agriculture. Indicate the extent to which you agree with the given statements. Indicate by ticking (✓) against the appropriate answer whether you Strongly Agree = SA, Agree =A, Undecided = U, Disagree = D, or Strongly Disagree = SD. Tick only one answer. All the responces are correct to the best of your knowledge.

SN	Statements	SA	A	U	D	SD
1	Learning agriculture is interesting					
2	Agriculture is an important subject in my life					
3	I can describe agriculture lessons as very enjoyable					
4	Agriculture is a difficult subject to study					
5	I score poorly in agriculture because of the way am taught					
6	Agriculture lessons give me an opportunity for cooperative social interactions					
7	Given a chance I can drop agriculture					
8	I find it challenging to understand agriculture					
9	I believe I can master agriculture knowledge and skills					
10	Studying agriculture in small groups is interesting					
11	Careers related to agriculture can be boring					
12	I prefer agriculture to other technical subjects					
13	I spend a lot of time learning agriculture					
14	I am satisfied with the way agriculture is being taught					
15	I prepare well for agriculture tests and projects					
16	It is important that I get an A in agriculture subject					
17	I interact with other students during agriculture lesson					
18	I put a lot of effort in studying agriculture					
19	Understanding agriculture will benefit me in career choice					
20	I will use agriculture skills in my life and career					
21	I am confident I will do well in agriculture test					
22	I believe I can master agriculture knowledge and skills					
23	I spend a lot of time studying agriculture					
24	My career will involve agriculture knowledge					
25	I always look forward to agriculture lessons					

Source: Adapted and modified from Science Motivation Questionnnaire designed by Glynn et al. (2009).

Appendix IV: Agriculture Achievement Test (AAT)

Class:……..Gender:…….

INSTRUCTIONS

TIME: 45 MIN

ANSWER ALL THE QUESTIONS IN THE SPACE PROVIDED.

For examiners use only

Question	1	2	3	4	5	6	7
Marks							

1. Name **two** categories of plant nutrients (2mks)

   ……....

   ……....

   ……

2. List **three** processes through which carbon is returned to the atmosphere. (3mks)

   ……....

   ……....

   ……

3. Highlight **three** deficiency symptoms of sulphur in crops. (3mks)

   ……....

   ……

   ……

4. State **four** functions of boron in crop development. (4mks)

   ……....

   ……....

   ……

5. Highlight **four** properties of nitrogeneous fertilizers. (4mks)

   ……....

   ……....

   ……

6. Outline **four** methods of fertilizer application in crop. (4mks)

   ……....

   ……....

   ……

7 (a) Name **two** methods of soil sampling (2mks)

……....

……....

b) State **four** informations contained in a composite sample. (4mks)

……....

……....

……

c) Highlight **four** ways of classifying inorganic fertilizers. (4mks)

……....

……....

……

……

Appendix V: Marking Scheme for Agriculture Achievement Test (AAT)

Class……Gender……..

INSTRUCTIONS

TIME: 45 MIN

ANSWER ALL THE QUESTIONS IN THE SPACE PROVIDED.

For examiners use only

Question	1	2	3	4	5	6	7
Marks							

1. **Name two categories of plant nutrients (2mks).**
   - -Macro nutrient
   - -Micro nutrient
2. **List three processes through which carbon is returned to the atmosphere in the carbon cycle (3mks).**
   - -Respiration
   - -Combustion
   - -Decomposition
3. **Highlight three deficiency symptoms of sulphur in crops** (**3mks)**
   - -Stunted growth
   - -Plants leaves become uniformly yellow
   - -Reduction in formation of plant proteins
4. **State four functions of boron in crop development (4mks)**
   - -important in calcium utilization
   - -Necessary in sugar translocation
   - -Needed in water absorption
   - -Aids in fruits development
5. **Highlight four properties of nitrogeneous fertilizers (4mks)**
   - -Highly soluble in soil water
   - -They are hygroscopic
   - -Are easily leached
   - - Have short residue effect.

6. Outline four methods of fertilizer application in crop. (4mks)

-Broadcasting.

-Folliar application.

-Drip method.

- Side dressing.

7. (a) Name two methods of soil sampling. (2mks)

-zigzag.

- Traverse.

b) State four information contained in a composite sample. (4mks)

- Field number.
- Date of sampling.
- Address of the farmer.
- Name of the farmer.

c) Outline four ways of classifying inorganic fertilizers. (4mks)

- Time of application.
- Nutrient contained.
- Mode of application.
- Effect on soil PH.

Appendix VI: Table of Specification

	Sub-topics					
	Plant nutrient	Carbon cycle	Macro nutrient	Inorganic fertilizers	Fertilizer application	Soil sampling
Knowledge	2	-	-	-	-	2
Comprehensive	-	3	4	-	4	
Application			3	4	4	-
Analysis	-	-	-	-	-	-
Synthesis	-	-	-	4	-	-
Evaluation	-	-	-	-	-	-
Sub-total	2	3	7	8	8	2
		Total =	30 Mks			

Appendix VII: Intitutional Introductory Letter

CHUKA UNIVERSITY

Knowledge is Wealth *(Sapientia divitia est)* Akili ni Mali

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REF: NM29/45688/19

15th February, 2024

Director
National Commission for Science Technology and Innovation

P O Box 30623, 00100
Nairobi.

Dear Sir / Madam,

Johnson Muthomi Mwathi

The above-named person is a *bona fide* student of Chuka University pursuing MSC in Agricultural Extension proposal titled: **Effect of Cooperative Teaching Strategy on Students Achievement and Motivation to Learn Agriculture in Secondary Schools of Kirinyaga East Sub-county, Kenya.**

Mr. Muthomi has defended at the Faculty level and is now expected to conduct research. Any assistance accorded will be highly appreciated.

Yours sincerely,

Prof. Moses Muraya, Ph.D.

DIRECTOR
BOARD OF POSTGRADUATE STUDIES

Appendix VIII: Ethics Review Letter

CHUKA UNIVERSITY

Knowledge is Wealth *(Sapientia divitia est)* Akili ni Mali

CHUKA UNIVERSITY INSTITUTIONAL ETHICS REVIEW COMMITTEE

Telephones: 020-2310512/18
Direct Line: 0772894438
Email: info@chuka.ac.ke,
P. O. Box 109-60400, Chuka
Website: www.chuka.ac.ke

6th February, 2024

REF: CUIERC/ NACOSTI/466
TO: **Johnson Muthomi Mwathi**

RE: Effect of Cooperative Teaching Strategy on Students Achievement and Motivation to Learn Agriculture in Secondary Schools of Kirinyaga East Sub-County, Kenya

This is to inform you that *Chuka University IERC* has reviewed and approved your above research proposal. Your application approval number is *NACOSTI/NBC/AC-0812*. The approval period is 6th February, 2024 – 6th February, 2025.

This approval is subject to compliance with the following requirements;

i. Only approved documents including (informed consents, study instruments, MTA) will be used
ii. All changes including (amendments, deviations, and violations) are submitted for review and approval by *Chuka University IERC*.
iii. Death and life threatening problems and serious adverse events or unexpected adverse events whether related or unrelated to the study must be reported to *Chuka University IERC* within 72 hours of notification
iv. Any changes, anticipated or otherwise that may increase the risks or affected safety or welfare of study participants and others or affect the integrity of the research must be reported to *Chuka University IERC* within 72 hours
v. Clearance for export of biological specimens must be obtained from relevant institutions.
vi. Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. Attach a comprehensive progress report to support the renewal.
vii. Submission of an executive summary report within 90 days upon completion of the study to *Chuka University IERC*.

Prior to commencing your study, you will be expected to obtain a research license from National Commission for Science, Technology and Innovation (NACOSTI) https://oris.nacosti.go.ke and also obtain other clearances needed.

Yours sincerely

Dr. Benjamin Kanga
SECRETARY

Appendix IX: NACOSTI License

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: **843930**

Date of Issue: **27/February/2024**

RESEARCH LICENSE

This is to Certify that Mr.. JOHNSON MUTHOMI MWATHI of Chuka University, has been licensed to conduct research as per the provision of the Science, Technology and Innovation Act, 2013 (Rev.2014) in Kirinyaga on the topic: EFFECT OF COOPERATIVE TEACHING STRATEGY ON STUDENTS ACHIEVEMENT AND MOTIVATION TO LEARN AGRICULTURE IN SECONDARY SCHOOLS OF KIRINYAGA EAST SUB-COUNTY, KENYA for the period ending : 27/February/2025.

License No: **NACOSTI/P/24/33517**

843930

Applicant Identification Number

Director General
NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Verification QR Code

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

See overleaf for conditions

Appendix X:Map of Kirinyaga East Sub-County