UNIVERSITY FOR DEVELOPMENT STUDIES

EFFECTIVENESS OF PROJECT METHOD OF TEACHING ON AGRICULTUREAL SKILLS ACQUISITION AMONG AGRICULTURAL SCIENCE STUDENTS OF AWE SENIOR HIGH SCHOOL IN THE NAVRONGO MUNICIPALITY

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BY

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THIS THESIS IS SUBMITTED TO THE UNIVERSITY FOR DEVELOPMENT STUDIES IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF MASTERS OF AGRICULTURAL EDUCATION

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DECLARATION

Candidate's Declaration

I hereby declare that this thesis is the result of my original work and that no part of it has been presented for another degree in this University or elsewhere.

Candidate Signature:………………………….. Date:…………………………….

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Supervisor's Declaration

I hereby declare that the preparation and presentation of this thesis work was supervised in accordance with the rules and guidelines on supervision of thesis laid down regulation in this university

Supervisor Signature:…………………………. Date:…………………………….

Name : Mr. Hudu Zakaria

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DEDICATION

This work is dedicated to the Almighty God, my beloved wife Atanga Philipa and the entire Amuriyaga family for the varied roles the played during my study in the University.

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ACRONYMS / ABBREIATIONS

ACRONYM/ABBREVIATION	MEANING
SHS	Senior High School
GES	Ghana Education Service
MOFA	Ministry of Food and Agriculture
ISSER	Institute of Statistical Social and Economic Research
GDP	Gross Domestic product
GSS	Ghana Statistical Service
GOG	Government of Ghana
METASIP	Medium Term Agricultural Investment Plan
FAO	Food and Agricultural Organization
MOE	Ministry of Education
SCORE	Science Community Representing Education
PBL	Project Based Learning
PAR	Participatory Action Research
ICT	Information Communication Technology
BECE	Basic Education Certification Examination
TLMs	Teaching and learning Materials

ABSTRACT

This study assessed the effectiveness of project method of teaching on students' knowledge and skills acquisition among agricultural science students of Awe Senior High School in the Navrongo Municipal of the Upper East Region of Ghana. Participatory Action Research methodology was employed in assessing the effectiveness and best way of implementing project method of teaching. Through simple random sampling, 100 students were sampled and randomly assigned a project of raising tomato seedlings in a group of five or individually. Observations, personal interview, focus group discussion and key informant interviews were employed in gathering data for the study. Discourse analysis, descriptive and inferential statistics were employed in analysing the data gathered. Repeated measures t- test or paired t-tested, Chi-square analysis and Kendell's coefficient of concordance were applied in analysing the data and testing the hypotheses. Results of the study found lecture method of teaching as the commonly used teaching method in teaching agriculture science theory with class demonstration mostly employed in teaching practical sessions. Students before the intervention (project method of teaching) were found to have very poor knowledge in nursery practices. Their knowledge about tomato nursery were mainly limited to recalling of the various necessary practices. In general, just about a third of them prior to the intervention scored a knowledge index of above 0.5. Also the study found project method of teaching as effective in contributing to the improvement of students' knowledge on nursery practices. There was significant improvement of student's knowledge after they undertook their projects. Similarly the project also contributed significantly in improving students' skills acquisition of nursery practice. There was significant improvement in students' competency in undertaking tomato nursery after going through their projects. Giving students project in group of not more than five students were found as the more effective way of organizing project method of teaching. The group method was found to be cost effective and efficient in improving students' knowledge and skills in nursery practices. The constraints / challenges to undertaking project method of teaching were identified as inadequate tools/ equipment, large class size and grouping problem, short periods allocated to practical, poor skilled farm laborer, difficult and time consuming and high cost of materials, in decreasing order of severity. It is recommended that the school authority and Ghana Education Service (GES) should endeavour to provide adequate teaching and learning materials to schools to ensure. Effective teaching and learning. Project method of teaching should be employed in teaching skills as it found to be effective imparting knowledge and skills on students. To ensure cost effectiveness and effective knowledge and acquisition, project method of teaching should be organized in a group of not more than five students. **Key**: project method of teaching nursery practice, agricultural skills, teaching and learning, Agricultural students and Awe SHS

CHAPTER ONE

BACKGROUND OF THE STUDY

1.0 Introduction

In the midst of rising youth unemployment, the requirements of the job market in terms of skills and experience keep on changing and unleashing stiffer competition among job seekers. In some instances the curricula and training of educational systems failed to produce graduates with the requisite technical skills and competencies demanded by employers (CBI, 2011; Hinchliffe and Jolly, 2011and UKCES, 2011). The skills gap is often attributed to the non-responsiveness of the educational system to the labour market requirement in their curricula development and instructional methods, and techniques employed in training students.

Responsive educational system must focused on assisting the development of employable skills needed to facilitate students' ability to meet the expectations of employers and to generate self-employment opportunities. The stiff competition in today's job market is eminent for students to develop technical skills apart from general employable skills. It is therefore, incumbent on education system to develop curricula and employ pragmatic teaching methods which will equip students with the requisite employability skills and needed technical skills to enable graduates take up self-employment. It is a firmed believed that with responsive educational training which produce students with the requisite employable skills and right technical competencies to create entrepreneurial opportunities, the problem of rising jobless individuals among the youth will be solved. Entrepreneurial and self-employment generation have been noted as the lasting and sustainable way of dealing with the problem of youth unemployment in Ghana. Owusu-Ansah and Kofi (2012) noted that entrepreneurial education and training, and the promotion of creativity and self-employment among school leavers is the best way of sustainable dealing with the situation of graduate unemployment in Ghana.

Peprah et*al* (2015) observed that in recent times, Ghana has experienced a downward trend in youth employment inspite of several attempts made by government to control the unemployment situation. It is reported that as many as 50% of graduates from Ghanaian universities and polytechnics are not able to be employed two years after their national service, and 20% of them usually do not find jobs three years after finishing school and completing their mandatory national services (Aryeetey, 2011; as cited in Owusu-Ansah et al., 2012). Inspite of the fact that the economy of Ghana have registered impressive performance over the past two decades (ISSER, 2013, ISSER, 2010, Aryeetey and Baah-Boateng, 2007), the country is still saddled with the problem of jobless among the youth. However, the agricultural sector which still remains the largest employer (MOFA, 2012), have been experiencing declining growth, giving way to the service sector as the leading contributor to national GDP since 2010 (Aryeetey, 2011 and MOFA, 2012).

According to Institute of Statistical Social and Economic Research 'state of nation report' (ISSER, 2012) and Ghana Statistical Service 2015 labour force report (GSS, 2017) agricultural sector still remains the main source of employment to majority of Ghanaians, employing directly about 50.6% of the Ghanaian workforce whiles supporting about 80% of the populates through indirect employment such as agro processing, input distribution and output marketing. However, the sector still remain largely undeveloped with rudimentary technologies and farming practices undertaking by stallholder farmers being responsible for the production of 80 percent of the country's staple food (MOFA, 2010). As results, the agricultural sector's contribution to national GDP dropped from 31% in 2008 to just 20.1% in 2016, with growth rate falling from 7.4 to 3.6 within the same period (GSS, 2017 and GOG, 2017), registering average annual growth rate of 4.1 compared with 6% annual growth rate envisaged in the country's Medium Term Agricultural Investment Plan (METASIP).

Agricultural sector, arguable, hold the key to the problem of youth unemployment if the sector could attracts the needed investment and government commitment required to revitalize and modernize it to be attractive the youth. However, previous attempts by government to leverage on the agricultural sector potential to create jobs, have not yielded the desired results. Government policies and projects such as youth in agriculture, the block farming concepts, agricultural mechanization centre, youth employment module in agriculture and national service agricultural scheme are few examples of government policies and projects which attempts to attract the youth into agriculture. Not much had been achieved by these policies and initiatives, as many of the youth continue to avoid farming and other agricultural enterprises.

Lack of skills and competencies in agriculture coupled with negative attitude of the youth towards farming and other agricultural enterprises have often been cited as a major setback to attracting the youth to the agricultural sector. With the requisite skills training and right orientation to students pursuing agricultural science, the needed interest and competencies in agriculture can be generated to motivate the youth take up professions in agriculture.

1.2 Problem Statement

It is an understatement to say that the skills and competences required of agricultural science students exceed those found among "regular" Senior Secondary students. It is expected that graduates of Senior High Schools (SHSs) agricultural science would have a basic understanding of agriculture science concepts, posses the required skills and needed competencies in agricultural practices and the right attitude to enable them take up professions in agricultural sector or further their education in different aspects of agriculture. However, graduates of agricultural science often lacked the required skills and competencies in basic agricultural practices making unable to engage in agricultural production as a professionals (Darko et al, 2015 and Blackie et al, 2009).

Also their employability is often challenged because they often lacked the basic skills in agricultural practices required by employers or to enable them generates self-employment opportunities. Educational system is expected to focus on imparting employable skills on students and facilitate their ability to meet the expectations of employers or be able to create and run agricultural enterprises as self-employer. Information gathered from literature have attributed this phenomenon to ineffective teaching and learning of practical agriculture, incompetent agricultural instructors and teachers, lack of basic teaching and learning materials among others (Darko et al., 2015; Alkali, 2010; Olaiyam and Ojo, 2008 and Shimaye, 2007).

Alkali (2010) bemoaned the over reliant of lecture teaching method usually used in teaching agricultural skills which often failed to impart on students the required skills and attitude to be able to take up farming after graduation. He indicated that only 3% of those who were trained in agricultural institutions take to agriculture after leaving school. He attributes this to ill preparation of the products whose training does not equip them with the requisite knowledge and practical skills in agriculture. As they unable to undertake basic agricultural practices on their own. Also Olaniyan and Ojo (2008) reported that the increase in students' enrolment in most secondary schools in recent times has created large class size that make it difficult for a single teacher to manage the practical lessons which offer every student the opportunity to practice. As such emphases are placed on theoretical agriculture to the detriment of practical lessons producing students who are ill equipped with the needed skills and competency in agricultural practices. Shimave (2007) noted that most secondary schools do not have school farms, and where they exist at all, they fail to meet the standard required of a school farm. This denied students the opportunity to practice what have been taught in the classrooms making them unable to demonstrate practical skills in their areas of study.

Again, the lack of appropriate teaching materials and aids often compelled teachers to use inappropriate instructional materials to teach agricultural concept or to augment the school farms for acquisition of skills. The graduates produced from such institutions cannot effectively demonstrate the basic skills they ought to possess and this affect their employability and their ability to engage in self-employment in agriculture. Agriculture is changing, and with it, a renewed set of skills is needed to address new challenges in agriculture. As attitudes, expectations and employment in agriculture have changed, there is evidence that the skills and competencies of graduates need to meet the needs of today's agricultural sector.

Also there is increased attention to holistic and multi-disciplinary approaches to addressing challenges of agriculture. As such agricultural professionals are expected to be able to integrate knowledge and practices of agriculture and other disciplines such as business, economic, marketing among others to be successful agricultural professionals.

In finding effective solutions to deal with the obvious skill gap of graduates of agricultural schools in comparism with the requisite employability and the skills and attitude require to engage in self-employment, many research attention have now be focused on investigating effective approach of organizing teaching and learning of agriculture to ensure that graduate produced possessed the requisite skills and competencies needed to be effective professionals in agriculture and agribusiness.

Theresa (2015) investigated the effect of video-taped instruction on the acquisition of slashing and raking skills in practical agricultural science among male and female secondary school students and concluded that video-taped instruction impact positively on agricultural skills acquisition. Also Samuel (2012) commented that Students who participated in nurturing school farm are bound to acquire the needed skills and appreciation of the relevance of agricultural practices. As cited in Theresa (2015), FAO, (2012) observed that, in secondary schools in particular, the familiarization of students with up-to-date methods for improved sustainable production of food that are applicable to their homesteads or farms is a potentially powerful tool for improving students' skills and competencies in agriculture.

It is in furtherance to the efforts of searching for effective and best way of organizing the teaching and learning of agriculture in SHSs to ensure the acquisition of requisite skills and practice among students, that this study sought to investigate the best way of organizing project method of teaching tomatoes nursery practice to impart the needed skills acquisition among students of Awe SHS in the Navrongo Municipality. The study used action research approach to assess the effectiveness of project teaching method in imparting tomato nursery practice and skills among students. Tomato nursery practices as a skills was selected because it is in the curriculum of SHSs and also tomato production is one of the popular vegetable being produce at the Tono irrigation site in the Municipality

1.3 Problem Diagnosis

Agricultural science curricula for SHSs in Ghana is being taught as both science and vocation, as students are expected to have the basic understanding of agriculture as science while acquiring the requisite competencies and skills to practices agriculture as a vocation or profession. As such the approaches and strategies used in teaching agriculture science is different from theoretical base subjects. The teaching syllabus for general agriculture science in SHSs in Ghana had been designed in a way that will offer knowledge and skills to students for whom Senior High School education is terminal. Knowledge and practices acquired in this subject will enable such students to work on their own, or seek employment in agricultural establishments. The syllabus also provides adequate foundation knowledge and skills for students who will want to pursue further education and training in agriculture after SHS' (MOE, 2010).

However, my casual observation and interaction with agricultural students, teachers and school authority of Awe Senior High School in the Navrongo Municipality, where I work as Educational supervisor (circuit supervisor) of Ghana Education services, reveals the following:

- the school lacks basic teaching and learning materials
- the requisite tools, equipment and facilities needed to undertake practical lessons is woeful inadequate
- the school do not have functional laboratory for practical lessons
- the school also lacks functional school garden for agricultural practical
- very little teaching period is allocated for practical lessons
- students generally have poor interest and attitude towards practical agriculture

- the school authority complains of lack of funds to finance practical activities such as convey students for laboratory works and field tours and to procure tools and equipment.
- teachers complains of large class size making practical lessons difficult and less effective
- teachers also complains of lack of in-service training to upgrade their skills

As a results of these numerous problems and constraints of the school, organizing effective practical lessons for students was identified as the biggest challenge facing school authority and agricultural sciences teachers. Consequently, students' agricultural practical skills acquisition is being negatively affected. Identifying the best way of organizing practical lessons which can impart the requisite skills on students, inspite of these constraints is the focus of this action research.

1.4 Evidence of the Problem

The ineffectiveness of practical skills acquisition caused by inadequate teaching and learning material, basic practical tools, equipment and facilities, is demonstrated in agricultural science students general lack of technical and employable skills. Agricultural students after leaving SHS often lacked the needed practical skills to be able to undertake basic agricultural practices and as such they often unable to successfully engage themselves in agriculture enterprise.

My interactions with the students of Awe SHS reveals that they rare have practical lessons and the few they do have, very few of them have the opportunity to have hand – on – experience on the learning activities. They often watch as teachers demonstrate to them basic agricultural tasks, while two or three students are allowed to try their hands on. This approach of teaching agricultural practical often reduce students to mere passive observers and as such they are unable to master the tasks. Teachers complain that the large student numbers coupled with adequate teaching and learning materials, tools and equipment often compel them to adopt demonstration method in teaching practical.

For instance, students were not able to demonstrate how to raise seedling in nursery beds before transplanting, even though nursery practices is in the first year syllabus of the general agriculture science, a subject every agricultural science student is expected to take. Many of the students I interacted with were unable to even list the basic activities in undertaking nursery practices much more independently.

1.5 Causes of the Problem

The apparent poor skills of agricultural science students of Awe SHS is a manifestation of poor handling of agricultural skills acquisition. The approaches and methods usually used to teach agricultural practices often failed to provide students with the needed hand-on experience required to enable students master the skills. The underlying cause of students' poor skills in agriculture is the lack of adequate teaching and learning materials, tool, equipment and facilities such as laboratory and school garden which are critical teaching agricultural practical skills. In the midst of all these challenges, the school have not yet identified the best way of handling practical lessons to ensure students are equipped with requisite practical skills require to be competent as future agricultural practitioners.

The inability of the school to offer hand-on experience to students by way of allowing them to practice and try out what they have learnt in the classroom is negatively affecting student interest in mastering agricultural practice. The obvious lack of conducive environment in the school which is required to create the necessary learning situation for skills acquisition is greatly compromising students' competency and future employability. To make the best out of the current situation, this proposed action research is designed to test the effectiveness of using project method of teaching to improve students' skills acquisition through hand-on experience. The action research will also help identify the best way of organizing and undertaking project method of teaching agricultural skills.

1.6 Main Research Objective

1.6.1 main research objective

The main objective of this study is to 'examine the effectiveness of project method of teaching in improving the teaching and learning of agricultural science among agricultural students of the Awe Senior High School'.

1.6.2 Specific Objective

Specifically, the study seeks to:

1. Analyse the type of teaching methods commonly used in the teaching of agricultural science in Awe Senior High School.
2. Examine the extent to which project teaching method could be used to improve on agricultural skills acquisition among agricultural science students' of Awe Senior High School.
3. Examine the most effective way of using project method of teaching to improve agricultural skills acquisition among agricultural science students of Awe Senior High School
4. Analyse the constraints facing the use of project teaching method in the teaching of agricultural science in the Awe Senior High School.

1.7 Research Questions

1. What types of teaching methods are commonly used in the teaching of agricultural science in the Awe Senior High School?
2. To what extent do project methods of teaching used to improve on agricultural skills acquisition among agricultural science students of Awe Senior High School?
3. What is the most effective way of using project teaching method to improve on agricultural skills acquisition among agricultural science students of Awe Senior High School?
4. What are the constraints militating against the use of project method in the teaching of agricultural science in the Awe Senior High School?

1.7.1 Hypothesis

Ho1: There is no significant difference in the knowledge of students before and after the intervention

Ha1: There is significant difference in knowledge of students before and after the intervention

Ho2: There is no significant difference in skills of students before and after the intervention

Ha2: There is significant difference in skills of students before and after the intervention

Ho3: There is no significant difference in the knowledge level of students who took the project in groups and those who did it individually.

Ha3: There is significant difference in the knowledge level of students who took the project in groups and those who did it individually.

1.8 Justification

Ministry of Education (2010) recommended SHSs offering general agricultural science, to keep factional school farms and laboratories, while adopting appropriate teaching methods require to impart both scientific and practical agricultural skills to students. In order to ensure that agricultural science school levers possess the requisite skills and competencies to enhance their employability and self-employment opportunities then effective teaching learning methods must be found and applied by instructors and learners.

This study is therefore relevance and important as it will provide useful information to agricultural science educators on how best to organize project method of teaching in such a manner that will ensure acquisition of practical skills among students. Also in the wake of aging farmer population in Ghana (MOFA, 2012) coupled with the unattractiveness of the agricultural sector to the Ghanaian youth, there is the need to produce agricultural graduates with the requisite technical skills and practice, who are inspired to take profession in farming to replace the aging farmer population. To achieve this, there is the need to research on various teaching methods and techniques used and recommend best practices to teachers, students and school authorities for implementation.

It is against this backdrop, that this study is especially useful, as it will help provide useful information on best practices and constraints in using project teaching methods to teach agricultural skills and practice to students. Information from this study will be especially useful to agricultural science instructors, school authorities, `students, policy makers and curriculum developers in their efforts to improve teaching and learning of agricultural science which will guarantee the production of graduates with the requisite employable skills and the right attitude and competencies to be successful agricultural entrepreneurs.

1.9 Theoretical and Conceptual Issue

The essence of project teaching methods are, that it must involve the solution of a problem and that it must culminate in action. Decreasing school levers employability in the midst of mountain unemployment continue to be a great concern to educationist, employers and governments. It has been strongly argued that if educational curricula and methods of teaching can refocused on producing competent graduates with requisite employable skills, the problem of graduate unemployment will be half way solved (Owusu-Ansah and Kofi 2012).

Therefore, the focus of this study is to investigate how best project teaching method can be employed to improve agricultural students' skills and technical competency in agriculture. Students' perceived competence is often assessed by their self-efficacy and self-concept. Hughes, Galbraith, and White, (2011) argued that both self-efficacy and self-concept contain a common element of perceived competencies. As observed by March, (1992), as cited in Hughes et al, (2011), Self-efficacy and self-concept differ in the extent to which competent contributes to their composition. While, self-efficacy is seen as dealing primarily with cognitive perceptions of competent that of self-concept is typically seen as being comprised of affective perceptions as well as competent perceptions.

Pajares and Schunk (2002) provided a framework that distinguishes between the competent elements of self-concept and self-efficacy. Self-efficacy perceptions ask "can" questions (e.g., Can I sow tomato seeds? Can I make nursery beds? Can I transplant seedlings?), whereas self-concept competency perceptions ask "being" questions (e.g., Am I good at sowing tomato seeds? Have I ever raised nursery beds? Do I ever transplanted seedlings?). Skaalvik (1997) sees the cognitive dimension of self-concept as being differentiated into descriptive (I am a good person) and evaluative (Is my life meaningful? How well do I do?) components. Cognitive or descriptive and evaluative components give rise to the emotional or affective reactions of self-concept (How do I feel about myself as a agricultural science learner? Do people like me? I am proud that I keep out of trouble.). Taken together the aspects of the self-concept form a self-schema that includes beliefs about one's abilities, roles, skills, experiences, and personal characteristics (Jerslid, 1965; Marsh & Shavelson, 1985; West & Fish, 1973), that is accompanied by perceptions of self-esteem-value judgments about the self and one's own self-worth (Pajares, 1996).

In contrast, self-efficacy-"beliefs in one's capabilities to organize and execute the courses of action required to produce given attainments" (Bandura, 1997, p. 3). It is a context-specific judgment of capability to perform a task or engage in an activity. It is a judgment of one's own confidence that depends mostly on the task at hand. Rather than treating self-concept and self-efficacy as separate constructs, some researchers suggest that self-concept includes a self-efficacy component (e.g., Bong & Clark, 1999; Pajares, 1996; Schunk, 1991) and even that self-concept could subsume on self-efficacy.

This study of students' competencies in tomato nursery practices was guided by their self-efficacy and self-concept, both of which were relied on to measure how students think about their abilities to undertake the various nursery practices and how good they are in undertaking those practices. The study proceeded with the premise that if students are offer the opportunity to try out all the activities of tomato nursery their self-efficacy and self-concept in tomato nursery will be improved and this will increase their confidence in undertaking the task of nursery in the future. The project teaching methods is holistic in that it can serves as a teaching method at the same time assessment method. The project method as a teaching method, offer students the opportunity to have hands – on experience of the learning task through experiential learning techniques. It also serves as a task requiring students to execute and demonstrate their knowledge and skills and as such can be applied as an assessment method.

The underlying assumption underpinning this study is that, students' skills acquisition and practical competencies are bound to be facilitated through exposure to practical reality and assignment of tasks regarding skills to be imparted. Offering students the opportunity to undertake the step by step practice of tomato nursery activities through experiential learning techniques whiles tasking them to undertake the activities is bound to increase their self-efficacy and self-concepts regarding tomato nursery practices which hence impart on them the requisite practical competencies needed to undertake tomato nursery in particular and all nursery practice in general

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

This section presents review of relevant literature covering major issues and concepts employed in this study. The teaching and learning of agriculture science, project method of teaching and learning of agriculture, skill acquisition, agricultural students' employability, participatory action research among other concepts captured in previous studies is discussed in this section.

2.1 Teaching and learning of Practical

Teaching and learning of practical skills is a critical component of agricultural science education. The SHS agricultural science syllabus is designed to impart both science and practical skill of agriculture on students. Lunetta, Hofstein, and Clough, (2007) define practical teaching and learning as process of creating learning experience in which students interact with materials or with secondary sources of data to observe and understand the natural world. Also Science Community Representing Education (SCORE, (2008) defines practical lesson as any science teaching and learning activity which involves students, working individually or in small groups, manipulating and/or observing real objects and materials, as opposed to the virtual world. The term practical lesson can also be defined as an activity whereby students used their own hands to manipulate real objects during teaching and learning process or observe their teacher to manipulate a real object for them to see and practice later. During practical lessons, students observe or manipulate real objects or materials for themselves either individually or in small groups or witness teacher's demonstrations.

2.1 Practical Lessons and Hands - on Experience

Organizing practical learning process in order to create concrete experience for learners have been a concern for researchers, teachers and academics. Practical lessons which is often refers to as practical work or Hands –on experience or sometime experiential learning is aimed at exposing students to practical reality of learning object to enhance students familiarity and mastering of the object of learning. According to existing literature practical work (practical lesson), is the best way of learning science, it has also been reported that practical lessons makes learning more enjoyable (Osborne & Collins, 2001; Jenkins & Nelson, 2005; Toplis, 2012). Also practical lessons had long been noted to help 'to arouse and maintain' positive attitudes in students' towards science and other related disciplines (Hodson, 1990; Swain, Monk & Johnson, 1999). The existing literature has shown that practical lessons help to enhance students' conceptual understanding of science, scientific ideas, and allowing them to see and experience scientific phenomena (Wellington, 1998).

Also there is evidence that practical lessons in science help to generate motivation in science and enhance students' understanding of scientific concepts and happenings around them (SCORE, 2008). Beside, practical lesson helps promote 'hands-on' (physical activities) and 'brains-on' activities (mental activities) in school science inside and outside the laboratory, garden and school farms.

A well planned and effectively implemented practical lesson has the potential of engaging students both mentally and physically due to their direct involvement of practical activities where they used both their hands and brains to perform a particular task especially during science laboratory experiments and simulation experiences (Lunetta et al., 2007). There is even some evidence that practical lessons does not only make lesson interesting but also makes learning enjoyable (Cerini, Murray, & Reiss, 2003). From a Social learning theory perspective group work in the practical learning is believed to help bring to bear the necessary conceptualization and internalization, and provide opportunity for discussion and reflection among learners as well as between the teacher and the students. (Lunetta et al., 2007).

Specifically, on teaching and learning of agriculture practical lessons Okorie, (2001) indicates that, practical agricultural education encompasses farming and agro-allied business organizations including others involved services and sales in agriculture. The purpose of agricultural science practical lesson is to educate present and prospective farmers for proficiency in farming as observed by Phipps and Clarke (1993).

The primary role of practical agricultural teaching and learning is to equip students with the requisite knowledge, attitude, practice and skills in undertaking agricultural and farming tasks (Martin and Odubiya, 1991). Practical skills training of agriculture is also expected to motivate and generate entrepreneurial skills among students (Onuekwusi and Okorie, 2008).

However, studies have shown that very little attention is being paid to practical skills acquisition among SHSs students' studying agriculture (Modebelu and Nwakpadolu, 2013; Darko, Yuan, Okyere, Ansah, and Liu, 2016) which is greatly hampering agricultural students competency and employability. Adequate teaching and learning material, tools, equipment, laboratory, school farms and gardens, as well as poorly motivated teachers and poor attitude of students' towards agricultural practice have been cited as being responsible for the poor training of agricultural students. As noted by Darko, *et al*, (2016) that practical teaching of Agricultural Science in the Senior High Schools in Ghana is greatly impeded by inadequate teaching and learning material, ill equipped school laboratories, school farms and gardens, and poor funding of agricultural practice.

2.3 Teaching and Learning Methods in Agricultural Science

Several methods have been employed in teaching and learning of agriculture to impart the needed knowledge, attitude, practice and skills on students.

2.3.1 The Demonstration Teaching Method

Demonstration teaching method refers to the type of teaching method in which the teacher is the principal actor while the learners watch with the intention to act later. Here the teacher systematically shows whatever the learners are expected to do at the end of the lesson by showing them how to do it and explaining the step-by-step process in undertaking the task. Mundi (2006) described it as a display or an exhibition usually done by the teacher while the students watch with keen interest.

In this method agricultural science teacher simply display or exhibit what is to be taught while the students watch with keen interest. In other words in this method the teacher shows how something works or the procedure involved in the process. It is done by explanations by the teacher while the student watches (Nwachukwu, 2001). Agricultural science is a practical oriented course and therefore requires practical instructions and application via effective demonstration strategies.

Mundi, (2006) have highlighted the following as the characteristics and significance of demonstration teaching method:

It demands certain level of skills and practical;

It is a good method for introducing new skills;

It is a good method for developing understanding;

It is good in showing the appropriate ways of doing things;

It allows for very low interaction between students and materials in class, It helps to enlist the various senses in a human being;

It helps to motivate students especially when skilled teachers carry it out;

It saves time and energy especially for the teacher

Also demonstration method is an attention inducer and a powerful motivator in lesson delivery by the agricultural science teacher as it allows the teacher to use activities that ordinary will be too dangerous for the students to handle or carryout themselves e.g. chemical spraying and tractor operation among others.

2.3.2 Project Teaching Method

In the past quarter of a century, educational researchers and policy makers have called for a focus on the development of students' deep understanding, higher thinking skills, and problem solving skills (Krajcik, McNeill, and Reiser, 2007; Perry, Phillips, and Dowler, 2004). Project teaching method or otherwise refers to as project work, along with other innovative, complex, and authentic tasks, has been shown to support these goals (Krajcik, Blumenfeld, Marx, & Soloway, 1994; Perry et al., 2004; Perry, Hutchinson, & Thauberger, 2008). Teachers who initiate project work, however, tend to face challenges in enacting it effectively in their classrooms (Fallik, Eylon, & Rosenfeld, 2008; Tse, Lam, Lam, & Loh, 2005).

The project teaching method being the focus of this study is given detail literature review here. The reviews identifies key features of project work, describes benefits and challenges of implementing it, and discusses ways to support teachers in initiating and managing project works.

2.3.3 Key Features of Project Teaching Method

Project teaching method is based on the conviction that learning by doing, discussing in groups, and revisiting ideas and experiences are superior ways of gaining a better understanding of one's environment (Katz & Chard, 2000; Krajcik, Czerniak, & Berger, 2002). Gültekin (2007) as cited by Jansen, (2012) described project teaching method as "a learning approach based on students working for a period of time in order to intensively investigate the real world issues or problems in an interdisciplinary approach so as to produce something concrete through individual efforts or group work" (p. 96). Some other definitions of project teaching method highlights the methods, emphasize, flexibility and responsiveness of project teaching methods to students' input, cultural environment, and experiences (Helm & Katz, 2001; Katz & Chard, 2000; Krajcik, Blumenfeld, Marx, & Soloway, 1994). While these definitions of project work leave much room for interpretation, they do identify certain core criteria for project work as observed by Jansen (2012).

Thomas (2000) summarized these key features of project teaching method, which since then have been widely applied in research related to Project Based Learning (PBL):

1) The project's topic is central to learning. In project teaching method, projects represent the central learning strategy that helps students learn about concepts. Projects are not unrelated to the curriculum, nor are they there solely to enhance or illustrate the curriculum. Instead, the project becomes the curriculum (Thomas, 2000). It is via the project that students gain knowledge about disciplines and achieve learning goals.

2) The project evolves around driving questions that encourage students to investigate certain concepts (Blumenfeld et al., 1991; Fallik et al., 2008; Rivet & Krajcik, 2002; Thomas, 2000). Unlike tasks, units, or themes, project work structures learning around these purposeful questions. All the activities and

investigations that are done throughout a project need to contribute to answering these questions (Blumenfeld et al., 1991; Katz & Chard, 2000).

3) Students are engaged in in-depth investigations that allow them to construct their own knowledge, usually done by a small group, the whole class, or an individual (Katz & Chard, 2000). These investigations engage students in planning, designing, and conducting real-world research, and encourage them to collect and analyze data and draw inferences from those data (Rivet & Krajcik, 2004; Thomas, 2000).

4) There is an emphasis on student input and autonomy. In fact, projects are student-driven to a large degree. Students make decisions throughout all stages of the project, from selecting the topic to designing the project to presenting results. Although teachers may still initiate topics, projects are founded on students' interests (Helm, 2004; Katz & Chard, 2000; Solomon, 2003; Thomas, 2000).

5) Project work needs to be authentic and include complex questions that are relevant and meaningful to students (Buck Institute of Education, 2009). Authenticity implies responsiveness to students' real-world environments, interests, backgrounds, and lived experiences while incorporating concepts from several other disciplines (Blumenfeld & Krajcik, 2006; Fallik et al., 2008; Thomas, 2000).

6) There is an opportunity for collaboration. Projects need to allow students to negotiate, solve problems, and encourage students to provide, accept, and integrate feedback (Gültekin, 2007; Marx et al., 1997; Solomon, 2003).

7) Projects result in final products. These products arise from the process of investigation and represent student understanding in a variety of ways.

2.3.2.2 Benefits of Project Work

Successful accomplishments of project-based learning like the Project Approach have triggered many studies to focus on the justification of PBL in the classroom (Katz & Chard, 2000). Much research has been done, for example, to examine the effect of PBL on student motivation. Project work is structured around students' questions, lives, experiences, and abilities, and allows students to have control over their own learning process (Meyer, Turner, & Spencer, 1997; Perry, Philips, & Dowler, 2004; Katz & Chard, 2000). These key characteristics of project work have been shown to be important in increasing students' level of engagement, self-confidence, and intrinsic motivation to learn (Chard, 2001; Deci & Ryan, 2000; Howard, 2000; Meece, Anderman, & Anderman, 2006). This increase in students' motivation can be found across a variety of age groups, ability levels, and school settings. For example, Belland, Ertmer, and Simons (2006) investigated PBL among middle-school students with special needs. Students in three classes worked on an accessibility unit for 24 weeks with their teachers who were, although experienced, not accustomed to the concept of PBL.

2.3.2.3 Challenges of Project Work

Although many benefits of enacting project work have been described, project work's potential can only be realized through teachers implementing it effectively into their classrooms (Blumenfeld et al., 1991; Hmelo-Silver, 2004; Hmelo-Silver, Duncan, & Chinn, 2007; Meyer, Turner, & Spencer, 1997; Tali et al., 2006). However, despite project work's record of increasing students' learning and motivation, many teachers do not make project work part of their common teaching practices (Fallik et al., 2008;

Park Rogers, Cross, Gresalfi, Trauth-Nare, & Buck, 2010). Several factors seem to deter teachers from enacting complex, student-centered tasks like project work. First, like any other reform endeavour, changing teaching habits towards a more student-centered approach to learning may be met by reluctance based on teachers' well-ingrained beliefs and experiences (Brooks & Brooks, 1999; Park Rogers et al., 2010). Many teachers were never taught in project-based learning environments, nor have they been trained in dealing with concepts like project work (Brooks & Brooks, 1999). Years of experience in traditional school settings have made many of those teachers view teaching as a way for students to gain and retain knowledge, not to construct knowledge (Borko & Putnam, 1996; Brooks & Brooks, 1999; Park Rogers et al., 2010; Thomas, 2000). In the teacher-centered and structured classroom environments of these teachers, changing from a transmission model of education to encouraging investigations and inquiry is not easily achieved (Blumenfeld et al., 1991; Brooks & Brooks, 1999; Clark, 2006; Dori, Tal, & Peled, 2002; Taitelbaum, Mamlok-Naaman, Carmeli, & Hofstein, 2008; Van Driel, Bijaard, & Verloop, 2001).

Even when teachers report that they support the constructivist principles underlying project work, teaching habits tend to be so ingrained that they become hard to change (Brooks & Brooks, 1999). For example, Li (2011) studied the perceptions and practices of kindergarten teachers regarding the implementation of project work. Principals and kindergarten teachers (n = 129) filled out questionnaires, and video-recordings of 10 kindergartens were studied. Additionally, Li examined data resulting from semi-structured post-observation interviews. Almost all teachers (95%) felt that taking a project approach to learning was beneficial for students' learning. When it came down to their teaching practices, however, many of them held on to their original ways of teaching. For example, teachers were highly concerned with planning and preparing for tasks and tended to teach according to a detailed lesson plan on their desks rather than listening to their students' suggestions. Interactions between teachers and students tended to consist of the teachers delivering information and the students needing to answer questions correctly. Another factor discouraging teachers from enacting project-based learning lies in the role of the teacher during a student-centered project being distinctly different from a teacher-centered approach to teaching and learning (Katz & Chard, 2000; Schneider, Krajcik, & Blumenfeld, 2005). During project work, teachers have to become learners along with their students and guide and facilitate students' construction of knowledge and investigation; scaffold instruction; model, encourage, and coach students; and teach strategies for thinking and problem solving (Hmelo-Silver et al., 2007; Mergendoller & Thomas, 2001; Polman & Pea, 2001; Schneider, Krajcik, & Blumenfeld, 2005). Furthermore, teachers need to continuously listen and interpret the understanding of their students throughout the project to plan for ongoing activities and assessments (Avargil, Herscovitz, & Dori, 2011).

The role of the teacher during project work and the specific teaching skills this role requires have challenged many teachers. For example, So and Kim (2009) examined how pre-service teachers (n = 97) applied their knowledge about PBL in designing a collaborative lesson in their subject area with the goal of integrating technology. The authors used student surveys to identify students' understandings, difficulties and misconceptions of ICT and PBL as well as students' final lesson plans to understand how students had applied their ICT and PBL knowledge in integrated lesson plans. Lesson plans revealed that students used technology merely as a way to deliver content, rather than as an instructional tool. Furthermore, lesson plans evidenced difficulties in selecting problems for investigation that required higher thinking skills, and in understanding how much scaffolding was appropriate. The results of the survey confirmed that students perceived creating authentic problems and their personal lack of ICT skills and scaffolding skills to be challenging factors of PBL, along with PBL's extensive time requirements. Avargil, Hersovitz, and Dori (2011) examined teacher challenges while implementing a high school chemistry module using a context-based design that aimed for the development of students' deep understanding and higher order thinking skills.

2.4 Ghana's Agriculture

Ghana's agriculture is dominated by smallholder subsistence producers characterized by family managed and operated rain fed cropping system with smallholder farmers produce about 80% of the country's agriculture output (MOFA, 2010). Inspite of the structural modification of Ghanaian economy, agricultural sector continues to provide employment for majority of the country's active labour force (GSS, 2017). Agriculture sector has witnessed consistent decline in it contribution to national GDP within the last decade. The sector contribution to national GDP dropped from 31% in 2008 to just 20.1% in 2016 (GOG 2017 and GS, 2017.), with growth rate falling from 7.4 to 3.6 within the same period, registering annual growth rate of 4.1 compare with 6% annual growth rate envisaged in the METASIP I & II (see MOFA, 2012 AND MOFA,2015) notwithstanding , in the national development agenda agriculture is expert to lead the growth and structural transformation of the economy and maximize the benefit of accelerated growth (MOFA, 2010 AND MOFA, 2012).

Major crops grown in Ghana are roots and tubers such as cassava and yam, cereals particularly maize and rice and vegetables such as pepper and tomato (MOFA, 2015). Vegetable cultivation in Ghana provide an excellent source of employment for both rural and urban dwellers as it is grown in many rural areas as well as the outskits of towns and cities to be supplied fresh to the urban markets and for exports (aavedra et al, 2014).

2.5 Tomato Production in Ghana

Vegetables are a complex group of a wide variety of different types of plants. Some species grow from year to year; other--grow and die within one or two years. They have diverse forms of propagation: by seeds or vegetative parts. They may be herbaceous, viny, shrubby, or tree in growth habit (AVRDC, 1990). The tomato (Lycopersicon esculentum Mill.) is the most widely grown vegetable in the world (Kelley and Boyhan, 2017).

The vegetable industry in Ghana can be regarded as having three distinct components: (1) commercial/market gardening areas sited around principal cities such as Accra, Kumasi, Takoradi and Tamale; (2) a form of truck farming in which vegetables are produced in rural areas from where they are purchased by contractors or middlemen and transported by road to the cities; (3) small domestic or backyard gardening. Most of the fresh vegetables required in Ghana can be grown in the country, with the exception of Irish potatoes and other vegetables which require cool temperature conditions (Sinnadurai S., 2016).

The vegetables most commonly grown in Ghana are: tomato (Lyco-persicon esculentum), onion (Allium cepa), shallots (Allium escalonicum), okra (Hibiscus esculentus), eggplant (Solanum melongena), local spinach (Amaranthus spp), Indian or Gambian spinach (Basella alba), sweet and chillipepper (Capsicum annuum), and hot pepper (C. frutescens). These vegetables find a ready market, not only in the cities but also in the rural areas (Sinnadurai S 2016).

Tomatoes are members of the Solanaceae family, which includes peppers, eggplant, Irish potatoes and tobacco. The tomato originated in the area extending from Equador to Chile in the western coastal plain of South America. The tomato was first domesticated in Mexico where a variety of sizes and colours were selected. The fruit was introduced to Europe in the mid-1500s. The first ones introduced there were probably yellow since they were given the name pomodoro in Italy, which means “golden apple” (Kelley and Boyhan, 2017; p3).

Tomatoes have significant nutritional value. In recent years, they have become known as an important source of lycopene, which is a powerful antioxidant that acts as an anticarcinogen. They also provide vitamins and minerals. One medium ripe tomato (~145 grams) can provide up to 40 percent of the recommended daily allowance of vitamin C and 20 percent of vitamin A. They also contribute B vitamins, potassium, iron and calcium to the diet (Kelley and Boyhan, 2017).

Data from Food and Agriculture Organization Statistics (FaoStat, 2016) on tomato production in Ghana within the last six decades, as shown in the scatter plot in figure 2.1, indicate a significant increase in production figures over the period.

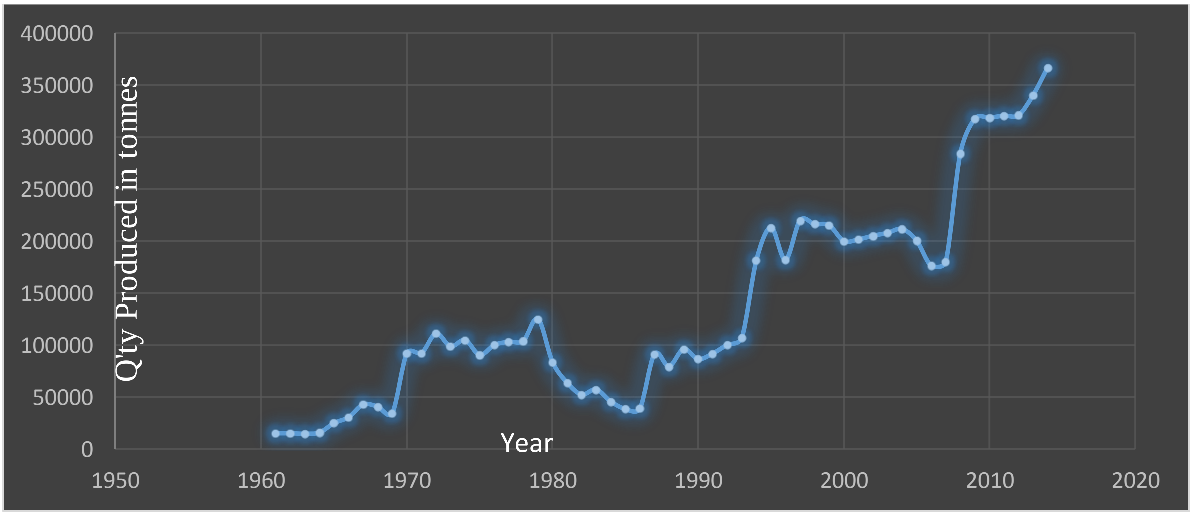

Figure 2.1 Tomatoes production in Ghana from 1961 to 2014
Source FoaStat, 2016

As shown in the Figure 2.1, tomatoes production steady raised over the period of 1961 to 1979, increasing from just 15 metro tonnes (mt) to over 100 metro tonnes within the period. It then decreased sharply form 111mt in 1979 to just 38.9mt in 1986.However, thin the last two decades there have been significant upward movement of tomato production in the country. As shown the figure 2.1 production figures significantly increased to 213mt in 1995 and then dipped to 176mt in 2006 before raising sharply to over 300 metro tonnes in 2014. Similarly trend was observed in Saavedra, et al, (2014) in their report on vegetable business opportunities in Ghana. In their report they observed that tomato production in particular has increased significantly in the last five years, almost doubling from 176.000 metric tons in 2006 to 340.000 tons in 2011.

However, Robinson, Elizabeth and Kolavalli, (2010) observed that the tomato sector in Ghana has failed to reach its potential, in terms of attaining yields comparable to other countries, in terms of the ability to sustain processing plants, and in terms of improving the livelihoods of those households involved in tomato production and the tomato commodity chain. Data for the tomato sector have not been collected consistently at a national level since the 1980s and so it is not possible to make strong statements concerning trends over area farmed to tomato, yields, or productivity.

However, the available data suggest that overall production doubled between the 1970s/80s and the 1990s. In the 1970s and early 1980s tomato production fell from around 100,000 tons per year to around 50,000 tons per year, then in the late 1980s increased back to around 100,000 tons. During the 1990s production expanded again, averaging around 200,000 tons per year by the end of the decade. However, during the 2000s, production appears to be falling gradually. A small proportion of Ghana's domestic production is exported to Ghana's neighbours, and domestic production is supplemented by imports from Burkina Faso during the December to May harvest season, estimated to be as high as 100,000 tons per year (Robinson and Kolavalli, 2010).

During the 1970s and 1980s, when data were being collected systematically by SRID/MoFA at the national level, average yields fluctuated around 4.8 tons per hectare with little upwards trend as observed in Robimson et al,, (2010). In the 1990s, average yields in the country were estimated to be just over 13 tons per hectare (Wolf 1999). ISODEC (2004) and SRID (2003) as cited in Robimson et al, (2010) suggest average yields of 7.5 tons/ha in the early 2000s and 6.7 tons/ha in 2008 as found in Asuming-Brempong and Asuming Boakye (2008). Robimson et al, (2010) three-region survey suggests average yields of tomato for these three regions to be 10.6 tons per hectare.

2.5 Raising Tomato Seedlings

Raising healthy seedlings under good nursery management is an important part of successful vegetable production, especially for tomato, pepper, eggplant and other crops that are commonly transplanted. Tomato seedlings can be raised in facilities ranging from simple shelters to sophisticated greenhouses. All structures should protect seedlings from heavy rainfall, low (≤ 5 °C) or high (≥ 35 °C) temperatures, intense sunlight, high relative humidity, and exposure to pests and diseases (Lin, Luther and Hanson, 2015).

2.5.1 Nursery Practices in Tomato Production

The facility for growing transplants, otherwise called the nursery, can be as simple as a raised bed in a selected corner of the field (usually near the water source), or as sophisticated as a glasshouse with micro sprinklers and an automatic temperature control system (AVRDC, 1990). All of these nurseries seek to provide the following conditions for growing seedlings:

- "Protection from pests, including higher animals, such as chicken. In a simple nursery, improvised fences, such as bamboo or nets, are provided. In screen houses, the protection is better since the seedlings are totally enclosed. Fine mesh enclosures provide protection against many insect pests.
- "Protection from rain and sun. Excessive rain can cause waterlogging in the seedbed, which may result in physiological damage to the seedlings. Excess moisture is also favourable for development of diseases. The only way to control rain damage fully is to provide a transparent roofing, which is costly. In resource deficient farms, rain damage is controlled simply by providing nets, mulches, or equivalent devices to reduce the size of raindrops that fall on the seedbed. Adequate drainage is provided by raising the seedbeds. Excessive sunlight may also cause damage to newly germinated seedlings. To protect them, partial shade such as coconut leaves or nets are used. However, the shade should be removed as soon as the seedlings are established. Prolonged shading may result in spindly and weak seedlings, many of which may eventually die.
- Protection against temperature extremes. In the tropics (except in elevations exceeding 2,000 m where frost may occur during some parts of the year), the ambient temperature is normally suitable for seedling production. However, when seedlings are grown in glass-or plastic-roofed greenhouses to protect them from rain damage, they may suffer from excessively high temperatures during sunny days (see AVRDC, 1990 and Lin et al, 2015)

According to the teaching syllabus for general agriculture science for SHSs in Ghana, nursery practices in raising seedlings includes: selection of nursery site, preparation of seed box, nursery bed bed/box, seed sowing, watering, shading, pricking out, stirring of soil, weed control, fertilizer application, pest and disease control, hardening-off, transplanting and watering after planting (see GES, 2010).

Tomatoes can be produced on a variety of soil types. They grow optimally in deep, medium textured sandy loam or loamy, fertile, well-drained soils. Avoid sites that tend to stay wet. Also, rotate away from fields that have had solanaceous crops within the past 3-4 years. Select sites that have good air movement (to reduce disease) and that are free from problem weeds (Lin et al, 2015). Also as onserved by Kelley and Boyhan, (2017) that tomatoes can be produced on a variety of soil types. They grow optimally in deep, medium textured sandy loam or loamy, fertile, well-drained soils. Avoid sites that tend to stay wet.

According AVRDC, (1990) in selection suitable site and soil for nursing seedlings, the following conditions should be considered:

- **Water-holding capacity and aeration.** Organic materials, such as peat, are able to retain moisture without causing waterlogged conditions. This characteristic is crucial because the germinating seeds and the roots of seedlings need both water and air. In contras (sandy soil tends to lose moisture very quickly and clay soil tends to retain too much moisture so long that air supply in the root zone becomes restricted. In the tropics, coconut coir dust, rice husk, mosses, and dried (fully decomposed) manure are used in a nursery mix to improve the soil’s water.-holding capacity and aeration.

- **Capacity to supply plant nutrients**. Vermiculite, perlite, and their tropical counterparts such as coconut coir dust and rice husk, are essentially inert and they contribute very Ii,ttle, if at all, to plant nutrition. So, mixes that are predominantly made up of these materials need elaborate fertilizer supplementation. Thus, nutrient-rich materials, such as compost, manure, and fertile soil, should be added to this nursery mix. The pH of the soil mix should be adjusted to a range of 6.0-7.0 to ensure the availability of nutrients. A test of the medium using commercially available quick soil test kits should give the pH reading, as well as the available nutrients. Supplementary fertilizer should be mixed with the medium when needed.
- **Freedom from soil-borne plant pathogens**. The soil contains millions of different kinds of microorganisms; many of these are helpful to the plant, but some are disease-causing. The nursery mix should retain only the beneficial types. To achieve this the nursery mix is often sterilized, either with the use of heat or chemicals. To most farmers in the developing countries, the only practical method is heat sterilization, which can be done in several ways such as 'raw heat method', such as burning straw on top of the seedbed, 'hot plate sterilization' or 'Steam sterilization'.

With regard varietal selection and sowing of tomato seeds on nursery beds Li et al, (2015) provided the following guidelines;

- Choose locally appropriate tomato varieties and purchase healthy, recently produced seeds from a reliable source.
- The amount of seed required to produce enough seedlings for one hectare is listed in Table 2.1. For higher-priced hybrid varieties, the amounts in Table 2.

1 are recommended, but for lower-priced open-pollinated varieties, the grower may wish to plant extra seed to ensure plenty of seedlings are available.

- Depending on the seed cost and germination rate, the grower may wish to plant 15-100% additional seeds to ensure enough seedlings are ready for planting at the optimal time.

Table 2. 1. Amount of tomato seed required to plant one hectare

Type of tomato		Number of seeds/g	Planting distance between rows and plants (m)	Seeds needed per ha planting (g)	Plants/ha
Fresh market	Indeterminate/ Determinate	250-300	0.75 x 0.4-0.5	100-150	26,000-33,000
Cherry	Indeterminate	450-550	0.75 x 0.5	65-80	26,00032,000
	Semi-determinate/ Determinate	450-550	0.75 x 0.5	65-80	26,00032,000
			1.5-2.1 x 0.5	25-35	20,00022,000
			2.1-2.4 x 0.6*	18-20	6,9007,900
Processing	Semi-determinate/ Determinate	250-300	1.5 x 0.3-0.4	75-105	16,00023,000

Source: Li et al, (2015)

Regarding seedling preparation, the choice of seedling raising methods depends on planting areas, convenience of operation, and flexibility. Seedlings grown in beds or seedboxes/trays suffer from root damage when the plants are pulled apart for transplanting; this can slow down subsequent growth. Seedlings grown in individual containers are healthier and more vigorous than those grown in beds or seedboxes/trays. Seedlings usually emerge within 3-5 days at optimal soil temperatures of 20-30 °C (See AVRDC, 1990; GES, 2010 and Li et al, 2015). It is highly recommended to raise all seedlings under protected structures such as simple net houses or net tunnels before they reach the hardening stage.

Seedlings are raised in beds when large quantities of seedlings are needed. However, seedlings may suffer from root damage when the plants are pulled out of the seedbeds for transplanting. Damage to the roots will delay growth or cause the seedlings to die after transplanted. As recommended in Li et al, (2015) in selecting location and seedbed size: choose an open, sunny and well-drained area not recently planted with a solanaceous crop (such as tomato, pepper, eggplant, potato). Incorporate well-decomposed and sieved compost or farmyard manure at a rate of 2 kg/m2 into beds. Form raised seedbeds 15 cm or higher and 80-100 cm wide to improve drainage (see fig 2.1). At least 150 m2 of seedbed area is needed to raise enough seedlings to plant one hectare.

Figure 2.2: Raised seedbeds

Source: Li et al, (2015)

In managing seedlings after sowing, the bed as shown in the figure 2.2 on the left is covered with a transparent plastic sheet to sterilize the seedbed soil through solarization.

Li et al (2015) recommends the following:

- **Damping-off control**: Young seedlings may develop a sunken, brown, necrotic lesion near the soil line due to fungal infection. If the lesion girdles the stem, the seedling collapses and soon dies (Fig. 2.2). To prevent this problem, apply terrazole (etridiazol 35% WP) at 0.25 g/500 ml after thinning. If damping-off symptoms develop further, apply terrazole 1-2 more times during the seedling stage.

Figure 2.3. Symptoms of tomato damping-off: the necrotic, brown lesion girdles the stem and the seedling collapses (red circle) and soon dies

Source: Li et al, (2015)

- **Fertilization**: Around 7-10 days after thinning, if the seedlings seem thin or the leaves turn a pale yellow-green colour, especially on the older foliage (Fig. 2.3), apply one of the following treatments once to the seedlings:
    - Option (1) 0.5% ammonium sulfate solution (5 g ammonium sulfate dissolved in 1 liter of water)

- Option (2) 0.25% urea solution (2.5 g urea dissolved in 1 liter of water)
- Option (3) 0.1% foliar nitrophoska solution (1 g dissolved in 1 liter of water)

Apply again one day before transplanting. Do not over-apply nitrogen or the plants will grow too tall and thin (Fig. 2.3, right picture, left plant). Monitor seedling growth; if the seedlings grow too rapidly before transplanting, apply less fertilizer.

Figure 2.4. Apply nitrogen solution when the older leaves of tomato seedlings turn a pale yellow-green color (left). Excessive nitrogen application or weak sunlight makes tomato seedlings tall, thin and spindly/leggy (left plant) rather than stocky, strong and sturdy (right plant)

Source: Li et al, (2015)

- **Hardening**: When the seedlings have 4 true leaves (around 20-25 days after sowing), harden the seedlings by slightly reducing the water supply. Around 6-9 days before transplanting, slightly reduce watering, remove the netting and expose the seedlings to strong sunlight so that they will be stocky and sturdy. Thoroughly water the seedlings 12-14 hours before transplanting them to the field.

CHAPTER THREE

METHODOLOGY

3.0 Introduction

This section presents methodological approach employed in carrying out the study. It presents research approach adopted, description of study area, data collection method and analysis.

3.1 Research Design

Participatory Action Research (PAR) will be employed in undertaking this study. In PAR, people in an organization share ownership over the research process from the design to the results of the study as observed by Kemmis and McTaggart, (2005). In PAR, the researcher does not participate as the professional expert, but as a team member in executing the study (Kidd and Kral, 2005). The fundamental goal of PAR is to improve practices through planning, acting, observing, reflecting, and collaborating with others in their own cultural context (Kemmis and McTaggart, 2005; McTaggart, 1997). Although PAR has various forms and shapes, the core principles of PAR focus on participants' experiences and beliefs, mutual involvement, and personal growth.

As the purpose of my study was to assess the effectiveness of project method of teaching on students' agricultural skills acquisition, employing PAR seemed desirable and appropriate. As the study involve testing the effectiveness of project method of teaching, and also identifying the best way of organizing and implementing this approach, the PAR design will be complemented by a pretest-posttest quasi – experimental design.

A pretest-posttest design is usually a quasi-experiment where participants are studied before and after the experimental manipulation. Pretest-posttest design, defined as participants who are studied before and after the experimental manipulation. Pretest-posttest designs are widely used in behavioral research, primarily for the purpose of comparing groups and/or measuring change resulting from experimental treatments (Marsden and Torgerson, 2012 and Dimitrov and Phillip, 2003). Pretest – posttest quasi – experimental design is considered appropriate for this study which sought to assess the effectiveness of project method of teaching on agricultural students' skills acquisition.

3.2 Profile of Awe Secondary Technical/High School

The study was conducted in the Awe Secondary/Technical School (SHS) situated at Saboro, a community within Kasena/Nankana Municipality – Navrongo in the Upper East Region of Ghana. The School was built in the 1954 as a Middle Boarding School and later changed to a Continuation School in 1969. Exactly nine years after, the school again changed into an experimental Junior Secondary School (1978).

In 1991, it was again converted into a Community Day School with only eleven (11) students. The school could not start with this small number as such was delayed for one year, with its first batch of students enrolling on the 1st January 1992 with a total students population of 84. The school started with only two programmes, Agriculture science, programmes and Visual Art. In the year 1993 the technical programme was added and later was closed down 1995 due to students' disturbance that was attributed to students from the technical department.

The technical department was reintroduced in the year 2001 by the then Headmaster Mr. Paul Achana Agoriba without the woodwork and metal work components. In

September 2007, the General Art programme was also introduced, Home Economic and General Science programme were introduce in 2012 and 2014 respectively to serve the varied educational needs of the community.

The school assumed its full boarding status in September 2013 and currently run six programmes with a total student's population of one Thousand Four Hundred and Twenty Two (1422) as at 2016/2017 academic year as shown in the table 3.1.

Table 3.1 Student Population of Awe SHS as at 2016/2017 academic year

S/N	PROGRAMME	SHS1	SHS2	SHS3	TOTAL
1	AGRIC SCIENCE	48	52	57	**157**
2	VISUAL ART	72	74	37	**183**
3	TECHNICAL	78	94	74	**246**
4	HOME ECONOMICS	54	52	58	**165**
5	GENERAL ART	202	197	173	**572**
6	GENERAL SCIENCE	38	37	24	**99**
		492	**506**	**423**	**1422**

Source: School Records, 2016/2017

3.3 Pre-intervention

Through the right community and school entering techniques, leadership of School Management Committee (SMC), Headmaster and teachers of Awe SHS was engaged. School authority, head of agricultural science department and teachers was briefed on the purpose of the action research and the procedure which will be embarked on in executing the research. Facilities such as land for the nursery practices, tools and equipment were all arranged with approval of the school authority.

Prior to the implementation of the intervention (project method of teaching) students' knowledge and skills on tomato nursery practice were assessed and recorded. Questionnaire administration, key informant interviews, focus group discussion and observation were employed to obtained information about the current situation of the school regarding skills acquisition and students' Knowledge, Attitude, Practices and Skills (KAPS).

In-depth interviews with the Headmaster of the School, Head of Agricultural Science Department and agricultural science teachers was undertaken to learn at first hand, the teaching and learning of agriculture science with emphasis on practical skills.

Short quiz and assigning tasks to students to perform were used to gauge students' prior KAPS regarding agricultural tasks in general nursing practice in particular. The general agriculture science text book provided information for the short quiz and tasks to assigned to students to help gauge students' prior KAPS.

3.4 Intervention

The intervention implemented for the Action Research is testing the effectiveness of Project Method of Teaching on students' knowledge and skills of tomato nursery practices. Project method of teaching has evolved from the philosophy of pragmatism which is experience – centered strategy related to life-situation. Successful accomplishments of project-based learning like the Project method of teaching have triggered many studies to focus on the justification of participant based learning in achieving learning objectives (Katz and Chard, 2000).

Students were assigned task of undertaking all the activities involved in nursery practices from nursery bed preparation to transplanting of seedlings. They were provided with all the necessary materials, tools and equipment to enable them undertake all the nursery practice by themselves, either in groups or individually. Although they were made to observed demonstration of the nursery practice after theoretical presentation of raising seedling based on the general agriculture science text book. Throughout the process of the project work, students were expected to be actively involved in making decisions about the design, enactment, and representation of the project while they learn through first-hand observations, hands-on experiences, and systematic reflection.

The project work were done in two different type namely individual project work and group project work. In the individual type, students were undertaking the nursery practice individually. Each student in this category was tasked to raise one nursery bed and execute all the nursery practice alone. While in the group type, students were put into group of five students and tasked to undertake the nursery practice as group.

These key characteristics of project work have been shown to be important in increasing students' level of engagement, self-confidence, and intrinsic motivation to learn (Ryan and Deci, 2000; Howard, 2000; Meece, Anderman, and Anderman, 2006).

3.5 Post Intervention

After the intervention was successful implemented, data were collected to assess the effect of the intervention. Also review meeting with school authority, head of agricultural science department, agricultural science teachers and selected students were organized to review and assess the implementation of the intervention. All the activities undertaken by the team were reviewed and lessons learnt were documented to guide future projects and implementation of the findings.

During the implementation phase, students' activities were observed guided by observation check list and video recording which were played at the school review and assessment meeting. Also students' KAPS of tomato nursery practices were assessed using semi structured questionnaire designed to gauge their knowledge level, attitude, practice and skills acquired by going through the project work.

3.6 Data Collection Method

Observation, personal interview, key informant interview and focus group discussion methods were employed in collecting data for this study. Semi-structured questionnaires and observational check list are the data collection instruments used to guide data collection. Semi-structured questionnaires were administered to students before and after the intervention (project teaching method) in which basic personal data, most frequent teaching method used, their understanding of basic concept of agriculture, their skills and practices of agriculture among other were collected. With the aid of check list, agricultural science teachers and Head of Departments of agriculture were interviewed to obtained in-depth information on the teaching and learning of agriculture. Also with the aid of observational check list, students' practice of tomato nursery were observed by both the researcher and teachers as member of the PAR.

3.7 Data Analysis

Brogan and Kutner, (1980) asserts that there are two common methods of analyzing data from a two-group pretest-posttest research design are (a) two-sample t test on the difference score between pretest and posttest and (b) repeated-measures/ split-plot analysis of variance. The repeated-measures/split-plot analysis subsumes the t test analysis, although the former requires more assumptions to be satisfied. A numerical example is given to illustrate some of the equivalences of the two methods of analysis. The investigator should choose the method of analysis based on the research objective(s). In this study repeated measures t-test or paired t – tested was applied in analysing the data for objective two (2) and three (3) of the study. Prior to the commencement of the study, a pretest was administered to the groups and after the treatment for four weeks; a posttest was administered by the agricultural science teachers under the supervision of the researcher. Mean difference was computed while the analysis of covariance (ANCOVA) was used to test the effects of project teaching method on nursery skills acquisition among students.

Also Chi-square analysis was applied to assess if there exist any significant difference in students' knowledge and skills acquisition among the two ways (individual and group project) of organizing project method teaching.

For objective four, students were asked to list and ranked the constraints they faced in undertaking their projects. And Kendell's coefficient of concordance was applied to assess the level of agreement among the ranks scores assigned by students. Kendall's coefficient of concordance (W) which was proposed by Maurice G. Kendall and Bernard Babington Smith is a measure of the agreement among raters or judges assessing a set of subjects in ranked order (Legendre, 2010). It is used to assess the degree to which respondents in a study provide common ranking on an issue with same general property.

The limits for W must fall between zero (0) and one (1). It is one (1) when the ranks assigned by each respondent are assumed to be the same as those assigned by other respondent and zero (0) when there is maximum disagreement among the rankings by the respondents. It should not be used to analyze sets of variables in which the negative and positive correlations have equal importance for the interpretation. In this study, W was employed to measure the degree of agreement among students in the ranking of constraints to executing project method of teaching. The W is calculated using the formulae;

$$W = \frac{12(S)}{m^2(n)(n^2-1)-mT}$$

Where ***n*** is the number of objects, ***m*** is the number of variables and ***T*** is a correction factor, ***S*** is a sum-of-squares statistic over the row sums of ranks R_i, and R is the mean of the R_i values computed first from the row-marginal sums of ranks R_i received by the objects:

$$S = \sum_{i=1}^{n}(R_i - \bar{R})^2$$

For tied ranks ***T*** is;

$$T = \sum_{k=1}^{g} t_k^3 - t_k$$

t_k= the number of tied ranks in each (k) of g groups of ties. The sum is computed over all groups of ties found in all m variables of the data table. T= 0 when there are no tied values and the equation becomes;

$$W = \frac{12(S)}{m^2(n)(n^2-1)}$$

W is an estimate of variance of the row sums of ranks Ri divided by the maximum possible value the variance can take; this occurs when all variables are in total agreement. Hence $0 \leq W \leq 1$

W of 1 represents perfect concordance (perfect agreement) and 0 indicates perfect disagreement in the ranking.

Hypothesis on *W*

Null Hypothesis (Ho): There is no agreement in the rankings of constraints to the execution of project teaching method of acquiring practical nursery priactice.

Testing the Significance of *W*

Friedman's chi-square statistic (χ^2) is obtained from *W* by the formula

$$\chi^2 = m(n-1)W$$

This quantity is asymptotically distributed like chi-square with *(n-1)* degrees of freedom; it can be used to test *W* for significance. This approach is satisfactory only for moderately large values of m and n (Kendall and Babington Smith, 1939; Legendre, 2010).

CHAPTER FOUR

RESULTS AND DISCUSSION

4.0 Introduction

This chapter presents results and discussions of an action research conducted to assess the effectiveness of project method of teaching agricultural practices on students' skills acquisition of tomato nursing practices. The research was conducted not only to test the effectiveness of giving students projects to undertake agricultural activities on their skills acquisition but also to identify the best and most effective way of implementing project teaching method.

The chapter is arranged into five sections. While section one presents students and parental demographic characteristics that of section two presents results and discussion on teaching methods commonly used in the teaching and learning of agriculture in the Awe SHS. Section three contains results and discussion on how the use of project teaching method can impart on students' skills acquisition. And that of section four presents findings on the best and most effective way of organizing and undertaking project method of teaching agricultural skills. Finally, section five, presents discussion on constraints in undertaking project teaching method in imparting agricultural skills.

4.1 Students' and Parental Demographic Information

Table 4.1, presents frequency distribution of students and parental demographic information. As shown in the table, overwhelming majority (82 percent) of the 100 students interviewed were boys. This demonstrates the male dominance nature of students perusing science related courses being experienced in the country. Inspite of the fact that women formed the majority of the country's agricultural labour force (see MOFA, 2012). Also a little over half (54 percent) of the students interviewed were less than 18 years, while about a third (36 percent) were within the age range of 18 – 20 years with only 10 percent being older than 20 years. This finding reflects the expected age range of SHS students considering the country educational system. The education system in the country consists of two years pre-school (kindergarten or early childhood education), nine year basic education and three secondary education. As such students in SHSs are expected to be in their late teen age.

Students before writing the Basic Education Certification Examination (BECE) are expected to filled Computerized Senior High School Placement Form in which they are required to indicate their preferred programme of study at the SHS level. As such students were asked to indicate whether agriculture was their first chosen programme. Analysis of their responses indicates that most of the student choose to offer agriculture. As shown in the Table 4.1, majority (87 percent) of them indicated that agriculture were their first choice when they were applying to enter SHS, while only 13 percent answered in the negative. They are explained that although agriculture was one of the three programmes they chose but it wasn't their first and most preferred course of study at the senior high level.

With regard to parental background, most (66 percent) of the parents of the students have no formal educational background, with only 34 percent having basic (21 percent), secondary (9 percent) and tertiary (4 percent) level of education. Also majority (57 percent) of the parents of the students interviewed are engaged in farming and other agricultural related enterprises as their main occupation with only 43 percent saying their parents engage in other employment activities as their main occupation even though they also engage in some form of agricultural activities as a part-time occupation. Many (45 percent) of the students interviewed indicate that their parents engaged in mixed farming (both crops and livestock farming) some indicated that their parents mainly kept livestock (16 percent) or engaged mainly in crop production (39 percent). Therefore, the students interviewed are mainly coming from farm household background and are expected to have a practical experience in farming and other agricultural related activities. This exposure will in no doubt have an impact on their ability to appreciate agricultural science concepts being taught in science and their interest in taking part in agricultural practices.

Table 4.1 Students and Parental Demographic Characteristics

Students' and Parental Characteristics		**Frequency**	**Percent (%)**
Sex of Students	Boy	82	82.0
	Girl	18	18.0
	Total	**100**	**100.0**
Age of students	Less than 18 years	54	54.0
	18 – 20 years	36	36.0
	Older than 20 years	10	10.0
	Total	**100**	**100.0**
Was Agric. your first choice	Yes	87	87.0
	No	13	13.0
	Total	**100**	**100.0**
Parental Education	No formal Education	66	66.0
	Basic level	21	21.0
	Secondary	9	9.0
	Tertiary	4	4.0
	Total	**100**	**100.0**
Main Occupation	Farming/agric. related	57	57.0
	Other occupation	43	43.0
	Total	**100**	**100.0**
Type of farming	Mixed farming	45	45.0
	Mainly Livestock Rearing	16	16.0
	Mainly crop production	39	39.0
	Total	**100**	**100.0**

Source: Analysis of field Data, 2017

4.2 Teaching and Learning of Agriculture

This section presents results on type of teaching methods mostly used in the teaching and learning of agriculture. Both students and teachers were interviewed on commonly used methods in the teaching and learning of agriculture. The teachers were asked to indicate which methods they mostly used in teaching both theoretical and practical agriculture, while students' views on how their teachers approach the teaching of agriculture were also sought. As such this section provided information gathered from the research which addresses objective one of the study which sought to examine the common teaching and learning methods employed in the school.

4.2.1 Most used Teaching Methods

Results of analysis of the six (6) agricultural elective teachers interviewed reveals the following as the common methods used in the teaching of theoretical agriculture;

1. Lecture teaching method
2. Classroom discussion with students
3. Classroom demonstrations
4. Questions and answers

They were of the view that, due to time and inadequate Teaching and Learning Materials (TLMs) they mostly relied on lecture method of teaching to enable them cover the syllabi and their scheme of work. A General Agriculture Science teacher observed that '*if you don't lecture you can't finish the syllabi for students to write their examinations*'. Even though they generally admit that the lecture methods alone is inadequate to ensuring effective teaching and learning of agriculture, but they maintained that is the only way they can cover all the topics in the agricultural curriculum. Responding to follow-up questions 'which method of teaching would have been the best;, they were generally of the view that combination of lecture method, discussion, demonstrations and questions and answer session would have been the best but they hardly have the time and needed TLMs to frequently do that.

With regard to the teaching of practical lessons, the following methods were mentioned as the frequent used methods in teaching practical agriculture lessons:

1. Lecture method
2. Classroom demonstration
3. Field demonstration
4. Filed trips and tours

Responding to a follow-up question on 'how do they used lecture method in teaching agriculture', horticulture teacher said '*sometimes you don't have the required TLMs to actually demonstrate the activities for the practical so you virtual end up by lecturing the students on the process of undertaking the practical activities in an abstract manner.* It was generally agreed that, practical lessons mostly require some resources such as vehicle to convey students for field trips and tours, acquiring material for field demonstration, which often limit the number of practical lessons held in a term. Agriculture science is a practical oriented course and therefore requires practical instructions and application via effective demonstration strategies.

4.2.2 Students' views on how Agriculture is Taught

Students views on type of teaching method their teachers mostly used in the teaching of agricultural science related courses in the school were sought and the results presented in the Table 4.2. As shown in the Table 4.2, majority (54 percent) of the students interviewed perceived that their teachers mostly used lecturing methods in teaching theoretical lessons, while 23 percent viewed classroom demonstration as the most used teaching method. However, regarding practical lessons, majority (54 percent) were of the view that classroom demonstrations are mostly used to teach them practical while 38 percent and 4 percent think that it is rather lecture method and field trips and tour respectively are the mostly used teaching method in delivering practical lessons.

Even though students interviewed generally have a varying views of the most used method in the teaching and learning of theoretical and practical agriculture in their school, most of them were of the view that lecture method and classroom method are the most used teaching methods in the teaching of theoretical and practical lessons respectively.

Regarding students view on how frequent they have practical lessons in their school, which was measured on a Likert scale as 'very frequent', somewhat frequent' and less frequent'. Analysis of their responses as shown in Table 4.2 reveals that only 10 percent of them think that they undertake practical lessons very frequently. While half of them think they undertake practical lessons less frequently and the remaining 40 percent viewed the frequency of their practical lessons as somewhat frequent.

Table 4.2: Method of teaching Agriculture in the School

Methods of Teaching Agriculture		Frequency	Percent
Most used Methods in teaching theoretical agric.	Lecture method	54	54.0
	Classroom Demonstration method	23	23.0
	Questions and answers methods	23	23.0
	Total	**100**	**100.0**
Most used Methods of teaching practical agric.	Lecture method	38	38.0
	Classroom Demonstration method	54	54.0
	Questions and answers methods	4	4.0
	Field Trip and tours	4	4.0
	Total	**100**	**100.0**
Frequent of practical lessons	Every frequent	10	10.0
	Somewhat frequent	40	40.0
	Less frequent	50	50.0
	Total	**100**	**100.0**

Source: Analtsis of field data, 2017

4.2.3 Students Learning of Agriculture

Students interviewed mainly relied on class notes, text books and electronic sources such as e-books in undertaking their private studies of theoretical agricultural concepts. Analysis of students' responses to the question 'how do you undertake your own studies?' as shown in the Figure 1, revealed that students mainly read their class notes (32 percent) or read mainly their text books and electronic sources of reading material (50 percent) or hold discussion among themselves (18 percent). Thus students interviewed relied mainly on notes taken during class lessons and their text books for their private studies.

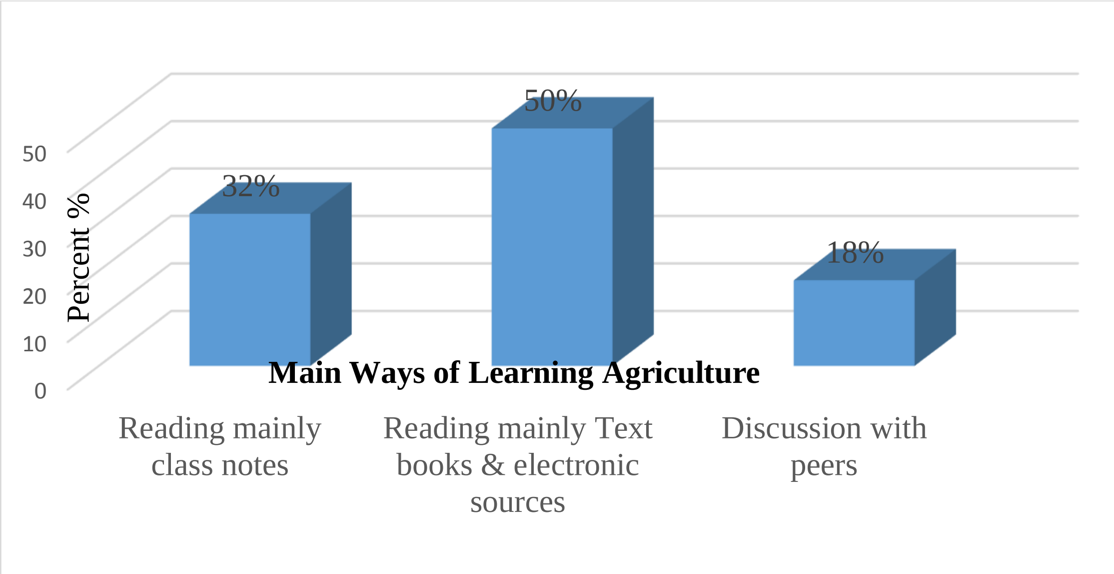

Figure 4.1: Bar Graph showing students main ways of learning

Source: Analysis of field data, 2017

Students were required to indicate how actively they participate in practical lessons on three points Likert scale as 'very active', 'somewhat active' and 'less active'. Analysis of their responses is presented in the bar graph shown in Figure 4.2. As shown in the figure, only a quarter (21 percent) of the students interviewed was of the view that they actively participate in practical lessons organized by their teachers. They explained that they always have to practice every activities demonstrated to them by their teachers. However, just about a half (48 percent) scored their participation in practical lessons as somewhat active and about a third (31 percent) ranked their participation in practical lessons as less active. Further probes reveals that due to limited TLMs and few number of practical lessons occurred by their teachers they hardly have the opportunity to actively take part in practical lessons.

Information gathered on students' response to the question whether they make efforts to acquire practical agricultural skills by themselves shows that students hardly make extra efforts to acquire agricultural skills. The only effort they make is to identify and classify plant specimens which they indicted will be enough to pass their examination. Thus students' motivation for undertaking practical lessons is to pass their examinations and not necessarily acquire the skills needed to be technically competent agricultural graduates.

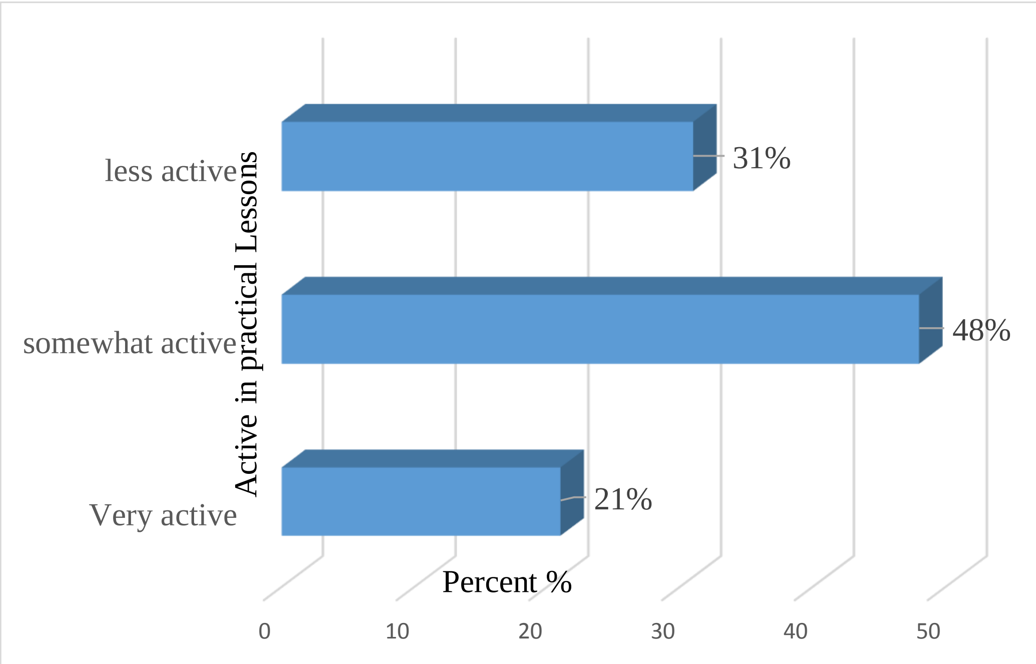

Figure 4.2: Bar graph showing students' participation in practical lessons

Source: Analysis of field data, 2017

4.3 Effectiveness of Project Teaching Method on Nursery Skills Acquisition

This section presents information on how the intervention implanted affect students' knowledge and skills on tomato nursery practices. This section therefore provided information addressing objective two of this study which sought to examine the effectiveness of project teaching method on students' agricultural skills acquisition.

The Project teaching method which has evolved from the philosophy of pragmatism and experience – centered strategy related to life-situation, was employed to impart tomato nursery practice skills on students. Katz and Chard, (2000) observed that project-based learning like the Project method of teaching have triggered many studies to focus on the justification of participant based learning in achieving learning objectives.

Students were assigned task of undertaking all the activities involved in nursery practices from nursery bed preparation to transplanting of seedlings. They were provided with all the necessary materials, tools and equipment to enable them undertake the all the nursery practice by themselves, either in groups or individually.

To scientifically examine the effectiveness of this intervention on students' nursery skills acquisition, data on students' prior knowledge and skills on nursery practices were gathered and analysed. All students who participated in this study have gone through nursery practices in their general agricultural science course. As such it was in order to examine their knowledge and skills level before they assigned the project work of raising tomato seedlings. The next subsection presents results of assessment of students' knowledge and skills level prior to the implementation of the intervention.

4.3.1 Students' pre intervention knowledge and skills on Nursery practices

This section presents results of analysis of students' prior knowledge of nursery practices before they undertook the project work.

4.3.1.1 Students' Prior Knowledge

Students' knowledge on nursery practices were measured on a four point Likert scale of 0 – 3. The general agricultural science text book for SHSs listed fourteen (14) nursery practices. If a student is able to recall a practice, it is score 1, if not 0. If a student recall a practice and correctly explained it, he/she is given a score of 2. If such a student also demonstrate how the practice is undertaken he/she is given the maximum score of 3 for that practice.

An index (refer to here as knowledge index) was developed to reflect students average score of all the fourteen nursery practices. A student score for each of the fourteen practices was divided by 3 (maximum score) and sum up. The sum was divided by 14 to obtain the average knowledge score for such a student and this represent the student's knowledge score. Students whose knowledge index was less than 0.25 were classified as having poor knowledge of nursery practice, while those whose index were between 0.25 – 0.5 and above 0.5 were classified as having average knowledge and above average respectively. Figure 4.3 shows distribution of students' prior knowledge score of all the fourteen nursery practices while table 4.3 present distribution of students' knowledge classification prior to the intervention.

As shown in the figure 4.3, respondents generally could recall most of the fourteen activities involved in nursery practices. About 80 percent, 73 percent and 71 percent could recalled site selection, preparing nursery seed box and bed respectively. Also 80 percent, 79 percent and 80 percent could respectively recalled seed sowing, weed control and watering of seedling. However very few could recall shading of seedlings in nursery bed (43 percent), picking out (41 percent), stirring of soil (32 percent), pest and disease control (31 percent) and hardening off of seedlings (32 percent).

Students were also required to explain these nursery practices by highlighting what it they are and their relevant. As shown in the figure 4.3, close to two-third (61 percent) of the students could explain site selection, while 52 percent could explain preparation of nursery beds and 75 percent could explain sowing of seeds in nursery bed. However, very few students could explain picking out (33 percent), pest and disease control (26 percent) and hardening off (23 percent).

However, students generally exhibited very poor ability to demonstrate these nursery practices. The results as shown in the figure illustrates that with the exception of site selection, preparation of nursery bed, sowing of seeds and watering of seedling where 52 percent, 46 percent, 54 percent and 52 percent respectively could correctly demonstrates how to do it, only few students could demonstrate how to perform the other activities. For instance, as shown in the Figure 4.3, only 30 percent could demonstrate shading of seeding in nursery beds, 23 percent could demonstrate stirring of soil, and 26 percent and 23 percent could respectively demonstrate pest and disease control and hardening off of uproot seedlings.

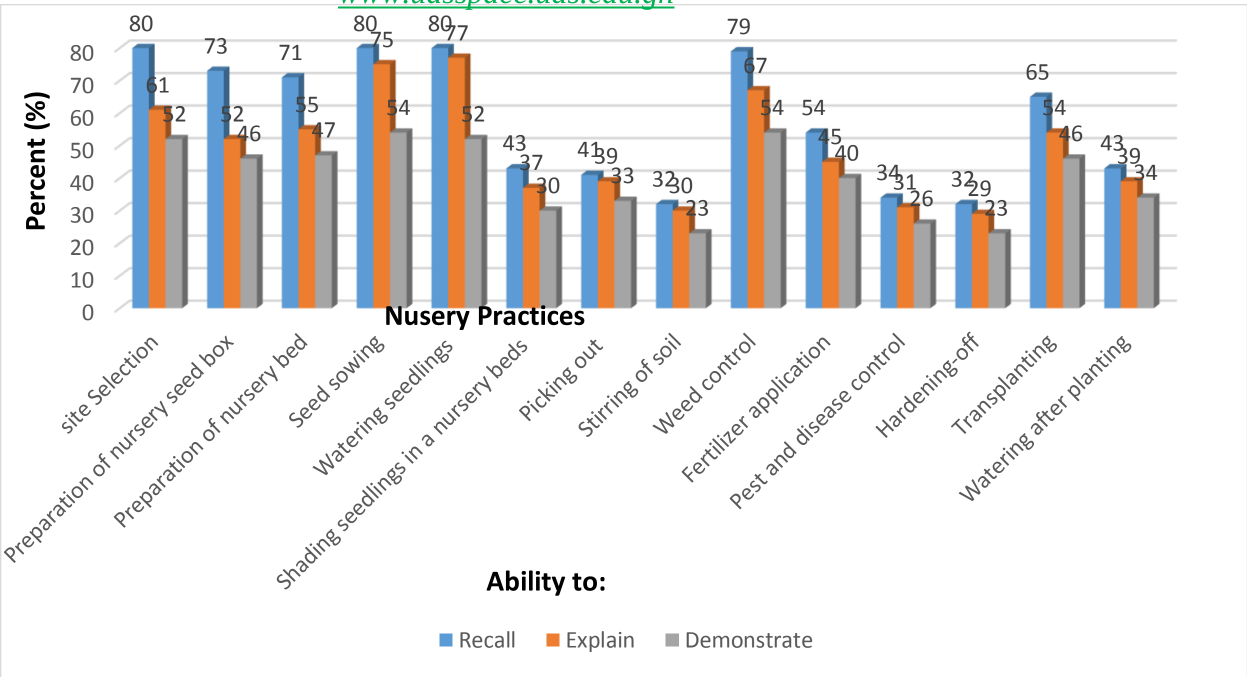

Figure 4.3: Pre intervention knowledge on nursery practices

Source: Field data Analysis 2017

In general, just about a third (37 percent) have their knowledge index being above 0.5 and as such classified as having above average knowledge before the intervention of project teaching method was implemented (see table 4,3). Also 41 percent have their knowledge index being less than 0.25 and as such classified as having poor knowledge. As shown in the table about a quarter (22 percent) score a knowledge index of 0.25 - 0.5 and were classified as having average knowledge of tomato nursery practices.

Many of the students (41 percent) inspite of have studied nursery practices in their general agricultural science demonstrate poor knowledge in nursery practices. With some of them not being able recall the practices and explain them. Majority of them were unable to demonstrate how to perform the tasks involved in nursery practices. It can therefore be argue that the current way in which the teaching and learning of agriculture is done the school need to be reviewed. It is obvious that lecture and classroom demonstration method teaching agricultural practices is failing in imparting the requisite knowledge and understanding on students.

Table 4.3 Prior Knowledge level

		Frequency	Percent (%)
	poor	41	41.0
Level of Knowledge pre	average	22	22.0
intervention	above average	37	37.0
	Total	**100**	**100.0**

Source Analysis of field data, 2017

4.3.1.2 Students Prior Skills

A four point Likert type scale was developed to measure students' level of skills in undertaking nursery practices. Students' skills were assessed by their ability to describe the tasks, mention the materials and tools require to accomplish the task and actual performance of the task. The bar graph shown in the figure 4.4 present frequency distribution of number of students who were able to describe the task, mention what is require to perform the task and actual perform the task for each of the nursery practices.

As shown in the figure, student perform fairly well in describing the tasks involved in each of the nursery practices. As shown in the figure 4.4, about half (50 percent) of the students participants of the study could described the task involved in site selection, 43 percent could described the tasks involved in preparing nursery beds, 51 percent and 49 percent could described the activities involved in the performance of seed sowing and watering of seedlings respectively.

However, for some tasks such as shading seedling in nursery beds (27 percent), picking out (20 percent) pest and disease control (23 percent) and hardening off of uprooted seedlings before planting them (20 percent) only very few students were able to describe the tasks involving in performing them.

Similarly, with regard to students' ability to identify the tools and materials require in performing nursery practice, students performed fairly well for some activities and very poorly for others. About 44 percent of students could identified tools and material require to assist in selecting site for nursery, 38 percent could identified the material and tools for preparing nursery beds and 45 percent could mentioned the tools and materials required for sowing.

However, only 30 percent, 27 percent, 17 percent and 15 percent could mentioned the tools and materials require to undertake fertilizer application, watering after planting, hardening off and pest and disease control respectively.

As shown in the figure (4.4) only 40 percent could correctly undertake site selection activities, while 30 percent and 41 percent could correctly execute nursery bed preparation and sowing respectively. Similarly, only 22 percent could correctly practice shading seedlings in nursery beds, while 17 percent and 27 percent could actually practice stirring of soil in nursery beds and fertilization respectively. In addition, only 14 percent could practice pest and disease control while 30 percent and 22 percent could practice transplanting and watering after transplanting respectively.

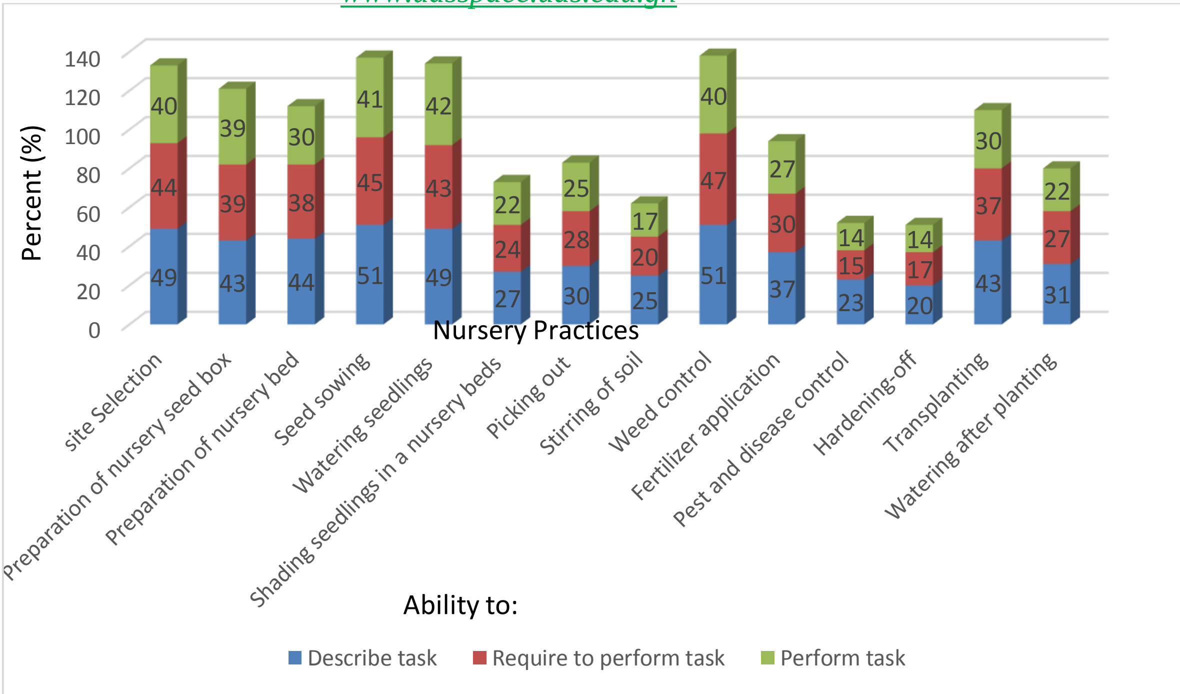

Figure 4.4 Students' pre intervention skills level of nursery practices

For each of the nursery practices students were asked to describe the activities involved in undertaking the task. If a student is able to describe the activities involved in the task he/she score '1' otherwise '0'. After describing the task, if a student is able to mention the materials and tools require to accomplish the said task he/she score 2. After which students were offered the opportunity to under the activities. Students who were able to correctly undertake the activities involved in the performance of nursery practices were assigned a score of 3.

To standardized the score, student score for each of the nursery practices was divided by 3 (the maximum score) and the average score representing students' skills index was calculated for all the students. As such the index was ranging from zero to one. Students whose skills index were less than 0.25 were classified as being 'Not yet competent', those with skills index of 0.25 – 0.5 were classified as 'averagely competent' and those with index of above 0.5 as 'very competent'. Frequency distribution of students' skills level is shown in the table 4.4. As shown in the about two –third (61 percent) of the students were not yet competent in undertaking nursery practices while 19 percent and 20 percent could be described as averagely competent and very competent respectively.

It is therefore clear that majority of students interviewed lack the requisite competent to undertake tomato nursery inspite of the fact that they have gone through nursery practices lesson in their general agriculture syllabus. It can therefore be argued that the current mode and method teaching is not imparting needed skills on students.

Table 4.4 Prior Intervention Skills Level

		Frequency	Percent (%)
Skill level before intervention	Not yet competent	61	61.0
	Averagely competent	19	19.0
	Very competent	20	20.0
	Total	**100**	**100.0**

Source: Analysis of field data, 2017

4.3.2 Post Intervention Analysis

After students were tasked to undertake raising of tomato seedling by practical carrying out the necessary practice in groups and individually, their knowledge and skills were again assessed. The results of the assessment referred to as post intervention knowledge and skills is presented this section.

Figure 4.5: Students undertaking nursery practices in a tomato nursery as part of their project work

4.3.2.1 Post Intervention Knowledge

After the intervention students' ability to recall, explain and demonstrate the various nursery practices were analysed and the results shown in the figure 4.6. As shown in the Figure, majority of the students could recalled site selection (90 percent), nursery bed preparation (86 percent), seed sowing (86 percent), shading of seedlings (78 percent), picking out (77 percent), weeding (76 percent) stirring of soil (76 percent), hardening off (76 percent) and transplanting (78 percent). This was much improvement over their pre intervention ability to recall nursery practices as shown in the figure 4.3. For instance, before the intervention only 41 percent, 32 percent and 34 percent could recalled picking out, stirring of soil and pest and disease control respectively as compare with post intervention results which shows that about 77 percent can now recall picking out, 76 percent for stirring of soil and 76 percent for disease and pest control.

Similarly, there was much improvement in students' ability to explain the various necessary practices after they have gone through the project method. As shown in the Figure 4.6, about 80 percent of the students can now explain how to undertake site selection for nursery practices compare with 61 percent who could do so before the intervention. Also 77 percent can now accurately explain the process of nursery bed preparation compare with 55 percent who could do so before the intervention. Similarly only 30 percent of the student participants could explain how to undertake stirring of soil in nursery bed before the intervention, which have seen more than two fold (72 percent) increased after the intervention.

Also, before the intervention, only 23 percent of the student participants could explain how to undertake hardening off of seedling before transplanting. This figure has increased to 70 percent of the respondents now being able to explain hardening off after the intervention. It can therefore be argued that the intervention have positive effects on students' ability to understand the nursery practices. Students' understanding of the nursery practices has seen much improvement after going through their projects of undertaking nursery practices.

With regard to students' post intervention ability to demonstrate how to practice the various nursery practices, drastic improvement were observed. While only 52 percent of the respondents could demonstrate how to undertake site selection for raising of seedling before the intervention, 77 percent of them can now demonstrate how to undertake site selection after they have gone through the project of undertaking. Similarly, while 70 percent of student participants were able to demonstrate how to practice picking out of seedling from nursery beds, after going through the project compare with only 33 percent who could do so before the intervention. Also, while only 30 percent were able to demonstrate how to undertake shading of seedlings in nursery beds before the intervention, after the intervention 64 percent can now be able to demonstrate the practice of shading seedlings on nursery beds.

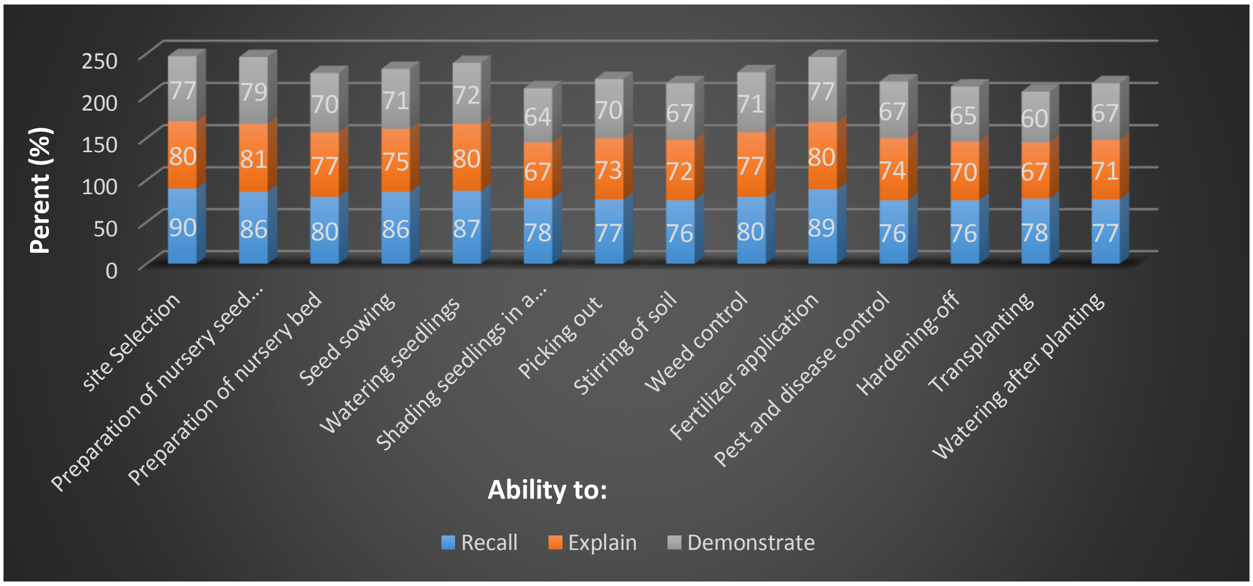

Figure 4.6: Students' knowledge of nursery practices after the intervention

Source: Analysis of field data, 2017

All the student participants of this study demonstrated high level of knowledge of nursery practices after going their projects assigned them as part of the intervention. Analysis of students' knowledge index, which measure students' ability to recall, explain and demonstrate the activities of the nursery practices, reveals much improvement on students overall knowledge level. The analysis revealed that none of the students have knowledge index of less than 0.25 after going through the project compare with 41 percent who scored less than o.25 before the intervention. Also 50 percent scored knowledge index of more than 0.5 after the intervention compare with only 37 percent before the intervention.

4.3.2.2 Post Intervention Skills level

Students' level of skills measured by their ability to describe task involved in carrying out nursery practices, understanding of tools and materials require in undertaking the activities and actual performance of the activities. Results of the analysis of ability under each of the criteria are shown in the figure 5.7. As shown in the figure, there have been appreciable increased in students' skills level after the implementation of the intervention. After students have gone through the project method, students who could accurately describe the task involved undertaking site selection increased from 49 percent to 83 percent. Similarly while 44 percent and 27 percent respectively could accurately describe the tasks involved in undertaking nursery bed preparation and shading of seedlings in nursery before the intervention, the figure sharply increased to 77 percent and 76 percent who could now describe the tasks involved in undertaking nursery bed preparation and shading of seedlings in nursery after they gone through their respective projects (see figure 4.7 and 4.4).

Also, as shown in the figure 5.6, about 72 percent and 70 percent of the students after going through their projects can now described stirring of soil in nursery beds and pest and disease control respectively. This represent substantive improvement compare with only 25 percent and 23 percent who were able to described the tasks involved in undertaking stirring of soil in nursery beds and pest and disease control respectively before the intervention.

Similarly results of improvement in students' ability to identify the tools and material require in undertaking the various nursery practices after intervention was administered was observed. Overwhelming majority (77 percent) after going through the project method of teaching tomato nursery practices were able to mentioned all the necessary tools and equipment needed to identify appropriate site for siting nursery compare to 44 percent who were able to do so before the intervention (see figure 4.4 and 4.7). Also as shown in the figure 4.4 and 4.7, while only 34 percent and 28 percent respectively could mentioned the necessary tools and equipment require to undertake the tasks of carrying shading of seedlings in nursery and picking out of mature seedling for transplanting, after going through the project method of teaching percent of student who could do increased to 74 percent and 69 percent respectively.

Similarly, students ability to actual perform the various nursery practices was greatly enhanced after they have gone through the project method, where they were offered the opportunity to actual practice the various nursery practices in groups and individually. As shown in the figure 4.4 and 4.7, while only 30 percent of the students could actually prepare nursery bed before the intervention, the students who were able to perform preparation of nursery bed increased to more than half (70 percent).

Also students' ability to undertake shading of seedlings on nursery bed and practice picking out of mature seedling from nursery bed/box for onward transplanting witnessed much improvement after students have been taken through project method of teaching which offered them the opportunity to have hand-on experience of nursery practices. As shown in the figure 4.4 and 4.7, while only 22 percent and 25 percent respectively were able to accurately practices shading of seedling on nursery bed and picking out of seedling for transplanting before the intervention, after going the intervention 70 percent and 67 percent have been able to perform shading of seedlings on nursery bed and practice picking out of seedlings from nursery respectively. Similarly, after going through the project method of teaching, 63 percent and 67 percent respectively have been able to respectively undertake hardening off of uprooted seedlings before transplanting and pest and disease control compare with only with only 14 percent who were do so before the intervention (see figure 4.4 and 4.6).

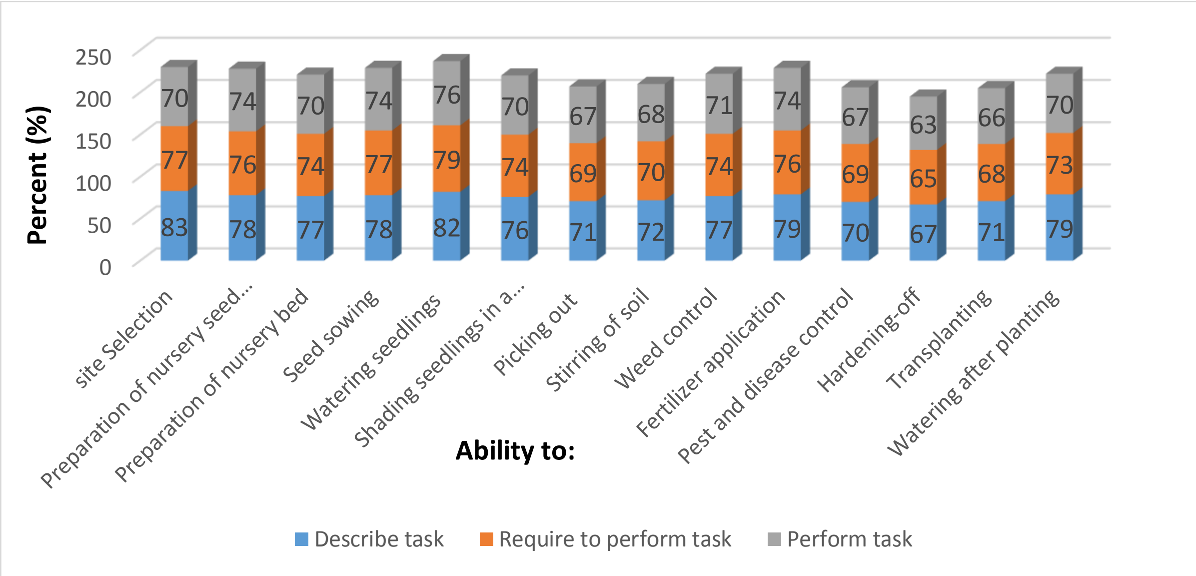

Figure 4.7 Bar Graph showing students' post intervention skills

Source: Analysis of field data, 2017

4.3.3 Effect of the intervention in improvement Students' Knowledge and Skills

This section presents results and discussion of findings of the study relating to effect of the intervention in improving students' knowledge and skills of nursery practice. As already discussed in section 4.3.2.1 and 4.3.2.2, there has been great improvement in student knowledge and skills after through the intervention.

4.3.3.1 Effect of the Intervention on Students' Knowledge

Based on students' knowledge index which was calculated as aggregate of students score on their ability to recall all the activities in nursery practices, explain the activities and demonstrate how to undertake the activities involved in nursery practices, students were categorised as poor (if score knowledge index less than 0.25) average (if score knowledge index of 0.25 – 0.5) and above average (if score knowledge index of more than 0.5). Figure 4.7 presents students' knowledge level before and after going the intervention.

As shown in the figure 4.8, while 41 percent students were classified as having poor knowledge based on their knowledge index before the intervention, after going through the project all of the students scored above poor. Also while only 22 percent of the student participants were found in the pre intervention assessment to have average knowledge of nursery practice, after going through project, additional 27 percent students, being the figure to 50 percent, were found to have average knowledge in the post intervention assessment. Similarly, while 37 percent of the students in the pre-intervention assessment were found to have above average knowledge on nursery practices, after going through the intervention, the figure increased to 50 percent. This indicates improvement of 13 percent compare with pre intervention assessment.

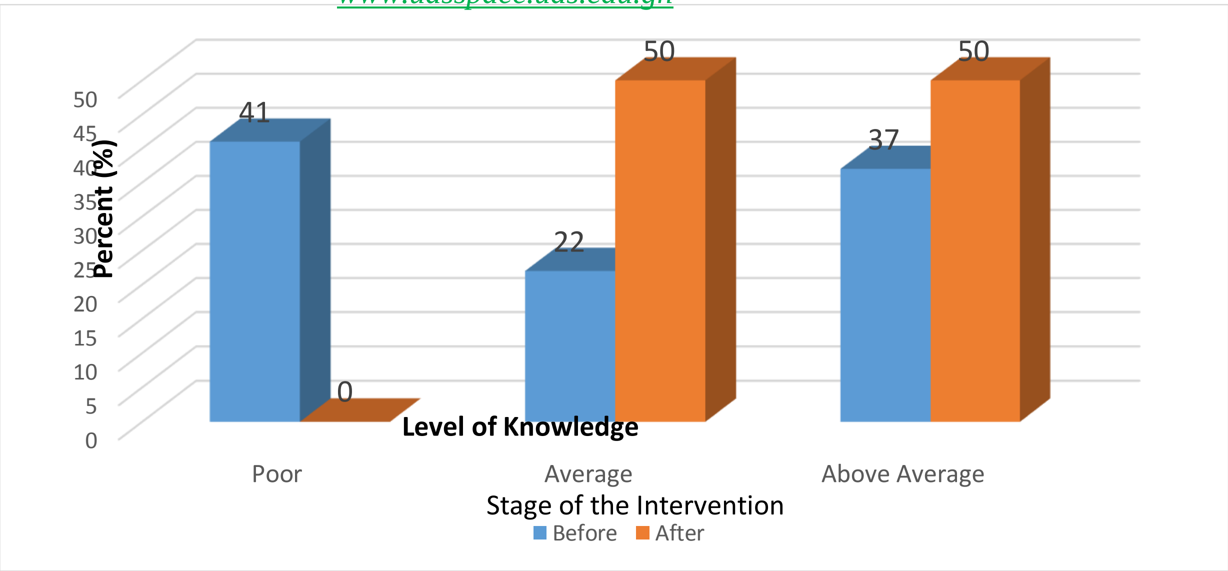

Figure 4.8 Bar graph of students' knowledge level before and after intervention

Source: Analysis of field data, 2017

To test significant difference between pre-intervention knowledge of students and post intervention knowledge paired t-test were conducted and results shown in table 4.6 and 4.7. The test was done to examine the hypothesis:

Ho: There is no significant difference in knowledge of students before and after the intervention

Ha: There is significant difference in knowledge of students before and after the intervention

As shown in the table 4.6, with t value of -13.029 (df = 99; sign = 0.000), the null hypothesis was rejected in favour of the alternative. This indicates significant difference in students' knowledge index before and after the intervention. As shown in the table 4.5, while the average students' knowledge index before the intervention was found to be 0.48, their average score after going through the intervention is 0.68.

This indicates a change of 0.20 between the students' knowledge index of before and after. Thus after going through the project, students averagely scored 0.2 knowledge index above their pre intervention knowledge index. Thus the intervention have significantly contributed in improving students' knowledge of nursery practice.

Table 4.5: Paired Samples Statistics

Stage of the intervention		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Knowledge Index Before	0.4810	100	0.45097	0.04510
	Knowledge Index After	0.6830	100	0.33244	0.03324

Source: Analysis of field data, 2017

Table 4.6: Paired Samples Test

Stage of the intervention		Paired Differences		t	df	Sig. (2-tailed)
		Mean	Std. Deviation			
Pair 1	Knowledge Index Before Knowledge Index After	-0.20200	0.15504	-13.029	99	.000

Source: Analysis of field data, 2017

4.3.3.2 Effect of the Intervention on Students' Skills

Students' pre intervention skills on nursery practices were assessed and compared with their post intervention skills to assess the effect of the intervention on students' skills. Students' skills were assessed based on their ability to describe the activities involved in undertaking the various nursery practices, mentioned the tools and materials require to perform the tasks and actual performance of the task. Students were scored under these three criteria and their skills index representing their aggregate score on all the three indicators was calculated. Based on the skills index students were graded as not yet competent (if student scored less than 0.25 skills index), averagely competent (for skills index of 0.25 – 0.5) and very competent (if student scored skills index of above 0.5). Figure 4.9 presents bar graph of students' skills level before and after the intervention.

As shown in the graph, all the students, after going through the project, were found to be either averagely competent and very competent while majority (60 percent) were found to be 'not yet competent' before the intervention. Thus in the pre intervention assessment, 60 percent of the participants were found to be not yet competent while only 19 percent and 20 percent were averagely competent and very competent respectively. However, after they have gone through the project, 61 percent and 39 percent respectively were found to be averagely competent and very competent respectively. Thus all the 61 students were found not be competent before the intervention are now either averagely competent or very competent. In general the intervention has had much positive effect on students' skills acquisition and competency.

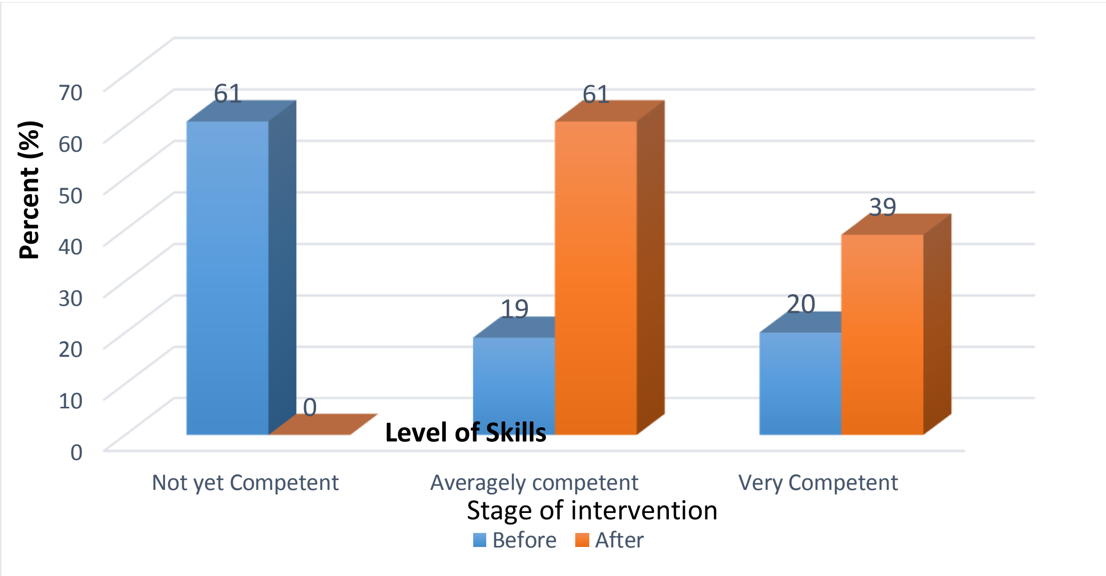

Figure 4.8: Bar graph of student skills level before and after the intervention

Source: Analysis of field data, 2017

To examine whether the intervention have significantly improved students' skills level paired t-test were conducted and results shown in table 4.7 and 4.8. The test was done to examine the hypothesis:

Ho: There is no significant difference in skills of students before and after the intervention

Ha: There is significant difference in skills of students before and after the intervention

As shown in the table 4.8, with t value of -19.092 (df = 99; sign = 0.000), the null hypothesis was rejected in favour of the alternative. This indicates significant difference in students' skills index before and after the intervention. As shown in the table 4.7, while the average students' skills index before the intervention was found to be 0.39, their average skills index after going through the intervention is 0.65.

This indicates a change of 0.26 between the students' knowledge index of before and after. Thus after going through the project, students averagely scored 0.26 skills index above their pre intervention knowledge index. Thus the intervention have significantly contributed in improving students' nursery practice skills. After going through the intervention the students 'average skills index have increased by 0.26. It is therefore deduce that, project method of teaching significantly help in improving agricultural students' skills acquisition and technical competency.

Table 4.7 Paired Samples Statistics

Skills level		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Skills Index Before	0.3900	100	0.39962	0.03996
	Skills Index After	0.6490	100	0.31734	0.03173

Source: Analysis of field data, 2017

Table 4.8 Paired Samples Test

		Paired Differences		t	df	Sig. (2-tailed)
		Mean	Std. Deviation			
Pair 1	Skills Index Before – Skills Index After	-0.25900	0.13566	-19.092	99	.000

Source: Analysis of field data, 2017

4.4 Effective way of Undertaking Project Method of Teaching

The study also assessed the best way of organizing project method of teaching to ensure its effectiveness in imparting knowledge and skills on students. This section presents results of analysis of two ways (individual and group) into which students can be organized for project method of teaching. This section therefore present information addressing objective three of the study which sought to 'to assess the most effective way of using project teaching method to improve on agricultural knowledge and skills acquisition among agricultural science students of Awe Senior High School'.

4.4.1 Knowledge Level of Students in Group and Individual

To administer the project method of teaching, students were randomly assigned to either undertake raising of tomato seedlings in groups of five or individually. After going through the project their knowledge level was assessed and contrasted to test the significant difference between the average performance of students in who undertook the project in groups and those who did it individually. This was done to test the hypothesis:

Ho: There is no significant difference in the knowledge level of students who took the project in groups and those who did it individually.

Ha: There is significant difference in the knowledge level of students who took the project in groups and those who did it individually.

To test the hypothesis students' post intervention knowledge index were subjected to independent t – test and tested at 5 percent level of significant. Result of the t-test is shown in the table 4.9.

As shown in the table with t-value of -2.02 (df =98), implies there is significant difference between average knowledge of students who underwent the nursery practices in group and those who did it individually at 5% level of significant. As such the null hypothesis which state 'there is no significant difference in the knowledge level of students who took the project in groups and those who did it individually' is rejected and the conclusion is that there is significant difference in the knowledge level of students who did the project in groups and those who did it individually.

As shown in the table (table 4.9) the average knowledge index of those who did the project in groups was found to be 0.73 compare with the average score of 0.63 for those did it individually. It therefore clear that those students who underwent the project as groups were more likely to score high knowledge index compare with those who did it individually. Apparently because doing it in group offer the students opportunity to discuss and share ideas as they do it together, which is not the case for those who did it individually. Also organizing it in group also reinforces group learning and team building very important in building students' skills acquisition.

Table 4.9: Group Statistics and Independent Samples Test of knowledge before and after

Participation form	N	Mean	Std. Deviation	t	df	Sig.
Individual	50	0.6360	0.32811	-2.021	98	0.0418
Group	50	0.7300	0.33335			

Source: Analysis of field data, 2017

Also students' knowledge index which was classified into classes as 'poor', 'average' and 'above average' for knowledge index of less than 0.25, 0.25 – 0.5 and above 0.5 respectively were subjected to Chi - square analysis to test if there is significant difference in students' knowledge category between those who did the project in groups and those who did it individually. Results of the cross tabulation and Chi-square analysis is shown in the table 4.10.

As shown in the table with Pearson Chi-Square ($\chi2$) = 3.56; df= 1; sig. = 0.046, implies there is significant difference in the knowledge level of students who did the project in groups and those who did it individually at 5% level of significant. As shown in the table 4.10, majority (58 percent) of students who did the project in groups scored above average knowledge compare with only 42 percent in the case of those who did it individually.

Table 4.10 cross tabulation of participation category and post intervention knowledge

Post intervention Knowledge level			Participation form		Total
			Individual	Group	
Knowledge	Average	Count	29	21	50
		% within Participation category	58.0%	42.0%	50.0%
	Above average	Count	21	29	50
		% within Participation category	42.0%	58.0%	50.0%
Total		**Count**	**50**	**50**	**100**
		% within Participation category	**100.0%**	**100.0%**	**100.0%**

Pearson Chi-Square (χ^2) = 3.56; df= 1; sig. = 0.0460

Source: Analysis of field data, 2017

4.4.2 Differential improvement of students' knowledge

Improvement of students' knowledge level after going through the project and whether doing the project in groups and individually bring any significant difference to students' knowledge improvement were examined and tested. The difference of students' knowledge index before and after the project was calculated and compare across the two forms of participation as 'group and individual'. Independent t-test was conducted to test whether there is significant difference in knowledge improvement between students who did the project in groups and those who did it individually. This was to test the hypothesis that:

Ho: there is no significant difference in knowledge improvement between students who did the project in groups and those who did it individually.

Ha: there is significant difference in knowledge improvement between students who did the project in groups and those who did it individually.

Results of the independent t-test are shown in the table 4.11. As shown in the table 4.11 with t –value = 1.976 (df = 98) and p = 0.047 indicates that there is significant difference in knowledge improvement between students who did their project in groups and those who did theirs individually at 5% level of significant. As shown in the table 4.11 while the average knowledge index of those who did their project in groups were increased by 0.22 those who did it individually have theirs increased by 0.18.

Table 4.11 Independent Samples Test of students' knowledge difference before and after

Participation form	N	Mean	Std. Deviation	t	df	Sig.
Individual	50	0.1800	0.15194	1.976	98	0.047
Group	50	0.2240	0.15649			

Source: Analysis of field data, 2017

4.4.2 Skills level of Students in Group and Individual

Post intervention skills index of students who did their project in groups was contrasted with those who did theirs individually. This was done to test the hypothesis:

Ho: There is no significant difference in the skills level of students who took the project in groups and those who did it individually.

Ha: There is significant difference in the skills level of students who took the project in groups and those who did it individually.

To test the hypothesis students' post intervention skills index were subjected to independent t – test and tested at 5 percent level of significant. Result of the t-test is shown in the table 4.12.

With t-value of -1.96 (df =98), as shown in the table 4.12, means that there is significant difference between average skills index of students who underwent the nursery practices in group and those who did it individually at 5% level of significant. As such the null hypothesis which state 'there is no significant difference in the skills level of students who took the project in groups and those who did it individually' is rejected and the conclusion is that there is significant difference in the skills of students who did the project in groups and those who did it individually.

As shown in the table (table 4.12) the average skills index of those who did the project in groups was found to be 0.71 compare with the average score of 0.612 for those did it individually. It therefore clear that students who underwent the project as groups were more likely to have acquired more skills compare with those who did it individually. Apparently because doing it in group offer the students opportunity to discuss and share ideas as they do it together, which is not the case for those who did it individually. They can also assist each other in undertaking the activities to achieve collective perfection. Also organizing it in group also reinforces group learning and team building very important in building students' skills acquisition.

Table 4.12 Independent Samples Test of students' skills before and after

Participation form	N	Mean	Std. Deviation	t	df	Sig.
Individual	50	0.6120	0.31079	-1.968	98	0.046
Group	50	0.7060	0.32262			

Source: Analysis of field data, 2017

Also students' skills index which was classified into classes as 'not yet competent', 'averagely competent' and 'very competent' for skills index of less than 0.25, 0.25 – 0.5 and above 0.5 respectively were subjected to Chi - square analysis to test if there is significant difference in students' skills level between those who did the project in groups and those who did it individually. Results of the cross tabulation and Chi-square analysis are shown in the table 4.13.

As shown in the table with Pearson Chi-Square ($\chi 2$) = 3.44; df= 1; sig. = 0.048, implies there is significant difference in the skills level of students who did the project in groups and those who did it individually at 5% level of significant. As shown in the table 4.10, many (46 percent) of students who did the project in groups scored very competent in their skills level compare with only 32 percent in the case of those who did it individually. Similarly, more than two-third (68 percent) of students who did their project individually were found to be averagely competent while about half (54 percent) of students of students who did theirs in groups were also found to be averagely competent in their skills level after the intervention.

Table 4.13 cross tabulation of participation category and post intervention skills

Post intervention skills level			Participation form		Total
			Individual	Group	
Skill level	Averagely competent	Count	34	27	61
		% within Student category	68.0%	54.0%	61.0%
	Very Competent	Count	16	23	39
		% within Student category	32.0%	46.0%	39.0%
Total		**Count**	**50**	**50**	**100**
		% within Student category	**100.0%**	**100.0%**	**100.0%**

Pearson Chi-Square ($\chi 2$) = 3.442 df= 1; sig. = 0.0481
Source: Analysis of field data, 2017

4.4.2.1 Differential Improvement of Students' Skills Before and After

Whether doing the project in groups or individual have any significantly varying effect on the improvement of students' skills level was examined. The difference of students' skills index before and after the project was calculated and compare across the two forms of participation as 'group and individual'. Independent t-test was conducted to test whether there is significant difference in skills improvement between students who did the project in groups and those who did it individually. This was to test the hypothesis that:

Ho: there is no significant difference in skills improvement between students who did the project in groups and those who did it individually.

Ha: there is significant difference in skills improvement between students who did the project in groups and those who did it individually.

Results of the independent t-test is shown in the table 4.14. As shown in the table 4.14 with t –value = 0.220 (df = 98) and p = 0.220indicates that there is no significant difference in skills improvement between students who did their project in groups and those who did theirs individually at 5% level of significant. Thus students achieved most equal improvement in their skills level whether did the project in groups or individually.

Table 4.14 Group Statistics and Independent Samples Test of skills improvement

Student category	N	Mean	Std. Deviation	t	df	Sig.
Individual	50	0.2620	0.13834	0.220	98	0.826
Group	50	0.2560	0.13426			

Source: Analysis of field data, 2017

4.5 Constraints and Challenges in Project Method of Teaching

This section presents the study findings on constraints and challenges in undertaking project method of teaching from teachers' and students' perspectives. As such this sections presents findings of the study addressing objective four of this study which sought to 'analyse the constraints facing the use of project teaching method in the teaching of agricultural science in the Awe Senior High School'.

4.5.1 Constraints/Challenges from Teachers' point of view

During the in-depth interview sessions with the teachers and school authorities (headmasters and head of agricultural science department), the question on constraints and challenges they faced in using project as method of teaching practical skills were toughly discussed. The following were commonly mentioned as constraints to their ability to organize project teaching method for their students:

- **Poorly develop school farm and garden;** teachers were of the view that they do not have functioning school farm nor garden, but make do with the open field available in the school which they have some few plants for teaching. The field serving as the school/garden is not fenced and do not have regular source of water. However, the school few farm animals such as pigs, goats and sheep. The animal are kept under semi-intensive rearing system in which the animal are allowed to roam and are only housed during the night. The teachers were obviously worried about the lack of proper functioning school farm/garden and limited species of animal which in their view affect effective teaching and learning. The GES syllabus for general agricultural science requires schools to have functioning school farms and garden which should have at least one animal each from the common species of animals in the country (GES, 2010). Obviously worried, one teacher asked, during the focus group discussion, '*how do you expect a teacher to give students practical projects when the school lacks functioning farm to support students undertake such projects*..?'(Verbatim comment of a teacher).

- **Inadequate tools/equipment and material:** Project method of teaching make use of tools and equipment to enable students have hands – on experience in carrying their projects, however, teachers observed that apart from hoe and cutlasses which students bring to school, the school do not have sufficient simple farm tools such hand folk, travel and watering canes. Inadequate number of these farm tools coupled with the large number of students makes it practically difficulty to use project method of teaching. In carrying out this project, the researcher have sourced these simple farm tools to augment the few provided by the school to ensure every have access to these tools which essential in carrying nursery practices.

- **Inconveniences in carrying out school for practical:** Even though, the school had a bus for carrying students out of campus for practical work, the teachers complained, such arrangement usually distract classes and distort day's lessons. They explained that the bus cannot convey all agriculture students at once to practical site and have to do it in many rounds and this make monitoring difficult as some truants students take advantage of that to abscond from schools.

- **Insufficient funding for practical**: Practical lessons are always expensive to organize, especially if it had to be undertaken outside the school compound where students have to be conveyed to practical site. Fuelling and maintaining the bus to support practical activities have been noted by the school authority as one of the challenges they faced in organizing practical sessions. The teachers observed, if you give students project which require them to go out of the school compound, then the school have to provide fuel for the bus to convey them. One teacher at the focus group discussion lamented '*how can we strengthen practical lessons and give students practical projects, if anytime you request for a bus to convey students for practical, you always get no fuel response from the headmaster*..? (Verbatim comments from a teacher). Also the cost of practical material such seeds for nursery, fertilizer and other agrochemicals, shading material among other are expensive for the school to purchase to support practical lessons. There is no dedicated funding to support agriculture practical and this makes it difficult to raise the needed resources to carrying practical and for that matter give student projects. Also buying reagents for laboratory work is a challenge because of funding constraints.

- **Large class size:** teachers complained of their inability to used project method of teaching because of the large students numbers. In project method of teaching, the teacher have to make sure that every students have a hands- on experience of the practical lessons. Because of the large class size teachers complained they will not be able to monitor students' project effectively and as such they rare use project method of teaching.

- **Poor farm manager and labourer**; in the school there is a non – teaching staff in charge of the school farm and the same person also serve as farm labourer, which teachers identified as challenge in getting adequate human resource support to carry out practical teaching. Ideally the school should had one farm manager and a number of farm labourers for crops and animal, which is not the case currently. The farm workers role include maintaining the school farms/gardens and assisting teachers and students in carrying out practical lessons. The teachers indicated that, because of the inadequate farm workers they find it difficult to undertake project method of teaching. Also the skills of the farm labourer had been described by teachers as poor and that they unable to understand the practical students are suppose and as such cannot offer any support in that regard. One teacher observe '*the farm labourer also do not have the skills, how can he assist us or students to carrying their projects'* (Verbatim comments from a teacher.

4.5.2 Constraints/challenges from students' perspective

During the interview session, students were required to indicate the constraint they faced in carrying out their project and the rank constraints in order of their severity. The following were mentioned by students as constitute constraints/challenges in carrying their projects;

- Poorly equipped school farm
- Inadequate tools/equipment

- Large class size and grouping problem
- Short periods allocated to practical
- Poor skills farm labourer
- Difficult and time consuming
- High cost of materials

Table 4.15, presents frequency distribution of rank score assigned to the constraints identified by the students, while Table 4.16 presents means rank score, ranked position and Kendall coefficient of concordance (w). As shown in the table 4.15, about 44% of the students ranked poorly equipped school farm as their one constraints, while 22% ranked inadequate tools/equipment as their most severe constraint in carrying their projects.

About half (53%) ranked large class size and grouping problem as their third most severe constrain in carrying their projects, while majority (58%) ranked short periods allocated to practical as the number 4^{th} severe constraints they faced in carrying out their projects. Also 29% of the students interviewed ranked poor skills of farm labourer as their number 6^{th} constraint while 45% ranked difficult and time consuming nature of project method of teaching their number 6^{th} constraint. High cost of material was ranked by 35% of the students as the number 7^{th} or least constraint.

Table 4.15 Distribution of ranks of constraints

Constraints	Rank Position						
	1st	2nd	3rd	4th	5th	6th	7th
	%	%	%	%	%	%	%
Poorly equipped school farm	44.0	18.0	8.0	5.0	4.0	10.0	11.0
Inadequate tools/equipment	22.0	38.0	18.0	8.0	10.0	4.0	0.0
Large class size and grouping problem	8.0	19.0	53.0	3.0	7.0	0.0	10.0
Short periods allocated to practical	12.0	6.0	0.0	58.0	3.0	7.0	14.0
Poor skills farm labourer	6.0	3.0	8.0	12.0	29.0	29.0	13.0
Difficult and time consuming	4.0	4.0	3.0	6.0	24.0	45.0	14.0
High cost of materials	4.0	4.0	6.0	16.0	27.0	8.0	35.0

N = 100:
Source: Analysis of field data, 2017

To assess the level of agreement of ranks assigned by students to the constraints, Kendall's coefficient of concordance test was conducted. The test was found to be significant with Chi-square (df = 6) = 176.374; Sig. = 0.000. Also, Kendall's Wa = 0.592 indicating that about 60% of the ranks assigned by the students were in agreement.

As shown by the mean rank score, inadequate tools/equipment was ranked as the most severe constraint followed by poorly equipped school farm. With large class size and grouping problem and short periods allocated to practical were respectively ranked as the 3rd and 4th constraint to undertaking projects, while poor skills farm labourer and difficult and time consuming ranked as the 5th and 6th constraints respectively. High cost of materials was ranked as the least constraint to undertaking project method of teaching by students.

Table 4.16: Distribution of mean ranked scores

Constraints	Mean Rank	Rank Position
Poorly equipped school farm	2.79	2nd
Inadequate tools/equipment	2.54	1st
Large class size and grouping problem	3.17	3rd
Short periods allocated to practical	4.11	4th
Poor skills farm labourers	4.92	5th
Difficult and time consuming	5.32	7th
High cost of materials	5.16	6th

N = 100; Kendall's W^a = 0.592; Chi-square = 176.374; df = 6; Sig. = 0.000;

Source: Analysis of field data, 2017

CHAPATER FIVE

5.0 CONCLUSION AND RECOMMENDATIONS

This chapter presents summary of the findings of this study, conclusions drawn from the findings and recommendations made.

5.1 Summary of Major Findings

Information gathered from teachers and students regarding teaching and learning of agriculture in the Awe SHS that the lecture method of teaching is commonly used in the school. Other methods of teaching mostly used included, classroom discussion with students, classroom demonstrations and. Questions and answers. Teachers were of the view that, due to time and inadequate Teaching and Learning Materials (TLMs) they mostly relied on lecture method of teaching to enable them covered the syllabi and their scheme of work. Also majority of the students interviewed indicated that they teacher mostly used the lecture method of teaching in most of their teaching of theoretical teaching and demonstration for practical lessons.

Prior to the intervention (project method of teaching) students' knowledge in nursery practices were general poor and only limited to mere recall of the various necessary practices. They however, performed averagely in explaining the various necessary practices. In general, just about a third (37 percent) have their knowledge index being above 0.5 and as such classified as having above average knowledge before the intervention of project teaching method was implemented. Similarly they were found to lack the basic skills and competency in undertaking nursery practices prior to the intervention.

The study found project method of teaching as significant in contribution to improvement of students' knowledge on nursery practices. The paired t – tested conducted on students' knowledge score before and after the intervention established significant difference in students' knowledge and before they undertake and project and after they went through the project. This indicates significant difference in students' knowledge index before and after the intervention. The average students' knowledge index before the intervention was found to be 0.48, their average score after going through the intervention was found to be 0.68. This indicates a change of 0.20 between the students' knowledge index of before and after.

Similarly the study found positive effect of the project on students' skills acquisition. The paired t – test conducted established significant difference in students' skills or competent level before and after the intervention. This indicates significant difference in students' skills index before and after the intervention. While the average students' skills index before the intervention was found to be 0.39, their average skills index after going through the intervention increased to 0.65.

The found the grouping students in project method of teaching to be effective in improving students' knowledge compare with giving project individually. The independent t – test conducted, established significant difference between average knowledge of students who underwent the nursery practices in group and those who did it individually. The average knowledge index of those who did the project in groups was found to be 0.73 compare with the average score of 0.63 for those did it individually. It therefore clear that those students who underwent the project as groups were more likely to score high knowledge index compare with those who did it individually.

Similarly, the study found group method of conducting project method of teaching to be effect in imparting skills than individual method. The independent t – test conducted established significant difference between average skills index of students who underwent the nursery practices in group and those who did it individually at 5% level of significant. The average skills index of those who did the project in groups was found to be 0.71 compare with the average score of 0.612 for those did it individually. It therefore clear that those students who underwent the project as groups were more likely to have acquired more skills compare with those who did it individually.

The constraints/challenges to undertaking project method of teaching were identified as poorly equipped school farm, inadequate tools/equipment, large class size and grouping problem, short periods allocated to practical, poor skills farm labourer, difficult and time consuming and high cost of materials. Inadequate tools/equipment was ranked as the most severe constraint followed by poorly equipped school farm. With large class size and grouping problem and short periods allocated to practical were respectively ranked as the 3^{rd} and 4^{th} constraints to undertaking projects, while poor skills farm labourer and difficult and time consuming ranked as the 5^{th} and 6^{th} constraints respectively. High cost of materials was ranked as the least constraint to undertaking project method of teaching by students.

5.2. Conclusions

Lecture method of teaching was found as the commonly used teaching method in teaching agriculture science theory with class demonstration mostly employed in teaching practical sessions. Other methods of teaching mostly used included, classroom discussion with students, classroom demonstrations and. Questions and answers.

Students before the intervention (project method of teaching) were found to have very poor knowledge in nursery practices. Their knowledge about tomato nursery was mainly limited to recalling of the various necessary practices. In general, just about a third of them prior to the intervention score a knowledge index of above 0.5.

The study found project method of teaching as significant in contribution to improvement of students' knowledge on nursery practices. There significant improvement of students' knowledge after they undertook their projects. Similarly the project also contributed significant in improving students' skills acquisition of nursery practice. There was significant improvement in students' competency in undertaking tomato nursery after going through their projects.

Giving students projects in groups of not more than five students were found as most effective way of organizing project method of teaching in imparting knowledge and skills to students. The group method was found to be cost effective and efficient in improving students' knowledge and skills in nursery practices.

The constraints/challenges to undertaking project method of teaching were identified as inadequate tools/equipment, large class size and grouping problem, short periods allocated to practical, poor skills farm labourer, difficult and time consuming and high cost of materials, in decreasing order of severity.

5.3 Recommendations

Based on the findings of the study the following recommendations are made:

1. The school authority and GES should endeavour to provide adequate teaching and learning materials to the school to ensure effective teaching and learning

2. Project method of teaching should be employ in teaching skills as it found to be effective in imparting knowledge and skills on students
3. To ensure cost effectiveness and effective knowledge and skills acquisition, project method of teaching should be organized in a group of not more than five students
4. The school farm in the school should be developed, properly and fenced with regular supply of water, and equipped with the basic farm tools/equipment and plant, and animal stock.
5. It is also recommended for regular in-service training of teachers and farm labourers to ensure skills upgrading require for effective teaching and learning
6. Adequate provision should be made in terms of time allocation for agricultural practical
7. Further studies on other methods of teaching should be conducted to inform teachers and educational planers

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APPENDICES