UNIVERSITY OF EDUCATION, WINNEBA

COMPARING ACTIVITY-BASED AND DISCUSSION METHODS OF TEACHING AND LEARNING OF SEED GERMINATION: A CASE STUDY IN ANYINASU M/A JUNIOR HIGH SCHOOL, ASHANTI REGION

EBENEZER APPIAH

2016

UNIVERSITY OF EDUCATION, WINNEBA

COMPARING ACTIVITY-BASED AND DISCUSSION METHODS OF TEACHING AND LEARNING OF SEED GERMINATION: A CASE STUDY IN ANYINASU M/A JUNIOR HIGH SCHOOL, ASHANTI REGION

EBENEZER APPIAH

7040130024

DISSERTATION IN THE DEPARTMENT OF SCIENCE EDUCATION, FACULTY OF SCIENCE EDUCATION, SUBMITTED TO THE SCHOOL OF GRADUATE STUDIES, UNIVERSITY OF EDUCATION, WINNEBA, IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF THE MASTER OF EDUCATION DEGREE IN SCIENCE EDUCATION.

MARCH, 2016

DECLARATION

Student's Declaration

I, Ebenezer Appiah, hereby declare that this Thesis, with the exception of quotations and references contained in published works which have all been identified and duly acknowledged, is entirely my own original work, and it has not been submitted, either in part or whole, for another degree elsewhere.

Signature: ……..

Date: ……

Supervisor's Declaration

I hereby declare that the preparation and presentation of this work was supervised in accordance with the guidelines for supervision of Thesis as laid down by the University of Education, Winneba.

Name of Supervisor: .....

Signature: ……

Date: ……

ACKNOWLEDGEMENTS

My profound gratitude goes to the Almighty God for His grace and mercy that has brought me this far. Daddy, may your name be praised forever.

I am highly indebted to my supervisor, Prof. Yaw Ameyaw, a lecturer at the Department of Biology Education for his guidance, suggestions, constructive criticisms, and encouragement that has enabled me to complete this study. God bless you.

I appreciate the support of all lecturers, especially those who lecture at the Faculty of Science.

Special thanks go to my family for their support, prayers, and pieces of advice that I continue to receive day-in and day-out. God bless you all.

I commend the head teacher, Mr. Christian Sosu,the staff and the pupils of Anyinasu M/A Junior High School for their support, encouragement and co-operation which helped me to complete this programme successfully. I am proud to be part of this great family.

I also appreciate the support of all friends and loved ones. Guys, I salute you.

DEDICATION

This dissertation is dedicated to my grandmother, Mother Marie Fernande Yeboah for her inspiration, blessings, and enormous love.

TABLE OF CONTENTS

CHAPTER TWO

LITERATURE REVIEW **8**

CHAPTER THREE

METHODOLOGY **25**

LIST OF TABLES

LIST OF FIGURES

Figure Page

ABBREVIATIONS

TLMs: Teaching and learning materials are the resources selected or prepared by the teacher and/or pupils to enhance teaching and learning.

MEST: Ministry of Environment, Science and Technology

MESS: Ministry of Education, Science and Sports

ICSU: International Council for Science

PISA: Programme for International Student Assessment

OECD: Organization for Economic Co-operation and Development

WAEC: West African Examinations Council

M/A: Municipal Assembly

JHS: Junior High School

Pupils: Learners at the basic level

ABSTRACT

The aim of this study was to compare the activity-based and discussion methods of teaching and learning of seed germination: a case study in Anyinasu M/A Junior High School. Thirty pupils were involved in the study. The pupils were put into two groups (Group 'A' and Group 'B'). Group 'A' of 15 pupils were taught seed germination using discussion method whiles Group 'B' also made up of 15 pupils, were taught the same concept using activity-based approach. The two groups were post-tested based on test items prepared by the researcher. The study revealed that Group 'A' members recorded a mean value of 6.4 (25.6%). However, members in Group 'B' recorded a mean value of 15.1 (60.4%). Again, it was discovered that most pupils (10 pupils representing 66.7%) from Group 'B' scored above average. Meanwhile, only 2 pupils (representing 13.3%) from Group 'A' obtained similar score. Paired sample test (t-test) result indicates a significant difference of 0.000 ($p<0.05$). It was concluded that activity-based method of teaching is significantly effective than the discussion method of teaching as far as teaching and learning of science is concerned.

CHAPTER ONE

INTRODUCTION

1.0 Overview

This chapter presents the background of the study, the statement of the problem, the purpose of the study, the objectives of the study, the research questions, the significance of the study, delimitation and limitations of the study, and finally, the organization of the chapters.

1.1 Background to the Study

Education, as broadly known, enables the individual to contribute to the growth and development of personality, the communities, and the nation at large. Science education is one such area we cannot overlook as far as quality education is concerned. For meaningful scientific education, it is important for pupils to be trained in the investigative process of seeking answers to problems. This requires pupils to physically explore and discover knowledge within their environment and in the laboratory to be able to contribute new scientific principles and ideas to the body of knowledge already existing in their culture (Ministry of Education, Science and Sports, 2007).

The acceptance of knowledge achieved through science education is high because of its practical dimension and application; hence priority is given to science education all over the world (Maleque, Begum, Islam, & Riad, 2007). Science education enables a nation's citizenry to acquire basic science literacy, coupled with scientific ways of knowing–namely drawing conclusions based on observation, experimentation and analysis–provides citizens with the tools needed for rational debate and sound

decision-making based on scientific knowledge (International Council for Science, 2011).

The experience of the industrialized nations has shown that a critical mass of scientists, researchers, engineers and technicians will propel a country towards the next stage of modernization. By nurturing a culture of science, this socio-economic breakthrough could be achieved with a citizenry equipped with the knowledge, skills, values and attitudes made keener by quality education in science and technology (Ministry of Environment, Science and Technology, 2009).

Effective and stimulating science education is fundamental to both the future of science and the ongoing development of our global society. Yet there is concern in the majority of countries that the overall level of scientific literacy is poor and that children are not being attracted to scientific studies and eventual careers as scientists (ICSU, 2011).

Students' understanding of the subject may be impacted when they lack interest in it. Lack of student interest in school science is a concern, particularly when it leads to a decline in enrolment in science courses at secondary school level (Toffay, 2012). The 2006 Programme for International Student Assessment (PISA) study showed that 19.2% of the 15 year olds surveyed across Organization for Economic Co-operation and Development (OECD) countries demonstrated a low level of science proficiency (Organization for Economic Co-operation and Development, 2006). This is an important indicator of how many students within these countries will lack the ability as adults to participate fully in a society that requires some decisions to be made using basic science knowledge. In addition, this report highlighted that while the majority of students were reported to be motivated to learn science, only a minority expressed

taking a close interest. This is a concern because only students who take a greater interest in the subject will be willing to invest the effort to do well according to Toffay (2012).

The quality of science teaching and learning has been questioned over time by parents, science educators, and the general public and even by the government (Okebukola, 1997; Ololube, 2006; Attafuah, 2007). Moreover, Stanley, Slate and Jones (1999) reported that poor teaching and learning methods affect students' academic performance negatively.

Science is a way of life and it is a continuous process of investigation and experimentation in order to widen the scope of understanding of the natural world according to Asabere-Ameyaw and Oppong (2003). Practical work is known to be an essential component of studying the natural sciences. Doing science is not only limited to reading or hearing but it holds students in laboratory work to test ideas and develop understanding (Ewers, 2001). Hence, science-teaching plan is incomplete without science experiences (Shah & Rahat, 2014).

Most science teachers in schools hardly use the activity oriented approach in the teaching of integrated science due to lack of equipment and technical know-how (West African Examinations Council, 2007). This is contained in the Chief Examiner's report (2007) on West African Senior Secondary School Certificate Examination organized by the West African Examinations Council (WAEC). It was clear from candidates' scripts that most lessons were taught theoretically.

Teaching methods, among other factors, have been reported severally to be responsible for the observed poor performance of students over the years. Hence the need to investigate more effective teaching methods that guarantee achievement of set goals and objectives of science education.

1.2 Statement of the Problem

At the basic level, science is taught as an integrated subject comprising; biology, physics, chemistry and agriculture to enable pupils understand the behaviour of materials and objects around them and live successfully in their environment. Unfortunately, however, this has not been the case, as pupils are not able to apply science concepts taught in the classroom to external examination bodies (Anderson & Helmes, 2001). The performance of learners in science at the basic level has been discouraging. This situation continues to the secondary school level where most of the candidates who write their final examinations are unable to do well in the sciences, especially Integrated Science which is a core subject (WAEC, 2010).

Despite the fact that several factors account for the observed poor performance of students in Integrated Science, the researcher feels that the low performance in the subject at Junior High School (JHS)) may be attributed to lack of practical approach (hands-on activity) in the teaching of Integrated Science. This is supported by Millar and Abrahams (2009), who argued that lack of practical work is an important factor which accounts for the poor performance of students in the sciences (for example, Integrated Science). There is therefore the need to undertake this research to apply the use of hands-on activity and discussion methods in the teaching and learning of seed germination at Anyinasu M/A Junior High School.

1.3 Purpose of the Study

The effectiveness of any instruction is dependent on the instructional approach and the nature of science activities carried out. The purpose of this study is to compare activity-based and discussion methods in teaching and learning of germination of seeds at Anyinasu M/A Junior High School.

1.4 **Objectives of the Study**

The specific objectives of the study were to find out:

1. An effective method of teaching and learning the concept seed germination.
2. If there is any significant difference in the achievement levels between students taught using activity-based and discussion methods in the teaching and learning of the concept seed germination.
3. How relevant teaching and learning materials (TLMs) enhance the teaching and learning of the concept seed germination.

1.5 Research Questions

1. What method can be used to teachseed germination effectively?
2. What significant difference exists between students taught using hands-on activity method and discussion method in the teaching and learning of seed germination?
3. What relevant TLMs can enhance the teaching and learning of seed germination?

1.6 Significance of the Study

The core objective of every study is to have some valuable benefits and contributions to the end-users of the study. This study is of no exception.

The study would enable science teachers and other stakeholders in science education realize the importance of hands-on approaches for the teaching and learning of science so that stakeholders can intensify the organization of in-service training for teachers to improve their methods of teaching of science.

Furthermore, it is expected that the study would infuse broad innovations in the teaching approaches in Integrated Science to promote effective teaching and learning

of science at the basic level. It would significantly inform Integrated Science teachers the need for effective method (s) to teach and learn seed germination and other science concepts.

Again, the study would contribute significantly to the course of curriculum developers and policy-makers with regards to science education. Lastly, the study would help science teachers to identify problems that retard effective teaching and learning of Integrated Science.

1.7 Delimitation of theStudy

The study should have covered all the Junior High Schools within the Ejura-Sekyedumase Municipal but due tolack of fund and time constraint, it was delimited to the Anyinasu M/A Junior High School.

1.8 Limitations to the Study

The study captured only JHS 1 (form 1) pupils of Anyinasu M/A Junior High School.

1.9 Definition of terms

Activity-based method: It is a method of teaching whereby learners are engaged in hands-on activities.

Discussion method: It refers to a variety of forums for open-ended, collaborative exchange of ideas among a teacher and students or among students for the purpose of furthering students thinking, learning, problem-solving, understanding or literary appreciation.

Germination: This refers to the emergence of the embryo from the seed coat due to onset of growth and development of seed.

Seed germination: It is the growth of an embryonic plant contained within a seed; it results in the formation of the seedling**.**

1.10 Organization of the Chapters

This research report is organized into five chapters. Chapter one dealt with the background to the study, statement of the problem, purpose of the study, objectives of the study, research questions that guided the study,significance of the study, delimitation of the study, limitations to the study as well as definition of terms and abbreviations. Chapter two covered review of available literature relevant to the study. Chapter three focused on the methodology. Chapter four dealt with the results and discussion of the study, whilst chapter five dealt with the findings, conclusions, recommendationsand suggestions for further studies.

CHAPTER TWO

LITERATURE REVIEW

2.0 Overview

This chapter covers available literature relevant to the study. This includes conceptual and theoretical framework of hands-on activity (Activity-based) method in science teaching and learning, conceptual and theoretical framework of discussion method in science teaching and learning, effective ways to teach and learn seed germination, as well as, the relevance of TLMs in science education.

2.1 Conceptual and theoretical framework of hands-on activity (Activity-based) method in science teaching and learning

Constructivism maybe defined as an epistemological view (theory of knowledge), which sees learners as active participant in the teaching/learning process (Toffay, 2012). According to constructivist view of learning, each learner constructs his/her own knowledge and learning process based on previous experience. This theory asserts that learning takes place when psychological environment of the learner interacts with a particular structure (Khan, Muhammad, Ahmed, Saeed & Khan, 2012). For construction of relevant knowledge, it is imperative to have variety of activities in an active classroom (Abdelhamid, 2003; Murray, Donohoe & Goodhew, 2004).

Constructivist-based research suggests that informal science experiences lay the critical foundations for deep conceptual understanding (Strike & Posner, 1992, cited in Jones, Howe & Rue, 2000).In the constructivist classroom, teachers and students are viewed as active meaning makers who continually give contextually based meanings to each other's words and actions as they interact (Fletcher, 2000).

The inquiring and imaginative human mind have responded to the wonder and awe of nature in different ways. One kind of such response from the earliest times has been to observe the physical and biological environment carefully, look for any meaningful patterns and relations, make and use new tools to interact with nature, and build conceptual models to understand the world (Mishra& Yadav, 2013). Doing science is not only limited to reading or hearing but it holds students in laboratory work to test ideas and develop understanding (Ewers, 2001, cited in Shah & Rahat, 2014). Activity-based method of teaching is whereby learners are engaged in hands-on and brains-on activities. In Activity-Based Learning (ABL) teaching method, Harfield, Davies, Hede, Panko and Kenley (2007) stated that students actively participate in the learning experience rather than sit as passive listenersas cited by Khan, *et al.,* (2012). Learning activities provide opportunities for experiential learning, which involves links between the thinking and doing. It is assumed that students who handle the learning activities successfully do learn the concept to perform a particular activity (Khan,*et al.,* 2012). Learning activities, if based on real life experience help learners to transform information into their personal knowledge, which they can apply in different situations (Edward, 2001).

Mishra and Yadav(2013), conducted a study to investigate the "Effect of Activity-based Approach on Achievement in Science of Students at Elementary Stage". In all 60 students from Class VII of Shri Kanwartara High School of Khargone District of M.P - India were selected and randomly assigned to two groups (experimental & control group) of 30 students each. The Experimental Group was taught with activity-based approach whilst the Control Group was taught with traditional method of teaching. After successful presentations of the lessons, the two groups were tested. Post-test scores of the two groups were compared to see their effect on students'

achievement in science. The study revealed a significant difference between the means of the achievement scores of the Experimental Group of students who were taught using the activity-based approach and the Control Group of students who were also taught using the traditional method. The researchers concluded that the activity-based approach had significantly positive effect on enhancing the content wise achievement and academic achievement of the Class-VII students.

2.1.1 Advantages of activity-based method in science teaching and learning

Activity-based teaching has been accepted as a paradigm for science education, and is also reflected in some measure in textbooks developed at the national and state levels according to Mishra and Yadav (2013).Activity-based instruction provides opportunity for measuring learning through experience, direct observation and participation of children (Mishra & Yadav, 2013). Also, activity-based learning approach provides a way to integrate learning within students' knowledge, and by exposing them to a variety of activities, helps them learn how to learn (Stößlein, 2009). Science activities, if carried out in an effective manner, develop skills like team-working, communication, design, leadership, project managements, research, problem-solving, reflection and life-long learning in learners (Khan, *et al.*, 2012).Furthermore, science activities, if based on real life experiences, can help students to apply the same in their practical life, and hence, prepare students for future life (Khan, *et al.*, 2012 and Mishra & Yadav, 2013). Activity-based approach helps learners to develop original ideas making the learning process an entertaining one (Mishra & Yadav, 2013). Lastly, activity-based teaching and learning helps learners to construct mental models that allow for higher-order thinking and performance such as applied problem-solving and transfer of information and skills (Churchill, 2003).

2.1.2 Disadvantages of activity-based method in science teaching and learning

Disadvantages of activity-based method include:

The activity-based instruction requires long-term planning with minute details of the whole process because before engaging the learners, the teacher has to make sure that all students have sufficient knowledge and skills regarding the task they are going to perform. So this method cannot be used on a regular and daily basis as it involves a lengthy procedure. Also, learners have varied and level of merit and understanding, so less meritorious students might not prepare for a task as others, which might lead to failure of objectives of the whole process. Again, the objectives of the method can only be fulfilled if the planning of the lesson is flawless. If there is slightest flaw in the planning, this method would do more harm than good. Finally, many renowned educationists are of the opinion that the activity-based method is more suitable for branches of experimental sciences and less useful for subjects of social sciences (Activity-Based Education, 2011).

2.1.3 Role of the science teacher in activity-based method

The science teacher plays a significant role in the teaching and learning process. He/she attends to individuals/learners, helping them to acquire requisite skills and encouraging them to bring out their difficulties and try to solve such difficulties themselves. There are several activities the science teacher can engage his/her learners in but the approach according Mishra and Yadav (2013) must be less of a burden to learning and increasing the eagerness and happiness of school life. The activities must be well selected, planned and organized to promote effective teaching and learning of content. The learning environment will not be conducive for students unless/until a teacher devised a good strategy of teaching.In an activity–based teaching and learning environment, theteacher

is a facilitator, motivator, guide and a coach but not a sage on the stage (Khan,*et al.*, 2012).

2.2 Conceptual and theoretical framework of discussion method in science teaching and learning

Teaching strategies using social constructivism as a frame of reference relate to teaching contexts that might be personally meaningful to students. These also involve negotiating understanding with students through class discussions in small and large groups of students (Wood, Cobb & Yackel, 1995; Duggan & Gott, 2002).

Discussion is an instructional conversation composed of teacher-learner interaction, including higher order questions (by the teacher), statements and responses where learners are to apply their knowledge and think critically in order to enhance their understanding about the issue, problem, or other content being discussed (Wilen, 2004).Rahman, Khalil, Jumani, Ajmal, Malik and Sharif (2011) are of the view that discussion is the thought of taking a problem and investigating all options with an ultimate objective to reach a mutual understanding of the problem. According to Wilkinson (2009), discussion methods are a variety of forums for open-ended, collaborative exchange of ideas among a teacher and students or among students for the purpose of furthering students' thinking, learning, problem-solving, understanding, or literary appreciation. Participants present multiple points of view, respond to ideas of others,and reflect on their own ideas in an effort to build their knowledge, understanding and interpretation of the matter at hand. Discussions may occur among members of a dyad small group, or whole class and be teacher-led or student-led. They frequently involve discussion of a written text, though discussion can also focus on a problem, issue, or topic that has its basis in a "text" in the larger sense of the term (for instance, a discipline, the media, a societal norm, etc. (Wilkinson, 2009).

Teaching by discussion can be an effective means of helping students apply abstract ideas and think critically about what they are learning. It is important to be clear about the objectives of holding the discussion and how it fits into the overall course. The discussion class is intended to be a free give and take between teacher and students and among students on the current topic of concern in the course or subject. If possible, rearrange the seating to allow students to face one another and not make the teacher the focus of the group. It is characterized by probing questions from the teacher designed to elicit student interpretations, opinions and questions (Rahman,*et al.*,2011).

Rahman, *et al.* (2011), conducted a study on the "Impact of Discussion Method on Students Performance" to investigate the effectiveness of teaching methods in a concept under social studies. The sample of the study consisted of 62 students of grade 10th. The students were grouped into Control and Experimental Groups equally. Two teaching methods (Discussion and Lecture methods) were used in the study. The Experimental Group was taught with discussion method along with lecture while the Control Group was taught with lecture method only. Four lessons were selected in the subject of social studies. Pretests and Posttests were developed for each topic. The results of the pre-tests revealed that there was no significant difference in the performance of both groups. However, the results of the post-tests revealed that there was a significant difference in the mean score of both Experimental and Control Group. The results of the study indicated that the mean score of theExperimental Group was higher than that of the Control Group. The researchers concluded that discussion method was more effective than lecture method. The researchers recommended that teachers may prefer discussion method in the teaching and learning of social studies.

2.2.1 Forms of discussion as a teaching method

The discussion methods of teaching vary on a number of dimensions according to Wilkinson (2009).Roby (1988) cited in Wilkinson (2009) classifies types of discussions primarily on a continuum that relates to whether the teacher or students, or both, have interpretive authority. A secondary dimension is the content of the discussion. Using these dimensions, Roby identified four types of discussion in teaching and learning as follow:

1. Problematical discussions which focus on the solutions to either complex or simple problems in which case the teacher is dominant in the discussions.
2. Dialectical discussions which focus on expressing, comparing and refining students and teachers' points of view, in which case students dominate in the discussions.
3. Informational discussions which focus on controversial issues within an accepting atmosphere, and students have considerable freedom to bring up issues they wish to discuss.
4. Quasi-discussions which include quiz shows and bull sessions. In the former, the teacher determines the questions to be asked and has almost all the interpretive authority; in the latter, the students have control over the topic and almost all the interpretive authority.

According to Jerolimek (1986) cited in Rahman,*et al.*(2011), two types of discussion have been identified. They are round table discussion and panel discussion.

Round table discussion: It involves small number of persons nearly three to eight. It needs a moderator to introduce the members of the discussion group, present the problem to be discussed and keep the discussion moving. The leader's role is one of guiding the group rather than one of dominating it. The responsibilities of a moderator

include: the introduction of the topic, keeping the discussion moving, avoiding having the group becomesidetracked, avoiding quibbling over irrelevancies, summarizing and drawing conclusions. While the responsibilities ofmembers of the discussion group are to be well informed on the topic, speak informally while avoiding arguing and quibbling, staying with the topic under discussion, have sources of information available, backing up statements with facts, and helping the group summarize its conclusions. In this type of discussion, the responsibilities of the audience (students) are to listen attentively, withhold questions until presentation is completed, ask for clarification of ideas, ask for evidence on questionable statements, confine remarks to the topic under discussion, and extend customary audience courtesies to members of the round table.

Panel discussion: A panel discussion is similar to a round table discussion in many ways, but different to exist. The responsibilities of the moderator are the same as in round table discussion. The procedure is more formal than that of the round table. It begins with a short statement by each discussion member. Panel is more audience oriented than round tables and each panelist is considered to be more or less an expert.

2.2.2 Role of the science teacher in discussion method of teaching and learning

The science teacher plays key roles to ensure the effectiveness of this method of teaching. According to the Pennsylvania State University (1996) cited in Rahman,*etal.* (2011), some recommended responsibilities of a teacher in discussion are as follow:

(a) Teacher makes sure that everyone has a chance to contribute

It is emphasized that once a question is posed; teacher should wait long enough for someone to answer it. Teacher might occasionally try having students write down an answer first, which gives more reserved students a chance to think about their thoughts before speaking.

(b) Organization, summary and synthesis

These help to structure the conclusions reached by the class and to keep them on track. A teacher should restate the correct portions of comments made by students. He/she can show attention by building on a student's point, by withholding judgment until several students respond, or by listing the multiple responses on the board and asking the students to group them. At the end of the class, the teacher summarizes key points made and connects them to the original question posed at the beginning of the discussion. It allows students to come to their own conclusions and to help structure and analyze them.

(c) Teacher tolerates opposition

If students are disagreeing in interpretation or conclusion, but are backing their arguments up, that is the nature of discussion. Sometimes, finding out what students are thinking and how they will respond to a given question is more important than momentary control. Discussion is a reflective, educative and structured group conversation with students. It emphasizes social intercourse between familiar people; encouraging students to think critically and creatively at higher cognitive levels; and requires that the discussion is organized and conducted by a leader. In discussion, the teacher plays his/her role as a model, as an enquirer, as a listener, and as a questioner (Rahman, *etal.,* 2011).

2.2.3 Role of participants (learners) in discussion method of teaching and learning

Jarolimek (1986) cited inRahman, *et al.*(2011) has described the guidelines for effective discussion as given below:

(a) Participants should come prepared for the discussion session and should listenattentively when others are peaking

(b) Participants need to remain objective, open-minded, avoid getting emotional andshould contribute their ideas.

(c) They should respect and accept the contributions of others but keep independentthinking. They should not be offended in case the group rejects their ideas.

(d) Participants should speak loudly and clearly and should ask for clarification of ideasthat are not understood.

(e) One member or group should not be allowed to dominate the discussion.

(f) The group should have confidence in their ability come to a satisfactory decision.

2.2.4 Advantages of discussion method of teaching and learning

Discussion method of teaching and learning has several advantages, including the following:

- Discussion sessions are more effective in stimulating students' interests and assessing their understanding of material (Capon, 2004;Rahman, *et al.,* 2011).
- Teacher-led discussions encourage students to evaluate events, topics and/or results; to clarify the bases for their judgments; and to beware of other points of view (Emmer, Evertson, Clements & Worsham, 1997, cited in Rahman, *e.t al.,* 2011).

- Teacher-led classroom discussions encourage the promotion and development of higher-order critical thinking in students and increase in engaged learning (Wilen, 2004).
- Discussion method of teaching promotes a democratic classroom and values (Wilen, 2004; Larson, 2000).
- Discussion is a forum in which students practice expressing themselves clearly and accurately, hearing the variety of expressions of the same idea and criticizing and evaluating successive approximations to an adequate statement according to Gage and Berliner (1988) cited in Rahman, *et. al.*(2011).

2.2.5Disadvantages of discussion method of teaching and learning

- It is not appropriate for all (science) topics.
- It can be used only to students who have some basic knowledge in the topic.
- Some of the students may feel shy or reluctant to take part while others may try to dominate.
- Teacher may lose control over the students and may end up in quarrelling (Activity Based Education, 2011).

2.3 Effective ways to teach and learn seed germination

Learning is generally defined as the relatively permanent change in behaviour, skills, knowledge or attitudes resulting from identifiable psychological or social experiences (Seifert & Sutton, 2009). On the other, teaching refers to a continuous process that involves bringing about desirable changes in learners through the use of appropriate methods(Ayeni, 2011).Tebabal and Kahssay(2011),cited in Ganyaupfu (2013) assert that the primary purpose of teaching at any level of education is to bring a fundamental change in the learner.

Research shows that pupils at the basic level should be provided with experiences to learn science by doing (Anderson & Helmes, 2001; Huber & Moore, 2001). To buttress that point, Osborne and Collins (2000) proposed that the learning cycle in children consists of exploration which is manipulation of materials, investigation that is testing of hypothesis, and reflection that is more important on the activity. Anamuah-Mensah and Ameyaw-Asabere(2004) are of the view that there is the need to fuse the indigenous ways of learning science with the modern technology if the science will become meaningful to pupils.As such, teaching should not merely focus on dispensing rules, definitions and procedures for students to memorize, but should rather actively engage students as primary participants(Zakaria, Chin & Daud, 2010). Zeeb (2004), cited in Ganyaupfu (2013) reported thatalignment of teaching methods with students' needs and preferred learning influence students' academic attainments.

The integrated science curriculum provides pupils with unified and inter-related perspective on fundamental ideas, concepts and principles in Physics, Chemistry, Biology and other allied subjects(Acquaye, Antwi, Eminah & Young, 2008). Practical work and investigations are essential components of the science curriculum (MESS, 2007). It has been established that effective practical activities enable students to build a bridge between what they see and handle (hands-on) and scientific ideas that account for their observations (Millar, 2004).

Despite the fact that teachers are the most significant factor in bringing about change in educational practice and outcomes (Duffee & Aikenhead 1992, cited in van Driel, Beijaard & Verloop, 2001), research indicates that the nature of teaching has significant influence on both what is taught and how teaching and learning occurs, which in turn influences learning outcomes (Lingbiao & Watkins, 2001).

Although many studies show that practical activities play a key role in teaching and learning science, some studies show that teachers' lack of pedagogical content knowledgein science is responsible for students' failure to learn (Halai, 2008; Ranade, 2008) integrated science.

A teacher cannot understand any discipline without adequate subject matter knowledge (Boz & Boz, 2008). Klafki (2000) holds the view that mastered subject matter knowledge is the precondition for teachers to transform subject matter knowledge to students and to select the best instructional methods.Taylor and Dana(2003) report thatscience teachers should emphasize the development of appropriate concepts of scientific evidence in their own teaching.Adunola (2011) maintains that teachers need to be conversant with numerous teaching strategies that take recognition of the magnitude of complexity of the concepts to be covered.Klafki (2000) concludes by saying teachers' use of the best instructional methods is considered to be aprerequisite for successful teaching and learning.

Van Driel,*et al.* (2001) outline how the development of pedagogical content knowledge (PCK) in experienced science teachers provides them with a framework for teaching, where teaching experience is the most important factor in the development of PCK. If teachers can develop a conceptual framework in which knowledge and beliefs about science, subject matter, teaching and learning, and students are integrated logically, then it can help them to link the theory to teaching practice (Van Driel,*et al.*, 2001). Teaching methods can work effectively mainly if they suit learners' needs since every learner interprets and responds to questions in a unique way according to Bharadwaj and Pal (2001), cited in Chang (2002).To facilitate the process of knowledge transmission, teachers should apply appropriate teaching methods that best suit specific objectives and level exit outcomes(Ganyaupfu, 2013).

Science teachers are expected to carry out variety of teaching activities such as putting pupils into groups, explaining concepts, asking questions, moderating discussions, going through assignments and demonstrating science experiments and/ or giving tests to facilitate intellectual understanding of science as a subject in a typical science classroom (Ghartey, 2007).

Yeboah (2011), in his quest to investigate the effect of teaching methods on the performance of SHS (Form) Two Visual Arts students of the West Africa Senior High School conducted a research. The study sought to compare the use of activity and discussion methods in the teaching and learning of germination of seeds. Two groups (Activity Method Group & Discussion Method Group) were selected for the study. Each group had a membership of 20 students. The two groups, upon receiving series of science lessons on the concept for a period of time, were tested. The post-test results revealed that the Activity Method Students performed better than their counterparts (Discussion Method Students). The researcher concluded that the activity method of teaching integrated science was more effective than the discussion method of teaching which is used by most teachers at the Senior High School Level.

2.4 Relevance of the use of TLMs in science education

We understand and use the word science as the intellectual and practical activity encompassing the systematic study of the structure and behaviour of the universe through observation and experimentation (ICSU, 2011). Scientific knowledge depends on evidence. The acceptance of knowledge achieved through science education is high because of its practical dimension and application; hence priority is given to science education all over the world (Maleque, Begum, Islam, & Riad, 2007). The development of a society without science education is unimaginable (Maleque,*et al.*,2007).We value science (as a product, as an enquiry process and as a social

institution) because of its success in explaining phenomena in elegant and parsimonious ways, which are intellectually satisfying and which often facilitate the purposeful manipulation of objects, materials and events (Millar, 2004).

Banu (2011) asserts that the goal of providing science students with clear and standard content knowledge can be successfully achieved if the conceptual knowledge is supported by the inclusion of practical work.Practical work is an essential part of science teaching and learning for developing students' scientific knowledge (Millar, 2004),

Teaching/learning materials (TLMs) are the resources carefully selected or prepared, by the teacher and/or pupils to enhance teaching and learning process. Science lessons (especially, practicalactivities) cannot be organized/delivered without appropriate/suitable teaching and learning materials (TLMs).

Lack of resources (teaching/learning materials) seemed to be a major issue facing teaching and learning at the Junior High School level in Ghana. For children (pupils) to understand basic concepts in science and to make science an interesting subject, more teaching and learning resources must be involved in many activities(Avoke, 2005). Whitcomb, Borko and Liston (2008) assert that teachers turn to themselves for inner resources (TLMs). They continue by saying these teaching and learning resources are used both in the classroom and outside the classroom which promote effective teaching and learning. The maximum and effective use of teaching/learning materials ensure that children gain first-hand experience through personal contact with the resources. With regards to the fact that children gain first-hand experience, Millar has this to say,"Practical work involves the students in observing or manipulating the objects and materials they are studying" (Millar, 2004). Mankoe (2007) advocates that the use of teaching and learning resources is a requirement for

effective teaching of any topic in any subject. Gates (2005) reports that objects are used in a systematic way to help the learner understand and begin to anticipate what is happening.Mankoe (2007) concludes by saying the important requirement for effective teaching of any topic in science is how well the teacher prepares his teaching and learning resources (TLMs).

Kasanda (2008) reports that the theoretical teaching of science subjects takes students beyond their sphere of experience and understanding, and thus, most science students regularly perceive the subjects (the sciences) as useful only for passing examination. Teaching requires a teacher to be knowledgeable in content, skilled in method and virtuous in disposition and character. Such a teacher is required to select appropriate teaching/learning materials in order to promote effective teaching and learning in the classroom (Osguthope, 2008).

2.5 Summary of literature

Learners at the basic level should be provided with experiences to learn science by doing.Doing science combines reading, hearing, hands-on and brains-on activities.

Teachers are expected to focus on the desired learning outcome and make decisions about pacing and curriculum emphasis so that students may have every opportunity to learn. Teachers mustuse teaching methods that suit both the content and the students. A teacher may use a variety of teaching methods including discussion, activity, demonstration, project work, field trips and many others in order to achieve his/her set goals and objectives.

Discussion is an instructional conversation composed of teacher-learner interaction, including higher order questions (by the teacher), statements and responses where learners are to apply their knowledge and think critically in order to enhance their understanding about an issue, problem, or other content being discussed.

An activity-based method of teaching is a method of teaching whereby learners are engaged in hands-on and brains-on activities.

Theoretical teaching of science subjects takes students beyond their sphere of experience and understanding.Science education without the use of teaching/learning materials (TLMs) is unacceptable by the scientific community.

CHAPTER THREE

METHODOLOGY

3.0 Overview

This chapter provides information on the research design used, research setting,the issue of case study, population and sampling, instrument used for data collection, research procedure, data collection procedure, data analysis procedure and lesson plans that were used for the study.

3.1 Research design

Denzin and Lincoln (2005) state that a research design should comprise a flexible set of guidelines that connect theoretical paradigms; first, to strategies of inquiry followed by methods of collecting empirical material.Gay, Mills and Airasian (2005) explained that, research design indicates the basic structure of a study, the nature of the hypothesis and the variable involved in the study. There are three types of research designs; namely qualitative, quantitative and the mixed method design. The mixed method approach was employed for this study.

A mixed method research is the type of research in which a researcher or team of researchers combines elements of qualitative and quantitative research approaches (for example, use of qualitative and quantitative viewpoints, data collection, analysis, inference techniques) for broad purposes of breadth and depth of understanding and corroboration (Johnson, Onwuegbuzie& Turner, 2007). A research might beconsidered mixed if it employs qualitative and quantitative approaches at any stage, includingresearchquestionsdevelopment, samplingstrategiesdatacollectionapproaches, data analysis method, or conclusions (Creswell & Garrett, 2008; Tashakkori & Creswell, 2007). A mixed method design has the potential to reduce some of the

problems associated with singular methods; it combines the strengths of both methodologies (thus strengths of both qualitative and quantitative approaches).

Thedesign adopted for this study was mixed method approach, specifically,experimental and causal-comparative design.A causal-comparative design is a research design that seeks to find relationships between independent variables after an action or event has already occurred.The researcher's goal is to determine whether the independent variable affected the outcome, or dependent variable, by comparing two or more groups of individuals (Brewer & Kubn, 2012).

This research placed much emphasis on the post-test-only control group design. The post-test-only control group research design eliminates the problem of pre-testing reactivity. However, it does not control subject attrition due to absence of pre-test data on the subject. Data analysis from the post-testing exercise formed the basis for the comparison between the means of the two groups.

3.2 Research Variables

A description of research variable is presented as follows:

1. Independent Variables:

- Test given and feedback provided by teacher.
- Test given and feedback provided through self-assessment.

2. Dependent Variables:

- The dependent variable was the achievement of pupils at the end of instructional period.

3.3 Research setting

The research took place at the Anyinasu M/A Junior High School, which is within the Ejura-Sekyedumase Municipal of the Ashanti Region. The Ejura-Sekyedumase

Municipal is located within Longitudes $1^0$5" W and $1^0$39"W and Latitudes $7^0$9"N and $7^0$36"N. It is located in the Northern part of the Ashanti Region and it shares boundaries with Atbubu-Amantin District to the Northwest, Mampong Municipal to the East, Sekyere South District to the South and the Offinso Municipal to the West. It has a large land area of about 1340.1 square kilometers and constitutes about 7.3 percent of the region's total land area.

Anyinasu is a school town which has a population of about 4300. Majority of the inhabitants are farmers (specifically peasant farmers). The town has a cluster of schools (that is R/C Primary and JHS, SDA Primary and JHS, M/A Primary B, Osei Blessen JHS, Anyinasu M/A JHS, T.I Primary and JHS, Sanabu Primary and JHS and M/A Primary A). Anyinasu M/A JHS happens to be the oldest school in the town.It was established in 1963. The first head-teacher of the school was Mr. S. K. Addow. The current head-teacher is called Mr. Christian Sosu. The school has a student population of one-hundred and two(102); made up of fifty-five (55) girls and forty-seven (47) boys. The breakdown of the population is as follows: JHS One – thirty (30) students (eighteen females and twelve males), JHS Two – thirty-eight (38) students(twenty-one females and seventeen males), JHS Three – thirty-four (34) students (sixteen females and eighteen males). Anyinasu M/A JHS has a teaching staff of eight; a head-teacher and seven supporting teachers. Every teacher handles one subject.

3.4Case study

Case study is an empirical inquiry of conducting social science research, is suitable when the researcher has little control over occurrence, and the focus is on a current occurrence within a real-life context (Yin, 2009). According to Flyvbjerg (2006), case study is useful for both creating and analyzing a theory, based on an in-depth investigation of a single individual, group, or event (Yin, 2009).

Case studies are preferred when how and why questions are being posed, when the investigator has little control over events and when the focus is on a contemporary phenomenon with real life context (Yin, 2003). Comparing two methods (activity-based and discussion) in science teaching and learning at the study area (Anyinasu M/A JHS) is an example of a case study.

3.5Population and sample

By population is meant the target group or the group which is of interest to the researcher (Creswell, 2008). It is the large total group to which a researcher wants to generate his or her sample results (Johnson & Christensen, 2008). A sample is the group of individuals, who are selected from within a larger population by means of a sampling procedure. The sample represents the subjects the researcher would want to deal with because they bear the same characteristics as the target population (Anderson, 2006).

3.5.1 Population

The target population for the study consisted of all the JHS one pupils (learners) of Anyinasu M/A Junior High School. Thirty (30) pupils were involved in the study; eighteen (18) females and twelve (12) males.

3.5.2 Sampling technique

The sampling method used was the simple random sampling which is an example of probability sampling. To avoid bias, separate draws were held; one for the females and the other for the males. During the female draw, pieces of papers were numbered (1-18) and folded andthe females (18 in all) were asked to pick them. After discovering their respective numbers, they (females) were put into two groups (Group 'A' & Group 'B') – 9 members in each group. The males (12 in all), on the other

hand, were asked to join their female counterparts after they (males) have discovered their respective numbers (thus 1-6 in Group 'A' and 7-12 in Group 'B'). Groups 'A' and 'B' had 15 members each.Group 'A' was taught germination of seed based on discussion method of teaching whilst Group 'B' was taught germination of seed with activity-based method of teaching.

The table below (Table 1) illustrates the distribution of the study sample size

Table 1: Distribution of study sample size

Group	Pupils		
	Males	Females	Total
Group 'A'	6	9	15
Group 'B'	6	9	15

3.6 Instrument used

The researcher, in consultation with other science teachers developed an instrument (questions on germination of seeds) which was used for the study. The pupils were post-tested after they have been given separate treatments based on discussion and activity-based method of teaching and learning the concept "germination of seeds".

3.7 Research procedure

This study was undertaken within a period offour weeks (month). The target groups (Group 'A' and Group 'B') were taught germination of seeds based on discussion and activity-based methods of teaching and learning within the first two weeks. Two lessons were organized in each week for each of the two groups (Group 'A' and Group 'B'). Each lesson lasted for 70 minutes (that is 1 hour 10 minutes).

3.8 Data collection procedure

The third week was used to assess pupils' (learners) performance based on what they have learnt. Pupils were made to sit in such a way that they were unable to communicate or share ideas. The test items were distributed to all the thirty (30) pupils in two separate classrooms. The test items had special identification numbers; GA for Group 'A' and GB for Group 'B'. Test items were the same for all the two groups (Group 'A' and Group 'B'). Duration of the post-test exercise was 40 minutes.

3.9 Data analysis

Analysis and interpretation of the results was done within the last week (fourth week).All the 30 test scripts was marked, scored and compiled. Descriptive statistics was used to analyze the estimated marginal means, standard deviation, standard error means while Statistical Package for Social Sciences (SPSS version 16.0) was used to generate the t-value, standard deviation, standard error means and the significant difference of the two teaching methodologies. Microsoft excel spreadsheet (using bar chart) was used to analyze the pupils' achievements graphically.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.0 Overview

This chapter presents the results gathered from the scores of the test (post-test) administered to the two groups (Group 'A' and Group 'B'), analysis of the test scores,and finally, discussion of the major findings of the study.

Table 2:Test scores for Group 'A' (pupils taught with discussion method)

Score (x)	Percentage (%)	Frequency (f)	fx
1	4	1	1
2	8	2	4
3	12	2	6
6	24	2	12
7	28	2	14
8	32	4	32
13	52	1	13
14	56	1	14
Total	**%=100**	**∑f = 15**	**∑fx = 96**

Calculation of mean score and percentages of test scores for Group 'A'

Mean score for Group 'A' = $\sum fx/\sum f = 96/15 = 6.4$

Percentage mean score = $(6.4\times100)/25 = 25.6$

Actual mean score = 12.5 = 50%

4.1 Analysis and interpretation of test results for Group 'A' (discussion method group)

With reference to the table (Table 2) above, it could be seen that 2 pupils (representing 13.3% of the entire population of Group 'A') made a mark of 2 (8% of the total score) which was far below the average mark of 6.4 (25.6% of the total score).

Again, it could be realized that 4 pupils (26.7%) made a mark of 8 (32%) which was above the average mark of 6.4 (25.6% of the total score). However, they could not make the pass mark (thus 12.5 or 50%).

The analysis also revealed that only 2 pupils (13.3%) obtained the marks of 13 and 14 representing 52% and 56% of the test score respectively.

This analysis indicates that most pupilsfrom this group (Group 'A') could not make the pass mark.

Table 3: Test scores for Group 'B' (pupils taught with activity-based method)

Score (x)	Percentage (%)	Frequency (f)	fx
7	28	2	14
9	36	1	9
11	44	1	11
12	48	1	12
14	56	1	14
15	60	2	30
16	64	2	32
20	80	2	40
21	84	2	42
23	92	1	23
Total	**%=100**	**∑f = 15**	**∑fx = 227**

Calculation of mean score and percentages of test scores for Group 'B'

Mean score for Group 'B' = ∑fx/∑f = 227/15 = 15.1

Percentage mean score = (15.1×100)/25 = 60.4

Actual mean score = 12.5 = 50%

4.2 Analysis and interpretation of test resultsfor Group 'B'(activity-based method group)

The table above (Table 3) indicates that 2 pupils (representing 13.3% of the entire population of Group 'B') had a test score of 7 (representing 28% of the total score). In another breadth, 2 pupils (13.3%) obtained a score of 21 (representing 84%) which was far above the average score of 16.7 (66.8%).

Again, it could be deduced from the table (Table 2) above that a remarkable score of 23 (92%) was obtained by a pupil from this group (Group 'B').

This analysis demonstrates that most pupils (more than half of Group 'B' members) obtained the pass mark.Achievement scores of pupils in Group 'B' increased rapidly.

Table 4:Comparing test results of Group 'A'(pupils taught with discussion method) and Group 'B' (pupils taught with activity-based method)

Group	Mean score	Pupils who scored:		Group size	Percentage of pupils who scored:		Total
		Below average	Above average		Below average	Above average	
A	6.4	13	2	15	86.7	13.3	100
B	15.1	5	10	15	33.3	66.7	100

4.3Analysis and interpretation of the results

With reference to the table (Table 4) above, it could be seen that out of the 15 pupils who were tested in Group 'A', only 2 (13.3%) obtained more than the average mark (50% of the total score) as against 10 pupils (66.7%) who had more than half of the total score in Group 'B'. This implies that 13 pupils (86.7%) from Group 'A' obtained marks that were belowaverage. However, only 5 pupils (33.3%) from Group 'B' made similar scores(below average).

Furthermore, Group 'A' members (pupils taught with discussion method) had a mean score of 6.4 (25.6%) as against 15.1 (60.1%) mean score obtained by Group 'B' members (pupils taught with activity-based method). These figures indicate that the mean score forGroup 'A'(6.4) was far below that of the Group 'B' (that is 15.1). Also, Group 'A' mean score (25.6% in terms of percentage) did not match the actual mean score (50%) but that of Group 'B' (60.1%) surpassed it. Differences in mean scores

underscore the fact that the activity-based method that was used in teaching the concept of germination of seeds in Group 'B' achieves better results than the discussion method of teaching that was used in teaching members of Group 'B'.

Table 5: Comparing skewness of the two groups(Group 'A' and Group 'B')

Group	Group size	Mean score	% mean score	Maximum score	Minimum score	Range	Skewness
A	15	6.4	25.6	14	1	13	0.5004
B	15	15.1	60.1	23	7	16	-0.1689

4.3.1 Analysis and interpretationof the results

Table 5 shows that Group 'A' (pupils taught with discussion method of teaching) recorded 0.5004 in terms of skewness in comparison to -0.1689 for Group 'B'. This indicates that scores for Group 'A' wouldskew toward the lower marks due to the lower mean score (25 .6%) whilst that of Group 'B' would skew toward the high marks as a result of the mean score (60.1%).

The following graph shows the percentage mean scores of Group 'A' (pupils taught with discussion method of teaching) and Group 'B' (pupils taught with activity-based method).

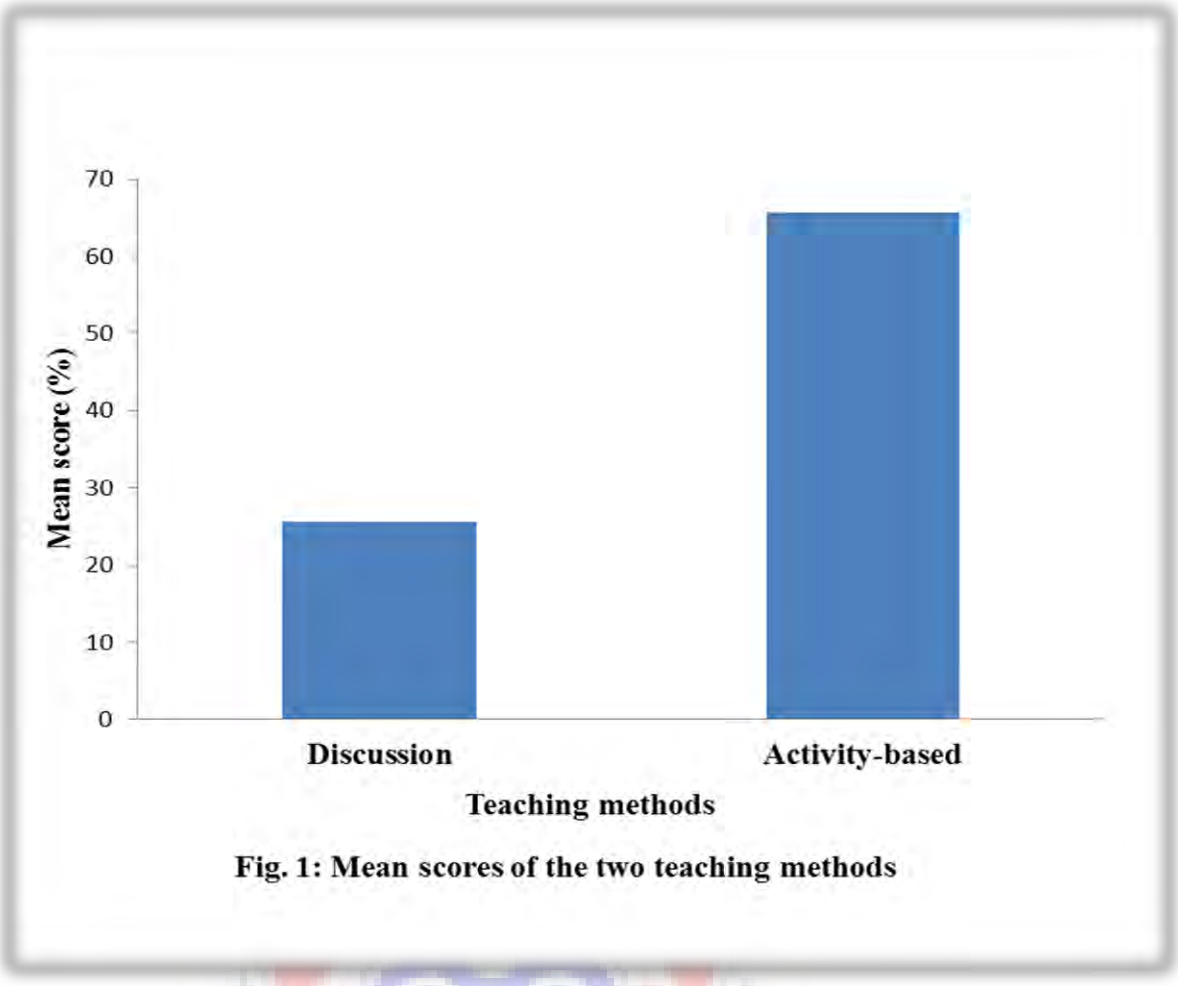


Fig. 1: Mean scores of the two teaching methods

4.4 What methodology can seed germination concept be best taught and learned?

Comparison of the two test results (results of Group 'A' and that of Group 'B') revealed that Group 'B' (pupils taught with activity-based method of teaching) performed better than Group 'A' (pupils taught with discussion method of teaching), with specific reference to Table 4 and Figure 1. Activity-based method of teaching is therefore the preferred methodology for teaching and learning science concepts.For instance, a concept such as germination of seeds is best taught and learned with the activity-based approach.

Table 6: Results of paired samples Test (T-Test)

1 Pair	Mean	Std. dev.	N	df	t-value	Sig. diff.
Discussion	6.40	3.814	15	14	-15.469	0.000
Activity-based	15.13	5.194	15			

**Significant at 0.000 level (one tailed test).

4.5 Analysis and interpretation of the results

The results above (as shown in Table 6) indicate that there was a significant difference in achievements between means scores of thepupils in Group 'B', who were taught seed germination with activity-based method of teaching and their counterparts (pupils in Group 'A') who were also taught the same concept with discussion method of teaching. A significant difference of 0.000 (p = 0.000) was revealed.Group 'A' (pupils taught with discussion method) recorded the following: Mean = 6.40, Standard deviation = 3.814. However, Group 'B' (pupils taught with activity-based method), recorded a Mean value of 15.13, Standard deviation of 5.194. The t-value for the two samples was -15.469, with a difference (df) of 14.

The results demonstrate that pupils would alwaysscore higher marks when they are taught science concepts with activity-based method of teaching.

4.6What significant difference exists between students taught using hands-on activity method and discussion method in the teaching and learning of seed germination?

Results of the paired samples test (as indicated in Table 6), clearly shows a significant difference of 0.000 (that is $p < 0.000$). There was a significant difference between means of the achievement scores of pupils that were taught seed germination with

activity-based approach and their counterparts who were taught the same concept (seed germination) with discussion method of teaching. Hands-on activity method of teachingenhanced pupils' achievements in science better than discussion method of teaching.

4.7 What relevant TLMs can enhance the teaching and learning of the concept of seed germination?

Even though several teaching/learning materials (TLMs) could be used to enhance pupils' understanding of the topic "Germination of seeds", the researcher believes that TLMs such as: soil sample, empty milo tin/milk tin/tin tomato or mineral water bottles whose upper parts have been removed, basin, test tubes, beakers, cotton wool, viable maize grains, viable beanseeds (cowpea), ice block, some amount of oil, a bucket of waterwhich were used effectively in the delivery of the lessons enhanced pupils' understanding of the concept. The fore mentioned teaching/learning materials were carefully selected and used throughout the instructional process. With the exception of the test tubes and the beakers, the remaining TLMs were provided by the pupils (these items were common in the community).

4.8 Discussion of the major findings from the study

The study revealed that out of 15 pupils who were taught germination of seeds with discussion method, only 2 pupils (representing 13% of the population of Group 'A') obtained a little above the average mark (that is more than 50% of the total score as indicated inTable 4). The remaining 13 pupils (representing 86.7%) failed the test (they obtained less than 50% of the test score as shown in Table 4). The results are in line withYeboah (2011), who recorded similar scores in his study.

Again, the study established that out of 15 pupils who were taught germination of seeds with activity-based approach, only 5 pupils (representing 33.3%) scored below average whilst 10 pupils (representing 66.7) obtained more than 50% of the test score as indicated in Table 4. This finding is in line with the post-test results recorded by Mishra and Yadav (2013) and Yeboah (2011) in their studies. For instance, Yeboah (2011) reported that more than half of his students (students belonging to the Activity Method Group) recorded higher scores in the post-test items administered after treatment.

Furthermore, the study revealed a significant difference (0.000) between the means of the achievement scores of Group 'B' pupils, after teaching them with activity-based method and the means of the achievement scores of Group 'A' pupils, after teaching them using the discussion method. This finding is in line with the findings of Mishra and Yadav (2013) and Yeboah (2011), who obtained similar results in their studies.

The study also revealed a mean score of 6.4 (25.65) for Group 'A' (pupils who were taught science concept with discussion method of teaching) and 15.1 (60.1%) for Group 'B' (pupils who were taught the same concept with activity-based method of teaching). Similar mean scores were recorded by students of West Africa Senior High School (Yeboah, 2011).

Lastly, the study brought to bear the relevance of teaching/learning materials (TLMs). Pupils in Group 'B' (activity-based method group) participated fully throughout the instructional periods. This made them understand the concept better thereby recording better scores. The pupils also acquired certain skills (manipulative skills) and they appreciated the learning environment. Researchers such as: Osguthope (2008); Whitcomb, Borko and Liston (2008); Mankoe (2007); Gates (2005); Avoke

(2005);Millar (2004) and many other researchers have reported on the relevance of teaching/ learning materials to learners (students) and teachers.

CHAPTER FIVE

SUMMARY OF THE STUDY, CONCLUSIONS, RECOMMENDATIONS AND SUGGESTIONS FOR FURTHER STUDIES

5.0 Overview

This chapter presents the summary of the study, conclusions, recommendations, and finally, suggestions for further studies.

5.1 Summary of the Study

Activity-based approach promotes greater interest and better attitude towards the material being learned by pupils (students) than discussion method of teaching. Pupils acquired manipulative skills as they carried out series of activities. They also participated fully in the teaching and learning process.

Activity-based method of teaching promotes better understanding of science concepts. Pupils who were taught germination of seeds with activity-based approach scored higher marks than their counterparts who were taught the same concept with discussion method of teaching.

Pupils (learners)who are provided with suitable/appropriate teaching and learning materials (TLMs), especially TLMs that are common in their locality would always feel proud about them.

5.2 Conclusions

Activity-based method of teaching is significantly effective than the discussion method as far as teaching and learning of science is concerned.

Activity-based method of teaching enhances pupils' understanding of science concepts, leading to greater academic achievements than the discussion method of teaching/learning science concepts.

5.3 Recommendations

The following recommendations are made based on the findings of the studies:

Teachers must be equipped with the needed knowledge and skills of implementing activity-based approach in the basic schools through pre-service and in-service training programmes. Such training programmes, if well-organized would go a long way in addressing poor teaching approaches.

Ghana Education Service should provide the basic schools enough teaching/learning materialsso that effective teaching and learning can take place.

There is the need for further studies to be conducted in order to investigate the effects teaching methods have on students' academic achievements, especially in the basic schools.

School authorities should split large classes into more manageable units for teachers to have a more effective and meaningful science lessons.

5.4 Suggestions for further studies

Further studies should be undertaken to compare pupils' academic achievements based on the discussion method of teaching/learning and the activity-based method of teaching/learning science concepts in different schools.

REFERENCES

Abdelhamid, T. S. (2003). Evaluation of teacher-student learning style disparity in construction management education. *Journal of Construction Education, 8*(3), 124-145.

Acquaye, K. O., Antwi, V., Eminah, J. K. & Techie, Y. T. (2008). *Integrated Science for Junior High Schools (Pupils Book 1).* Accra: Masterman Publishing Limited.

Activity Based Education(2011). Retrieved on December 13th, 2016, from http://activitybasededucation-blogspot.com/2011/07/abl-merits-and-demerits-html?m=1

Adunola, O. (2011). *The Impact of Teachers' Teaching Methods on the Academic Performance of Primary School Pupils in Ijebu-Ode Local cut Area of Ogun State.* Ogun State, Nigeria: Ego Booster Books.

Anamuah-Mensah, J. & Ameyaw-Asabere, A. (2004). The Fusion of Modern and Indigenous Science and Technology: How should it be done? *African Journal of Educational Studies in Mathematics and Science, 2*, 63-75.

Anderson, K. I. (2006). *The Relevance of Science Education: As seen by Pupils in Ghanaian Junior Secondary Schools.* Department of Mathematics and Science Education. University of the Western Cape. A published Doctor of Philosophy Thesis.

Anderson, R. D. & Helmes, J. V. (2001). The Ideal of Standards and the Reality of Schools: Needed Research. *Journal of Research in Science Teaching, 38*, pp 3-16.

Asabere-Ameyaw, A. & Oppong, E. K. (2003). *Integrated Science for the Basic School Teacher 1.* Winneba: I.E.D.E, University of Education,Winneba.

Attafuah, P. (2007). *Junior secondary school pupils and teachers' perception of their science classroom environment.* Unpublished Master's Thesis, University of Education, Winneba.

Avoke, M. (2005). *Special Educational Needs in Ghana.* Department of Special Education. University of Education, Winneba.

Ayeni, A. J. (2011). Teachers professional development and quality assurance in Nigerian Secondary Schools. *World Journal of Education, 1*(2), 143-149.

Banu, S. M. (2011). *The Role of Practical Work in Teaching and Learning Physics at Secondary Level in Bangladesh.* University of Canterbury, New Zealand. A published Master of Education Thesis.

Boz, N. & Boz, Y. (2008). A qualitative case study of prospective chemistry teachers' knowledge about instructional strategies: Introducing particular theory. *Journal of Science Teacher Education, 19*(2), 135-156.

Braimoh, D. & Okedeyi, A. (2001). Direction of professional development for classroom teachers in effective science, technology and mathematics teaching: Matters arising. *Lagos Journal of Science Education, 5*, 33 - 37.

Brewer, W. E. & Kubn, J. (2012). Causal-Comparative Design. In: Kubn, E. W. & Salkind, J. N. (Ed.). *Encyclopedia of Research Design* (pp. 125-131). Thousand Oaks: SAGE Publications, Inc.

Capon, N. & Kuhn, D. (2004). What's so good about problem-based learning. *Cognition and Instruction, 22*(1), 61-79.

Chang, W. (2002). Interactive Teaching Approach in Year One University Physics in Taiwan: Implementation and Evaluation. *Asia-Pacific Forum on Science Learning and Teaching*.

Chief Examiner's Report (2007). Annual Report of the West African Examinations Council (WAEC). Accra: Ghana Publishing Company.

Churchhill, D. (2003). *Effective design principles for activity-based learning: the crucial role of learning objectives in science and engineering.*

Cresswell, J. W. (2008). *Educational research: Planning, conducting and evaluating quantitative and qualitative research.* Upper Saddle River, NJ: Pearson/Merrill Prentice Hall.

Cresswell, J. W. & Garrett, A. L. (2008). The movement of mixed methods research and the role of educators. *South African Journal of Education, 28*(3), 321-333.

Denzin,N. K. & Lincoln, Y. S. (2005). A Handbook of Qualitative Research (3rd ed.). Thousand Oats, CA: Sage Publication.

Duggan, S. & Gott, R. (2002). What sort of science education do we really need? *International Journal of Science Education, 24*, 661-679.

Edward, N. S. (2001). Evaluation of a constructivist approach to student induction in relation to students' learning style. *European Journal of Engineering Education, 26*(4), 429-440.

Ewers, T. G. (2001). Teacher-directed versus learning cycles methods: effects on science process skills mastery and teacher efficacy among elementary education students. *Dissertation Abstracts International, 62*(07).

Fletcher, J. A. (2000). Constructivism and Mathematics Education in Ghana. *Journal of the Mathematics Association Ghana, 12*, 27-35.

Flyvbjerg, B. (2006). Five misunderstandings about case-study research. *Quantitative Inquiry, 12*(2), 219-245.

Gage, N. L. & Berliner, C. D. (1988). *Educational Psychology (4th ed).* Boston: Houghton Mifflin.

Ganyaupfu, M. E. (2013). Teaching Methods and Students' Academic Performance. *International Journal of Humanities and Social Science Invention, 2*(9), 29-35.

Gates, B. (2005). *Learning Disabilities* (4th ed.). London: Churchill Livingstone.

Gay, L. R., Mills, G. & Airasian, P. W. (2005). *Educational research: Competencies for analysis and applications* (8th ed.). Upper Saddle River, NJ: Merrill.

Ghartey, A. J. (2007). Managing Science Practical Work in Senior Secondary School: Is a group work the answer? *Journal of Science and Mathematics Education, 3*(1).

Halai, N. (2008). Curriculum reform in science education in Pakistan. In: Coll, R. K. & Taylor, N. (Eds.). *Science Education in Context: An International Examinaton of the Influence of Context on Science Curricula Development and Implementation*, pp. 115-129.

Harfield, T., Davies, K., Hede, J., Panka, M. & Kenley, R. (2007). Activity-based teaching for Unitec New Zealand construction students. *Emirates Journal for Engineering Research*.

Hodson, D. (1998). *Teaching and learning science: Towards a personalized approach.* Buckingham: Open University Press.

Huber, R. A. & Moore, C. J. (2001). A Model for Extending Hands-on Science to be Inquiry Based. *School Science and Mathematics*, 32-42.

International Council for Science (ICSU, 2011). *International Council for Science Ad-hoc Review Panel on Science Education.* Paris: International Council for Science.

Johnson, R. B. & Christensen, L. (2008). *Educational Research: Quantitative, Qualitative and Mixed Approaches* (3rd ed.). Los Angeles: SAGE Publications.

Johnson, R. B., Onwuegbuzie, A. J. & Turner, L. A. (2007). Toward a definition of mixed methods research. *Journal of Mixed Methods Research, 1*(2), 112-133.

Jones, M. G., Howe, A. & Rue, M. J. (2000). Gender differences in students' experiences, interests and attitudes towards science and scientists. *Science Education, 84*, 180-192.

Kasanda, C. D. (2008). Improving Science and Mathematics Teachers' Subject Knowledge in Namibia. In: Coll, R. K. & Taylor, N. (Ed.). *Science Education in Context: An International Examination of the Influence of Context on Science Curricula Development and Implementation* (pp. 199-209). Rotterdam: Sense Publishers.

Khan, M., Muhammad, N., Ahmed, M., Saeed, F. & Khan, A. S. (2012). Impact of Activity-based Teaching on Students' Academic Achievements in Physics at Secondary Level. *Academic Research International, 3*(No. 1).

Klafki, W. (2000). Didktik analysis as the cone of the preparation of instruction. In: Westbury, I. , Hopmann, S. & Riquarts, K. (Eds.). *Teaching as a reflective practice the German didaktik tradition*.

Larson, B. E. (2000). Classroom discussion: A method of instruction and a curriculum outcome. *Teaching and Teacher Education, 16*, 661-667.

Lingbiao, G. & Watkins, D. (2001). Identifying and assessing the conception of teaching of secondary school physics teachers in China. *British Journal of Educational Psychology, 71*(3), 443-469.

Maleque, A., Begum, M., Islam, F. & Riad, S. S. (2007). *Shikkha Bigyan O Bangladesha Shikkha.* Dhaka, Bangladesh: The University Grants Commision of Bangladesh.

Mankoe, J. (2007). *Educational Administration and Management in Ghanna* (2nd ed.). Kumasi: Payless Publication Limited.

Millar, R. & Abraham, I. (2009). Practical work: Making it more effective. *School Science Review, 91*(334), 59-64.

Millar, R. (2004). The role of practical work in the teaching and learning of science. *High School Science Laboratory: Role and Vision, National Academy of Sciences, Washington, D. C.*

Millar, R. & Osborne, J. F. (1998). *Beyond 2000: Science Education for the Future.* London: King's College London.

Ministry of Education, Science and Sports (2007). *Teaching Syllabus for Integrated Science (Junior High School).* Accra, Ghana: Curriculum Research and Development Division (CRDD).

Ministry of Environment, Science and Technology (MESS, 2009). *National Service, Technology and Innovation Policy 2.* Accra: MEST.

Mishra, K. S. & Yadav, B. (2013). Effect of Activity Based Approach on Achievement in Science of students at Elementary Stage. *International Journal of Basic and Applied Science, 01*(04), 716-733.

Murray, P., Donohoe, S. & Goodhew, S. (2004). Flexible learning in construction education: A building pathology case study. *Structural Survey, 22*(5), 242-250.

Okebukola, P. A. (1997). *The state of science education in Nigeria. Paper presented at the ELLSA - British Council Primary Science Forum.* Kaduna, Nigeria, on the 5th April, 2007.

Ololube, N. P. (2006). *A study of academic and professional qualification on teachers' job effectiveness in Nigerian secondary schools.* A published Doctor of Philosophy Thesis. University of Helsinki.

Organization for Economic Co-operation and Development (2006). *Programme for International Students Assessment (PISA) 2006 Science Competencies for Tomorrow's World. Available at http://www.oecd.org/dataoecd/15/13/39725224.pdf*

Osborne, J. F. & Collins, S. (2000). *Pupils and Parents' view of the school curriculum.* London: King College.

Osborne, J., Simon, S. & Collins, S. (2003). Attitudes towards science: A review of the literature and its implications. *International Journal of Science Education, 25*(9), 1049 - 1079.

Osguthope, R. D. (2008). On the Reasons We Want Teachers of Good Disposition and Moral Character. *Journal of Teacher Education, 59*(4), 275-295.

Rahman, F., Khalil, K., Jumani, B. N., Ajmal, M., Malik, S. & Sharif, M. (2011). Impact of Discussion Method on Students Performance. *International Journal of Business and Social Science, 2*(7 Special Issue)).

Ranade, M. (2008). Science education in India. In: Coll, K. R. & Taylor, N. (Eds.). Sence Publishers, Rotterdam.

Roby, T. (1988). Models of Discussion. In: Dillon, J. T.(Ed.). *Questioning and discussion: A multidisciplinary study*, pp. 163-191.

Schreiner, C. & Sjoberg, S. (2004). Sowing the seeds of ROSE. Background, Rationale, Questionnaire Development and Data Collection for ROSE (The Relevance of Science Education) - a comparative study of students' views of science and science education.

Seifert, K. & Sutton, R. (2009). *Educational Psychology (Second Edition).* Retrieved on September 10th, 2016, from http://www.saylor.org/courses/psych 303/

Shah, I. & Rahat, T. (2014). Effect of Activity Based Teaching Method in Science. *International Journal of Humanities and Management Sciences (IJHMS), 2*(1).

Sjoberg, S. (2002). Science and education technology in Europe: Current challenges and possible solutions. In: Jenkins, E. W. (Ed.). *Connect UNESCO, 27*(3-4), 1-5.

Stanley, B. S. & Jones, C. H. (1999). Study behaviours of college preparatory and honours students in the ninth grade. *The High School Journal, 82*(3), 165 - 171.

StoBlein, M. (2009). Activity-based Learning Experiences in Quantitative Research Methodology for (Time-Constrained) Young Scholars - Course Design and Effectiveness. *POMS 20th Annual Conference.* Orlando, Florida, USA.

Strike, K. & Posner, G. (1992). A revisionist theory of conceptual change. In: Duschl, R. A. & Hamilton, R. (Eds.). *Philosophy of science, cognitive psychology and educational theory and practice*, pp. 147-176.

Tashakkori, A. & Cresswell, J. W. (2007). Exploring the nature of research questions in mixed methods research. *Journal of Mixed Methods Research, 1*(3), 207-211.

Taylor, A. & Dana, T. M. (2003). Secondary school physics teachers' conceptions of scientific evidence: An exploratory case study. *Journal of Research in Science Teaching, 40*(8), 721-736.

Tebabal, A. & Kahssay, G. (2011). The effects of student-centered approach in improving students' graphical interpretation skills and conceptual understanding of kinematical motion. *Lat. Am. J. Phy. Education, 5*(2), 374-381.

Toffay, J. (2012). *Attitude of Junior High School Students on the Importace of Science Education: A case study of Axim Township.* University of Education, Winneba, Department of Science Education. Unpublished dissertation.

Tytler, R., Osborne, J., Williams, G., Tytler, K. & Clark, J. C. (2008). *Opening up pathways: Engagement in STEM accross the Primary - Secondary school transition.* Canberra, Australia: Department of Education, Employement and Workplace Relations.

Van Driel, J. H., Beijaard, D. & Verloop, N. (2001). Professional development and reform in science education: The role of teachers' practical knowledge. *Journal of Research in Science Teaching, 38*(2), 137-158.

West African Examinations Council (WAEC, 2007). *Annual Report of the West African Examinations Council.* Accra: Ghana Publishing Company.

West African Examinations Council (2010). *Annual Report of the West African Examinations Council.* Accra: Ghana Publishing Company.

Whitcomb, J., Borko, H. & Liston, D. (2008). Why Teach? *Journal of Teacher Education, 59*(4), 267-272.

Wilen, W. (2004). Refuting misconceptions about classroom discussion. *Social Studies, 95*, 33-39.

Wilkinson, I. (2009). Discussion Methods. *EDUCATION. COM*. Retrieved on September 9th, 2016, from http://www.education.com/reference/article/discussion methods/

Wood, T., Cobb, P. & Yackel, E. (1995). Reflections on learning and teaching mathematics in elementary school. In: Steffe, L. P. & Gale, J. (Eds.). *Constructivism in Education*, pp. 401-422.

Yeboah, P. (2011). *A comparative study of discussion and activity methods in the teaching of germination of seeds: A case study of Form Two G/Arts students of the West Africa Senior High School-Accra.* University of Education, Winneba. Unpublished thesis.

Yin, R. K. (2003). *Application of study research (applied social research methods)* (4th ed.). Thousand Oaks: SAGE Publications.

Yin, R. K. (2009). *Case study research: Design and Methods* (4th ed.). California: SAGE Publications.

Zakaria, E. Chin, C. L. & Daud, Y. (2010). The effect of co-operative learning on students' mathematics achievements and attitude towards mathematics. *Journal of Social Sciences, 6*(2), 272-275.

APPENDIX A

Lesson plan for Group 'A' (discussion method of teaching and learning)

Subject: Integrated Science

Week: 1 & 2

Weekending: 14th October, 2016 and 21st October, 2016.

Class: JHS One

Number on roll: 15

Duration: 70 minutes

Topic: Germination of seed

Sub-Topic: Meaning of the term germination, types of germination, conditions necessary for germination of seeds.

Objectives: By the end of between the lessons, the pupil will be able to:

1. Define the term germination of seed.
2. Name the two types of germination.
3. Distinguish between epigael and hypogeal germination.
4. State the conditions necessary for germination of seeds.

Teaching/learning materials: Sample of viable maize seeds(grains), sample of viable bean seeds(cowpea), cotton wool, ice block, a bucket of water, some amount of oil, sample of soil, empty mineral water bottles whose upper parts have been removed, test tubes, beakers.

Teacher-learner activities

The researcher adopted a pattern that was developed and used by Rahman, et al. (2011). Below is the pattern:

Before the Activity

1. Introduce purpose of the class activity to students.
2. Describe the key feature of the lesson.
3. Show the types of learning material to students.

During Discussion Activity

1. Encourage students to be fully involved in the activity by asking questions occasionally and to test their comprehension of what is going on.
2. Elaborate the activity, when appropriate in order to help students understand concepts inherent in the lesson.
3. Encourage students to ask questions if they do not understand the topic of discussion.

After Class Activity

1. Help students to relate relevant ideas and to arrive at the final conclusions.
2. Discuss results.
3. Evaluate opinion and facts.
4. Encourage students to be prepared for the next activity.

Activity 1

The researcher served as the moderator of the discussion group (Group A). The moderator displayed the teaching/learning materials for pupils to observe. He then introduced the topic, "Germination of seed" and kept the discussion moving.

As the discussion progressed, pupils (learners) were able to bring out the meaning of the term germination.

Germination is the emergency of the embryo from the seed coat due to onset of growth and development of seed.

Activity 2

The moderator guided the pupils (learners) as they discussed the two types of seed germination.

1. Epigeal germination – This type of germination occurs when the cotyledons appear above the surface of the soil. Epigeal germination is caused by the elongation of the hypocotyls of the radical during germination. Crops such as cowpea and gourd demonstrate epigeal germination.
2. Hypogeal germination – This type of germination occurs when the cotyledons remain below the surface of the soil. Hypogeal germination is caused by the elongation of the epicotyls of the plumule. Crops such as maize, millet, and pea demonstrate this type of germination.

Activity 3

The moderator controlled the class as they discussed the conditions necessary for germination of seeds to occur.

Four test tubes labelled; A, B, C and D were displayed for the pupils (learners) to observe. The group then discussed the conditions that had been provided in each of the four test tubes.

1. Test tube A: Viable seeds, water, air (oxygen) and warmth.
2. Test tube B: Viable seeds, air and water but no warmth (was kept in a beaker containing ice).
3. Test tube C: Viable seeds, warmth and air but no water.
4. Test tube D: Viable seeds, water and warmth but no air.

The pupils (learners) used the test tubes (A, B, C, D) in identifying the conditions necessary for germination of seeds.

The conditions necessary for germination of seeds to occur are: Moisture, air (oxygen), suitable temperature (warmth) and viability of seed.

The moderator summarized the relevant points on the chalkboard. The moderator and his members (Group 'A' members) brought the discussion to a successful end.

Lesson plan for Group'B' (activity-based method of teaching and learning)

Subject: Integrated Science

Week: 1 & 2

Weekending: 14th October, 2016 and 21st October, 2016.

Class: JHS One

Number on roll: 15

Duration: 70 minutes

Topic: Germination of seed

Sub-Topic: Meaning of the term germination, types of germination, conditions necessary for germination of seeds.

Objectives: By the end of between the lessons, the pupil will be able to:

1. Define the term germination of seed.
2. Name the two types of germination.
3. Distinguish between epigeal and hypogeal germination.
4. State the conditions necessary for germination of seeds.

Teaching/learning materials: Fifteen (15) empty mineral water bottles whose upper parts have been removed, soil sample fetched from refused dumping area, four (4) test

tubes, sample of viable maize seeds (grains), sample of viable bean seeds (cowpea), cotton wool, ice block, beakers, some quantity of water, some quantity of oil.

Teacher – learner activities

The researcher gave each member of Group 'A' one empty transparent water bottle whose upper part has been removed.

Activity 1

The researcher asked learners (pupils) to fill their empty transparent water bottles with soil, sow maize grains (about six) and water the sown maize grains.

Activity 2

The researcher guided the learners (pupils) as they performed the following activities:

A. Label the four test tubes as A, B, C and D.
B. Put dry cotton wool into each of the four test tubes (test tubes: A, B, C, D).
C. In test tube A; put in viable cowpeas (three), provide the content with air and suitable temperature.
D. Put some viable cowpea (three) into test tube B, pour enough water to completely cover the seeds and pour some oil onto the surface of the water to prevent oxygen from reaching the seeds.
E. In test tube C, add some quantity of water to the cowpeas and keep the set-up in a beaker containing ice block in order to reduce its temperature.
F. In test tube D, put in viable cowpea (three), oxygen, add amount of water and leave the set-up in warm place.

Activity 3

A week after the experiment, the researcher asked learners (pupils) to bring the set-ups, observe them and come out with the conditions necessary for germination of seeds.

Test tube A: Seeds (cowpea) did not germinate because they (seeds) lacked water.

Test tube B: Seeds (cowpea) did not germinate because they lacked oxygen (air).

Test tube C: Seeds (cowpea) did not germinate because they lacked suitable temperature.

Test tube D: Seeds (cowpea) germinated because the seeds had all the conditions necessary for germination.

Meaning of the term germination

Germination refers to the emergence of the embryo from the seed coat due to the onset of growth and development of seed.

Types of germination

There are two types of germination. They are:

1. Epigeal germination – This type of germination occurs when the cotyledons appear above the soil as seen with the cowpea. Epigeal germination is caused by the elongation of the hypocotyls of the radical during germination. Crops such as cowpea and gourd demonstrate this type of germination.
2. Hypogeal germination – This type of germination occurs when the cotyledons remain below the soil surface as we have observed in the set-up with the maize grains. Hypogeal germination is caused by the elongation of the epicotyls of the plumule. Crops such as maize and pea demonstrate this type of germination.

Week three

Test items that had been set by the researcher in consultation with other integrated science teachers on the topic under review, germination of seeds were administered to Group 'A' (discussion method of teaching and learning) and Group 'B' (activity-based method of teaching and learning). Duration of the test was forty (40) minutes.

Week four

Test items were marked, scored and compiled. The scores were analyzed using: Descriptive statistics, Statistical Package for Social Sciences (SPSS) version 16.0 andMicrosoft Excel Spreadsheet.

APPENDIX B

ANYINASU M/A JUNIOR HIGH SCHOOL

QUESTIONS FOR JUNIOR HIGH SCHOOL ONE (JHS 1)

TIME: 40 MINUTES

DATE: 19TH OCTOBER, 2016

SECTION A: ANSWER ALL QUESTIONS

1. The emergence of embryo from the seed coat due to the onset of growth and development is termed……..…
2. Germination occurs only when certain……..……are met.
3. Germination makes it possible for a viable seed to develop into a young plant or ……..
4. The two types of germination are:

   (i)……

   (ii)……..…
5. In …….... germination, the cotyledons remain below the surface of the soil.
6. In ……..…… germination, the cotyledons appear above the surface of the soil.
7. Hypogeal germination occurs in crops such as:

   (a)……..

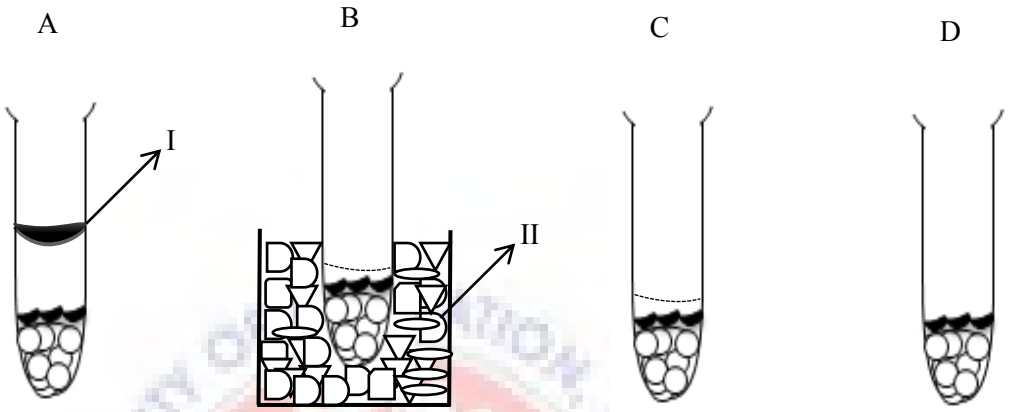
   (b)……..
8. Epigeal germination occurs in crops such as:

   (a)……..……

   (b)……

SECTION B: ANSWER ALL QUESTIONS

The set-up below was used during an experimental study. Use it to answer the questions that follow:



1. What is the aim of the experiment?

   .....

   ……..

2. Name the parts labelled:

   I……II……..……..

3. In which of the test tubes did the seeds germinate?

   .....

4. What made the seeds in the test tube (you have named in question 3 above) germinate?……

   ……..

5. State the conditions necessary for germination of seeds to occur?

   (a)……..

   (b)……...

   (c)……

   (d)……

6. State the conditions available to seeds in the test tubes labelled below:

   A……

   ……..

   C…….....

   ……

   D……

   ……..

7. What role did the ice block play in the beaker containing test tube B?

   ……

   ……

   ……

8. What was the function of the oil in test tube labelled A?

   ……

   ……

   ……

   ……

MARKING SCHEME

SECTION A

1. Germination 1 mk
2. Conditions 1 mk
3. Seedling 1 mk
4. (i) epigeal (ii) hypogeal 1×2 = 2 mks
5. Hypogeal 1 mk
6. Epigeal 1 mk
7. Maize, rice, millet, sorghum. 1/2×2 = 1 mk
8. Soyabean, French bean, Bambara bean. 1/2×2 = 1 mk

SECTION B

1. To determine the conditions necessary for germination to occur 2 mks
2. I – oil II – ice block 1×2 = 2 mks
3. Test tube C 2 mks
4. All the conditions necessary for germination to occur were provided 2 mks
5. Temperature/warmth, air/oxygen, water/moisture and viability of see 1/2×4=2mks
6. Test tube A: warmth, water but no oxygen

   Test tube B: water, air but no warmth

   Test tube C: air, water, warmth

   Test tube D: air, warmth but no water 1/2×4 = 2 mks
7. The ice block was used to reduce the temperature of the seeds 2 mks
8. It prevented air from entering the test tube 2 mks

APPENDIX C

Group A (discussion method)	
Mean	6.4
Standard Error	0.984644
Median	7
Mode	8
Standard Deviation	3.8135098
Sample Variance	14.542857
Kurtosis	-0.065915
Skewness	0.5003964
Range	13
Minimum	1
Maximum	14
Sum	96
Count	15
Confidence Level (95.0%)	2.1118513

GROUP B (activity-based method)	
Mean	15.13333333
Standard Error	1.341167461
Median	15
Mode	7
Standard Deviation	5.194319241
Sample Variance	26.98095238
Kurtosis	-1.070352024
Skewness	-0.168853804
Range	16
Minimum	7
Maximum	23
Sum	227
Count	15
Confidence Level (95.0%)	2.876518108

APPENDIX D

T-Test

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Discussion	6.40	15	3.814	.985
	Activity	15.13	15	5.194	1.341

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	Discussion & Activity	15	.927	.000

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Discussion - Activity	-8.733	2.187	.565	-9.944	-7.522	-15.469	14	.000

```
SAVE OUTFILE='C:\Users\user\Desktop\SPSS APP.sav'
  /COMPRESSED
```