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UTILISATION OF CO-OPERATIVE INSTRUCTIONAL APPROACHES TO IMPROVE THE PROCESS SKILLS OF SELECTED OSEI KYERETWIE SENIOR HIGH SCHOOL BIOLOGY STUDENTS

JOHN OWUSU-SEKYERE

University of Education,Winneba http://ir.uew.edu.gh

2012

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JOHN OWUSU-SEKYERE

M.ED SCIENCE

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A DISSERTATION IN THE DEPARTMENT OF SCIENCE EDUCATION SUBMITTED TO THE SCHOOL OF GRADUATE AND RESEARCH STUDIES, UNIVERSITY OF EDUCATION, WINNEBA IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF MASTERS' DEGREE IN SCIENCE EDUCATION

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DECLARATION

Candidate's declaration

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

Signature

……………………….. ……………………………

John Owusu -Sekyere Date

Supervisor's declaration

I hereby declare that the preparation and presentation of this dissertation were supervised in accordance with the guidelines on supervision of dissertations laid down by the University of Education, Winneba.

Signature

…………………….. ………………………..

Prof. John K. Eminah Date

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DEDICATION

I dedicate this work to my father and all members of my family.

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ABSTRACT

The main purpose of the study was to give suggestions to improve the process skills of selected senior high school students in Osei Kyeretwei Senior High School, Kumasi through the use of cooperative instructional approaches.

The study was an action research that used fifty, third year elective science students out of the total of two thousand students in the school based on purposive sampling procedure. The sampled students were further divided into ten groups with five members each through simple random sampling technique. A series of practical activities were conducted to find out the students level of understanding of the process skills before cooperative instructional approaches were used as an intervention. The results revealed that there was an improvement in the performance of the students as well as their content knowledge in science process skills after the intervention. This proves that cooperative learning is an effective instructional strategy for improving students‟ performance in process skills. It is therefore appropriate that science teachers prepare their science instructions such that equal opportunities are given to all students under their care. As a result there is a need for teacher educational institutions to reinforce cooperative instructional approaches in the science teaching and learning in their science lessons.

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CHAPTER ONE

INTRODUCTION

Overview

This chapter comprises the background to the study, the statement of the problem, purpose of the study, research questions and the significance of the study. The delimitations and limitations that were identified during the study as well as abbreviations used are also presented. Finally, it presents the organization of the study.

Background to the Study

Science curriculum innovation and reforms were characterized by the attempts to incorporate more practical oriented and investigative activities into science classes (Clark, 2003). Teachers attempted to get their students involved in the world of science, especially the world of research scientists. This involved consideration of the processes used by such scientists and the concepts they used. These moves were also accompanied by similar efforts to measure the outcomes of such processes. The Senior High School Biology syllabus (GES, 2012) emphasized the teaching and learning of science process skills. The Curriculum Research and Development Division of the Ghana Education Service refers to science process skills as" the learners" cognitive ability of creating meaning and structure from new information and experience." The emphasis placed on the

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development and use of science process skills by the revised national curriculum statement is evident when it expresses the views that from a teaching point, process skills are the building blocks from which suitable science tasks are constructed. It further argues that a framework of process skills enable teachers to formulate and design tasks which promote the critical thinking required by the curriculum.

From the learning point of view, process skills are important and necessary means by which the learner engages with the world and gains intellectual control of it through the formation of concepts and development of scientific thinking. The scientific method, scientific thinking and critical thinking have been terms used at various times to describe these science process skills.

Science learning follows a process approach. In scientific investigations, some of the key science process skills that a scientist should follow are: observation, analysis, classification, description, interpretation of data, hypothesis, prediction, planning, experimentation, keeping of records, measurement, conclusion and communication (Graves, 1995).

Observation involves noting the attributes of objects and situations through the use of the senses. Analysis is a means of trying to think of the possible causes of the event happening. Classification goes one step further by grouping together objects or situations based on shared attributes. Describing what is happening and explaining or interpreting it leads to guessing (hypothesis) what you think is the cause of what is happening. Prediction involves forecasting or saying in advance what would happen if the event or what is happening comes to an end. Then there

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is the planning to perform actual experiments during which records and measurements are taken as the experiment proceeds. It expresses physical characteristics in quantitative ways. Based on the records and measurements, taken conclusions could be drawn from the outcome of the experiment. The conclusions formed could then be communicated or made known to other people.

These science process skills are incorporated in all the three science learning areas (scientific investigations, constructing science knowledge and science society and the environment) of the science syllabus. In consequence, many of the science syllabus guide and instructional materials at the SHS level have important outcomes, the development of the science process skills. Learners using these instructional materials are expected to acquire these skills in addition to mastering the content of the subject matter. Having established the importance that was attached to science process skills by the CRDD, the question that arose was to what extent do the learners, who use this curriculum and instructional materials manage to acquire the science process skills? The answer to this question lies in the effective assessment of learner‟s competence in those specific skills such as practical activities through cooperative instructional approaches in which small intentionally selected groups of three to five students‟ work independently on a well- defined learning task. Individual students are held accountable for their own performance and the instructor serves as a facilitator in the group learning process.

A review of the West African Examination Council‟s chief examiners report on biology (WAEC, 2000-2009) for a period of ten years shows that not too much

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work had been done for students to gain mastery over some key process skills, hence leading to the abysmal performance of students in biology examinations every year at the West African Senior Certificate Examination (WASSCE). It was evident that hands- on practical activity procedure through cooperative instructional approaches would seem most appropriate for improving process skills competencies of SHS students in Ghanaian schools. Research had shown that learners learn process skills better if they are considered as important objects of instruction relatable to their environment using cooperative instructional approaches and the use of locally developed educational materials that are familiar and which meet the expectations of the learners.

The Statement of the Problem

Over the years, one of the major complaints in the WASSCE Biology Chief Examiner"s Report, were the scant use of process skills by Senior High School students during biology practical examinations. This was evident from the poor drawing and observation skills of the candidates in the practical examination. The persistence of this problem implies that whatever local interventions the biology teachers applied have only had minimal effects. Due to the importance of science process skills in the generation of valid scientific knowledge, there was the need for this problem to be addressed during their practical activities in the target school to provide a basis for future attempts to find a lasting solution to this gap in the SHS students" practical skills.

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Purpose of the Study

The poor performance of SHS students in biology practical examinations for a period of ten years (WAEC, 2000-2009) gives an assumption that either science process skills were not taught or learnt properly. Teaching and learning can only be done effectively if classroom factors such as physical infrastructure, class sizes, resource materials, methodologies of teachers that enhances them are addressed. The study was therefore aimed at improving the process skills of SHS students in biology practical activities through cooperative instructional approaches at Osei Kyeretwie Senior High School, Kumasi.

Research Questions

The following research questions directed the investigations.

1. Which of the required process skills specified by the designers of the SHS biology syllabus do the students exhibit during biology practical lessons?
2. What are the causes of the inability of the students to apply all the science process skills specified in the SHS biology syllabus?
3. Will the use of cooperative instructional approaches help the students to improve on their science process skills?

Significance of the Study

The findings of this research might serve as a source of information about classroom environment during the teaching and learning of biology practical

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lessons. The findings of the study will also inform government, policy makers and other stake holders in education on matters concerning enhancing the performance of students with respect to process skills in biology practical lessons.

Delimitation

The study was conducted at the Osei Kyeretwie Senior High School in Kumasi Metropolitan area of the Ashanti Region. It was carried out as a case study but its findings could apply to other senior high schools which have similar conditions. Science students and teachers were sampled for the study. It involves improving science process skills in biology practical activities.

Limitations of the Study

There are few weaknesses in the study design. First, there is a real possibility of unmeasured biases can occur when one instructor teaches the same topic. For example, differences in instructor‟s method of teaching may not have the same results.

Limiting the study to one SHS in the Kumasi Metropolitan Area of the Ashanti Region may not reveal the general picture of the influence of co-operative learning on SHS students in biology practical activities in Ghana. So generalization of the findings from this study to entire population of SHS students in other SHS may have its own difficulties.

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Abbreviations

WASSCE	-	West African Senior Secondary Certificate Examination
SHS	-	Senior High School.
WAEC	-	West African Examination Council
CRDD	-	Curriculum Research Development Division
SPS	-	Science Process Skills
UEW	-	University of Education, Winneba
GES	-	Ghana Education Service
GAST	-	Ghana Association of Science Teachers
OKESS	-	Osei Kyeretwie Senior High School

Organization of the Study

This study is organized into five chapters. The first chapter describes the background to the study, the statement of the problem, purpose of the study, the research questions, the significance of the study, delimitation and limitation of the study as well as definitions of the abbreviations of the terms used.

The second chapter provides the review of literature related to the study such as conceptual framework of the study, the concept of cooperative learning, benefit of cooperative learning, science teaching strategies, the concept of practical activity techniques of teaching science, merits of practical activity technique of teaching science, demerits of practical activity technique of teaching science, the

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Senior High School biology syllabus and empirical evidence of science process skills.

The third chapter presents information about the methodology employed in the study which include research design, population and sampling procedure, research instruments, description of the questionnaire items, scoring the questionnaire items, reliability and validity of the main instrument, intervention stages, data collection procedure and data analysis procedure. The fourth chapter focuses on research results, analysis and discussions on data.

Finally, the fifth gives a summary of the research findings, conclusion, recommendations and suggestions for further studies.

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CHAPTER TWO

REVIEW OF RELATED LITERATURE

Overview

This chapter is devoted to the review of the literature related to the study. The review is organized under the following sub-headings. The conceptual framework of the study, concept of cooperative learning, benefit of cooperative learning, science teaching strategies, concept of practical activity technique of teaching science, merits of practical activity technique of teaching science ,demerits of practical activity technique of teaching science, the SHS biology syllabus and empirical evidence of science process skills.

Conceptual Framework of the Study

The target of the study is premised on students, teachers, cooperative instructional approaches, practical activity, process skills and classroom environment. Therefore theories that have to do with the characteristics of these entities as they affect learning would be applicable. Since the learning of any subject-matter depends on the way it is presented to the learner by the teacher, the way the learner interacts with the learning experiences, and the environment within which the learning takes place are very essential. It is therefore expected that these entities will be affected by class size, teaching learning material

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adequacy, instructional methods employed by teachers, and supervisory role during practical lessons.

The theories of Maslow (1994) and Gagne (1990) would therefore provide theoretical basis for the study. Maslow‟s motivational theory expresses that there are two groups of needs. These are deficiency need and growth need which make science teaching more comprehensible, reduce forgetfulness, lead to transfer of knowledge and therefore help students to acquire favourable attitude toward science. Jegede (1998) asserts that the learners‟ understanding of any topic being taught is strongly influenced by the relationship that exists between the teacher, teaching strategies employed by the teacher and the students.

The Concept of Cooperative Learning

Cuseo (1992) defined cooperative learning as a learner-centered instructional process in which small, intentionally selected groups of three to five students work interdependently on a well-defined learning task. Individual students are held accountable for their own performance and the instructor serves as a facilitator/consultant in the group-learning process. Cooperative learning models are based on the premise that learning is best achieved interactively rather than through a one-way transmission process. To provide enhanced opportunity for interactive learning, students are generally encouraged to work in groups both in and out of class. Value is placed on cooperation and collaboration among students rather than on competitiveness and an individual‟s learning success or failure is linked with the learning success or failure of other group members. To

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be cooperative, a group must have clear positive interdependence; members must promote each other‟s learning and success face-to-face, hold each other personally and individually accountable to do his or her fair share of the work, appropriately use the interpersonal and small group skills needed for cooperative efforts to be successful.

Tsay and Brandy (2010) stressed that cooperative learning is students working together to attain group goals that cannot be obtained by working alone or competitively. The main purpose of cooperative learning is to actively involve students in the learning process, a level of student empowerment which is not possible in a lecture format. It is a process which requires knowledge to be discovered by students and transformed into concepts to which the students can relate. The knowledge is then reconstructed and expanded through new learning experiences. Learning takes place through dialogue among students in a social setting.

Slavin (1990) reported that cooperative learning is the instructional use of small groups so that students work together to maximize their own and each other‟s learning. They further stated that considerable research demonstrates that cooperative learning produces higher achievement, more positive relationships among students and healthier psychological adjustment than do competitive or individualistic experiences.

According to Cooper, Robinson and McKinney (1994) cooperative learning is a structured, systematic instructional strategy in which small groups of students

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work together toward a common goal. They list six distinguished features of this approach as positive interdependence, individual accountability, appropriate assignment to groups, the teacher as coach or facilitator, explicit attention to social skills and face-to-face problem solving.

According to Slavin (1996), there are dozens of "brand-name" types of cooperative learning groups, each endowed by its creator with particular structural elements that are thought (or demonstrated through research) to enhance learning. Johnson (1991) distinguished between types of groups on the basis of duration and purpose. Formal learning groups last from one class period to several weeks, whatever it takes to complete a specific task or assignment. The purpose is to use the group to accomplish shared goals, to capitalize on different talents and knowledge of the group and to maximize the learning of everyone in the group. Informal groups are temporary groups that last for only one discussion or one class period. Their major purpose is to ensure active learning. They might be used, for example, to break up a lecture with peer exchanges that require students to organize, explain and discuss their learning. Base groups are long-term groups with a stable membership, more like learning communities. Their main purpose is to provide support, encouragement and to help students feel connected to a community of learners.

According to Druckman and Bjork (1994), the goals of cooperative learning are to increase achievement of task performance and promote interactions between group members. The history of the study of cooperative learning dates back to the late 1800s and researchers still continue to collect data to test the limits of

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cooperative learning and to broaden the understanding of why and how cooperative learning produces its various effects. However, what we know already is more than enough to justify expanded use of cooperative learning as a routine and central feature of instruction (Slavin, 1990).Empirical and pragmatic studies related to cooperative learning are abundant; however most of this research involves children. The effects of cooperative learning at the college level are relatively few, most are of the practical application nature without controlled groups and the results are not as consistent as those from elementary and junior high students. There are several examples of positive achievement effects of cooperative learning in senior high school and college settings. However, a number of adult implementation studies have failed to find differences on achievement measures between cooperative learning and control groups (Druckman & Bjork, 1994).

Lynch (2010) pointed out that there is a crucial difference between simply putting students in groups to learn and structuring cooperation among students. Cooperation is not having students sit side by side at the same table to talk with one another as they do their individual assignments. Cooperation is not assigning a report to a group of students on which one student does all the work and the others put down their names. Cooperation is not having students do a task individually and then having the ones who finish first help the slower students. Cooperation is much more than being physically near other students discussing material with other students, or sharing material among students, although each of these is important in cooperative learning.

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In contrast to what cooperative learning is not, Johnson, Johnson and Smith (1998) identifies what it is by listing four elements that they considered essential for successful cooperative learning groups. These are:

1. Positive Interdependence: It exists when students believe that they are linked with others in a way that one cannot succeed unless the other members of the group succeed (and vice versa). Students are working together to get the job done. In other words, students must perceive that they "sink or swim together". In a problem-solving session, positive interdependence is structured by group members:

a. Agreeing on the answer and solution strategies for each problem (goal interdependence) and

b. Fulfilling assigned role responsibilities (role interdependence). Other ways of structuring positive interdependence include having common reward, being dependent on each other"s resources or a division of labour.

2. Face-to-face Promotive Interaction: This exists among students when they orally explain to each other how to solve problems, discuss with each other the nature of the concepts and strategies being learned, teach their knowledge to classmates and explain to each other the connection between present and past learning. This face-to-face interaction is promotive in the sense that students help, assist, encourage and support each other"s efforts to learn.

3. Individual Accountability/Personal Responsibility: This requires the teacher to ensure that the performance of each individual student is assessed and the results given back to the group and the individual. The group needs to know who needs more assistance in completing the assignment and group members need to know they cannot "hitch-hike" on the work of others. Common ways to structure individual accountability include giving an individual examination to each student, randomly calling on individual students to present their group"s answer and giving an individual oral examination while monitoring group work.

4. Collaborative Skills: These are necessary for effective group functioning. Students must have and use the needed leadership, decision-making, trust-building, communication and conflict-management skills. These skills have to be taught just as purposefully and precisely as academic skills. Many students have never worked cooperatively in learning situations and therefore, lack the needed social skills for doing so.

Group Processing involves a group discussion of how well they are achieving their goals and how well they are maintaining effective working relationships among members. At the end of their working period the groups process their functioning by answering two questions:

i. What is something each member did that was helpful for the group? And
ii. What is something each member could do to make the group even better tomorrow? Such processing enables learning groups to focus on group maintenance, facilitates the learning of collaborative skills, ensures that members receive feedback on their participation and reminds students to practice collaborative skills consistently.

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Benefits of Cooperative Learning

Panitz (1996) lists over fifty benefits provided by cooperative approaches. These benefits can be summarized into four major categories: social, psychological, academic and assessment.

Cooperative instructional approaches promote social interactions. Thus students benefit in a number of ways. By providing the opportunity to the students to explain their reasoning and conclusions, it became clear that cooperative instructional approaches help students develop oral communication skills, it again provide social interaction among students. Cooperative learning could also be used to model the appropriate social behaviour necessary for employment situations. By following the appropriate structuring for cooperative learning, students are able to develop and practice skills that will be needed to function in society and the workplaces. These skills include leadership, decision-making, trust building, communication and conflict-management.

The cooperative environment also develops a social support system for students. Other students, the instructor, administrators, other school staff, and potentially parents become integral parts of the learning process, thus supplying multiple opportunities for support to the students (Kessler & McCleod, 1995).

Students also benefit psychologically from cooperative learning. Johnson and Johnson (1999) stated that, cooperative learning experiences promote more positive attitudes toward learning and instruction than other teaching methodologies. Because students play an active role in the learning process in cooperative learning, a student‟s satisfaction with the learning experience is enhanced. Cooperative learning also helps to develop interpersonal relationships among students. The opportunity to discuss their ideas in smaller groups and received constructive feedback on those ideas helps to build student self-esteem. In a lecture format, individual students are called upon to respond to a question in front of the class without having much time to think about theirs answer. Cooperative learning creates a safe, nurturing environment because solutions come from the group rather than from the individual. Errors in conclusions and thought processes are corrected within the group before they are presented to the class.

Students also tend to be inspired by instructors who take their time to plan activities which promote an encouraging environment (Lunette, 1998). Receiving encouragement in a cooperative setting from both the instructor and peers helps to develop higher self-efficacy. As a result of higher self-efficacy, student grades tend to increase, thus, cooperative learning approaches provide several academic benefits for students. Research indicates that students who were taught by cooperative methods learned and retained significantly more information than students taught through other methods. Students verbalize their ideas to their groups. These help them to develop more clear concepts, thus, the thought process becomes fully embedded in the students‟ memory (Bershon, 1992). Discussions within the groups lead to more frequent summarization because the students are constantly explaining and elaborating, which in turn validates and strengthens thoughts. Students also benefit from cooperative instructional

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approaches academically in the sense that there is more of a potential for success when students work in groups. Individuals tend to give up when they get stuck, whereas a group of students are more likely to find a way to keep going (Johnson & Johnson, 1990). Cooperative approaches call for self-management from students because they must come prepared with completed assignments and they must understand the material which they have compiled. As a result, a more complete understanding of the material is developed. There are also many benefits of cooperative learning from the aspect of assessment. It provides instant feedback to the students and instructor because the effectiveness of each class can be observed. As instructors move around the room and observe each group of students interacting and explaining their theories, they are able to detect challenges early enough to correct them. Only a few minutes of observation during each class session can provide insight into students" abilities and growth. Cooperative instructional approaches also utilize a variety of assessments. Grades are not dependent solely on tests and individual assignments which only allow for right or wrong responses leaving little or no room for reflection and discussions or misconceptions. With cooperative learning, instructors can use more authentic assessments such as observation, peer assessment and writing reflections.

Science Teaching Strategies

There are numerous teaching strategies or methods that the science teacher can use in teaching the subject. Modern science teaching strategies involve the

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deliberate planning and organization of teaching-learning experiences and situations in the light of psychological and pedagogical principles with the view of achieving specific goals. When the deficiency needs are met, students are likely to function at the higher levels (that is growth needs level). This means that when the deficiency needs are met, self directed learning or the desire to know and understand would be engaged in more easily. The implication of this is that teachers can encourage students to meet their growth needs by enhancing the attractiveness of the learning situation. In the light of these, when the environment where the students are learning (in this study, class and laboratory) is made attractive, effective learning is likely to take place. Gagne‟s theoretical formulations are attempts to identify aspects of learning and to match these with the intellectual demands of the individual. While development is subordinated to learning, Gagne‟s paradigm insists on identifying valid ordered sequences of instruction (pre-requisites) that can facilitate the learning of intellectual skills. Gagne‟s theory offers an opportunity for the biology teacher to diagnose students‟ limitations and strengths more effectively, thus permitting more adequate individualization and personalization of biology instruction. Gagne‟s learning hierarchy also offers biology teachers the opportunities of developing and conceptualizing agreed-upon science goals and objectives in reality-oriented and learner-centred way. It is on this premise that Gagne anchors his belief that students learn an ordered additive capability. That is, the simpler and more specific capabilities is learned before the next more complex and general capability. Gagne therefore considered previous experience to have a major role in determining an individual‟s learning ability. Ideal classroom environment is therefore a condition for the students to actively carry out such activities and construct new information onto the already existing mental framework for meaningful learning to occur (Huitt, 2003).

To begin with, theoretical approach as a teaching strategy is a process of delivering verbally a body of knowledge according to a pre-planned scheme (Brown, Oke & Brown, 1992). This method according to Duckworth (1990) is also known as the lecture method. Thus the emphasis is on writing notes on discoveries made by scientists. By this method, the teacher prepares and gives out information verbally to students without students‟ participation in the lesson. The students therefore listen, take down notes and memorize facts and concepts. This approach to science teaching makes students get bored during science lessons. They also see scientific concepts as abstract and difficult (Reisman & Payne, 1997). This method according to Reisman and Payne (1997) is against the principle of learning by doing. The lecture method reduces teacher-students‟ interaction. However, this method of teaching is economical because no laboratory and expensive apparatus are required. It also encourages efficiency in time management since a single teacher can teach any number of students at a time (Duckworth, 1990).

According to Wadsworth (1998) people followed the theoretical approach due to limited knowledge of science that the students possessed. In modern times Wadsworth (1989) stated that science is seen more to be practically oriented or activity based. Students enjoy science lessons when they are involved in activities concerning the topic. There is therefore the need to adopt the activity-based and inquiry methods in the teaching of science especially at the basic and secondary levels (Reisman & Payne, 1997).

Secondly discussion as a teaching strategy is one of the best ways of helping students to understand and learn ideas. (Hake, 1993). According to Hake (1993), when students are given the chance to talk about things, it becomes easier to find out their knowledge in that topic. In order that learners see clearly how an idea applies to everyday life, they must be given the opportunity to use the discussion approach, and that the teacher only acts as a catalyst during the interaction among the students (Akpan, 1992). According to Graves (1995), in situations where class discussions are frequent each student develops self confidence since he realizes that he is contributing something. This method provides an excellent opportunity for students to practice their oral communication skills. It also encourages critical and evaluative thinking.

Another teaching strategy is an activity-based method. It is the process of assisting students to discover their own knowledge through an activity (Mensah, 1992). According to Mensah (1992), in addition to acquisition of knowledge, the approach also leads to acquisition of process skills such as measuring, recording, analyzing and interpretation of data. Activity-based method is more of a child-entered approach, as such; students may learn better and faster when they are taught through activities. (Reisman & Payne, 1997). When a student performs an activity as an individual, the learner easily understands and never forgets (Mensah, 1992).

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According to Mensah (1992), the activity method is used to teach science in which the students are at the centre of the learning process and made to interact with materials and experience things for him or herself. In this method, the students discover concepts and facts either unaided or with minimum teacher interference. The teacher is less active, a facilitator, co-learner and a guide. The activity method takes full advantage of the learner"s natural tendency to explore the familiar environment. The advantages of this method include students learning to use their hands and minds. Students learnt to organize, observe and become more curious to manipulate and carefully handle equipment during activity-based lessons. Again, activity-based methods of learning science results in performing experiments or practical exercises with scientific apparatus (Reisman & Payne, 1997). This method according to Reisman and Payne (1997) takes full advantage of the students" individual differences and abilities. However, the method is time consuming. It is also very expensive, since it involves the use of more materials.

Another strategy which is rarely used in science education is the field trip or excursion (Akpan, 1992). It involves organizing a group of students to visit companies or industries where things taught in theory can be seen practically.

According to Akpan (1992), field trip or excursion can be likened to a visit to another laboratory away from the school"s premises, which is equipped with instruments and materials that the school"s laboratory does not and cannot contain. Those places they visit can serve as resource centre to allow the students to acquaint themselves with principles and phenomena which had been hitherto

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abstract to them. Field trip enable learners to see those things they have theoretical and makes learning real (Reisman & Payne, 1997). According to Reisman and Payne (1997), it becomes very difficult for learners to forget what has been learnt and seen in field trip. This method is therefore recommended for students at the secondary school level since they easily remember things they have been taught and seen (Akpan, 1992).

Another important strategy of science teaching is the demonstration approach. The goal of this strategy is to help students acquire skills. The demonstration must be done in the full view of the class. In some cases, the teacher does it first and later asks students to perform while he goes round to watch, guide and give comments as the students work. Even though this approach involves mainly teacher‟s activity, it still involves experimentation which science educationists like Smith (1990) agreed to as being an essential aspect of science teaching. According to Gall, Borg and Gall (1996), once the concepts are firmly established, the other higher-order varieties of learning like problem solving can also take place.

One of the unique features of effective science teaching and learning is laboratory work which involves students in observation, experimentation through measuring and manipulation of equipment (Jenkins, 1998). Therefore, laboratory work is seen as an integral part of learning science.

Pre-university schools which were just being established as educational institutions soon began to create science laboratories as well. The aims of these

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laboratories were to provide scientific literacy and also to prepare students for further study, work and citizenship. Early times laboratory manuals‟ consisted mainly of description of experiments which included mensuration, heat, hydrostatics, the pendulum, determination of latent heat, demonstrating reactions and other such simple experiments (Jenkins, 1998). Thus, most laboratory work involves teacher demonstrating classical scientific experiments and students repeating experiments whose outcomes are already known.

The Concept of Practical Activity Techniques of Teaching Science

It is often argued that practical work is central to teaching and learning in science and that good quality practical work helps develop students‟ understanding of scientific processes and concepts.

The SHS teaching syllabus for elective biology, advices that teaching of biology should be student-centred and activity oriented. The teacher acts as a facilitator. For effective teaching and learning in this course, it is recommended that the school should establish a botanical garden, a fishpond in the school compound, have a collection of insect and small mammals in a cage at the science laboratory. This syllabus has a unit in almost each section dubbed scientific enquiry skills to help the teacher consciously teach and facilitate certain activities to help the students develop these skills.

(Abell and Lederman, 2007) defines practical activities as: learning experiences in which students interact with materials or with secondary sources of data to observe and understand the natural world. In a report written for the US National

Academy of Sciences, Robin Millar pointed out that when using the term "practical work" he referred to any teaching and learning activity which at some point involves the students in observing or manipulating the objects and materials they are studying (Lynch, 2010, p.2)

We use practical work in science classes when students are likely to have observed the phenomenon we are interest in, or to have observed it in sufficient detail in their everyday lives. The researcher sees activity based instruction as the form of learning where the learner is actively engaged in a task. The focus is on making the abstract concrete and on learning by doing. It can be teacher-driven with direction from an instructor or leaner-driven with the learner having freedom to explore.

Merits of Practical Activity Technique of Teaching Science

Lynch (2010) provides an explanation as to why the notion of „pupil as scientist‟ is attractive to science educators. Encouraging students to pursue their own enquiries, laps into their natural curiosity. Finding things out for you, through your own efforts, seem natural and developmental, rather than coercive, and may also help you to remember them better. It seems to offer a way of holding up evidence rather than authority, as the grounds for accepting knowledge. It is enabling, rather than dismissive, of the individual‟s ability, and right, to pursue knowledge and understanding for her/him self. Indeed one of the great cultural claims of science is its potential as a liberating force which the individual can and may enhance his or her own interaction with the natural world, challenge

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established tradition or prejudice, by confronting it with evidence. An enquiry-based approach may also encourage students to be more independent and self-reliant. In this way it supports general educational goals such as the development of the individuals" capacity for purposeful, autonomous action in the world. (p.3). He also identifies the value of practical activities in school sciences.

More specifically practical work is essential, it enables learners to manipulates tools and equipment effectively. It is also an important tool for teaching about experimental design. Indeed research suggests that students design better investigations when they actually carry them out rather than when only asked to write a plan. In an attempt to make sense of the various aims, Wellington (1998, p.6) offers a „crude summary of arguments" for the use of practical work.

Cognitive arguments: It is argued that practical work can improve pupils" understanding of science and promote their conceptual development by allowing them to „visualize" the laws and theories of science. It can illustrate, verify or affirm „theory work".

Affective arguments: Practical work, it has been argued, is motivating and exciting, it generates interest and enthusiasm. It helps learners to remember things; it helps to „make it stick".

Skills arguments: It is argued that practical work develops not only manipulative or manual dexterity skills, but also promotes higher-level, transferable skills such as observation, measurement, prediction and inference. These transferable skills are said not only to be valuable to future scientists but also to possess general utility and vocational value.

Some researchers have reported that practical work can increase students; sense of ownership of their learning and can increase their motivation (Brady, 2001).

The researcher therefore concludes that practical activities help to:

- Encourage accurate observation and description;
- Make phenomena more real;
- Arouse and maintain interest.
- Promote a logical and reasoning method of thought.

Activity based learning does give the child scope for independent learning and exploring something on their own without direction from a teacher.

Demerits of Practical Activity Technique of Teaching Science

However, Wellington notes several counter arguments to all these claims for practical work. Firstly, doing science and understanding science theories are different (Tsay and Brady, 2010).

Secondly, there is evidence that many pupils, particularly girls, are not very positive about doing experiments.

Thirdly, evidence for the transferability of skills is limited (Ausubel, 1998).

It would appear that they might be some scope for the science education community to engage in consideration of the purpose of science education and, in

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particular, the aims and purpose of „practical work‟. As Bennett and Kennedy (2001) point out, the plurality of espoused aims for practical work in science make the task of assessment very difficult.

Wellington (1998) found that despite curriculum reform aimed at improving the quality of practical work, students spent too much time and consequently, practicing lower level skills. As a result, students „failed to perceive the conceptual and procedural understandings that were the teachers‟ intended goals for the laboratory activities‟ (Lunetta, 2007, p.403).Activity is just part of learning. Without reflecting on the activity; thinking about it in certain ways to make a theory; testing that theory again etc. the active learning will have very little lasting value. There will be activity but nothing particular gained from it. Active learning should be balanced with other less concrete experiences. Active learning can become very trivial for advanced learners. When a concept is understood and the learner is ready to move on, it would be very tedious and time consuming to carry out another practical activity based around the concept. Comprehension of the concept can be tested in more efficient ways and the learner spared the hassle associated with lengthy practical exercises. Focusing on activity to make learning fun can actually hamper those students who wouldn‟t make good progress without it. Those more able learners could also come to believe that all learning should be fun and this may hamper their enthusiasm for tackling more difficult and advanced topics that does not so easily render itself being made into an "activity". Much advanced work in science is abstract and

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does not lend itself to activity. The learners may be limited in their learning because of being directed towards more practical elements of knowledge.

The Senior High School Biology Syllabus

The goal of science education is to develop scientific literate and concerned citizens who are able to think and act rationally. In fulfillment of this, the Biology Syllabus issued by the Curriculum Research and Development Division (CRDD,2009) lay emphasis on practical activities and process skills as a baseline for science education. The general aims and objectives of the subject as stated in the syllabus include;

- Understanding of the structure and functions of living organisms as well as appreciation of nature.
- Acquisition of adequate laboratory and field skills in order to carry out and evaluate experiments and projects in Biology.
- Acquisition of necessary scientific skills, for example, observing, classifying, measuring, keeping of records, communicating, interpreting biological data and conclusion
- Relevant knowledge in Biology, needed for future advanced studies in biological sciences.
- Acquisition of scientific attitudes for problem solving.
- Ability to apply biological principles in everyday life matters that affect personal, social, environmental, community health and economic problems.

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- Awareness of the existence of interrelationships between biology and other scientific disciplines.
- Development of sense of curiosity, creativity and critical mind.

These aims can only be most effectively achieved when biology teachers create learning situations and provide guided opportunities for students to acquire as much knowledge and understanding of topics in biology through their own activities. Students‟ questions are as much important as teachers‟ questions. Sometimes the teacher must show, demonstrate, and explain scientific concepts. The major part of the syllabus provides opportunities to explore various scientific situations in their environment to enable them make their own observations and discoveries and record them. Teachers should help students to learn to compare, classify, analyze, look for patterns, spot relationships and come to their own conclusions/deductions. Avoid rote learning and drill-oriented methods and rather emphasize participatory teaching and learning in lessons. For teaching to become interactive and students not to rely on rote learning. The duty of the teacher is to provide appropriate environment where the student will construct his/her knowledge by interacting with his/her environment. This can be achieved through participatory teaching and learning. However participatory teaching and learning can be effective with the use of relevant teaching and learning materials enable teachers do present learning tasks in an orderly manner and they help to make the message of the teacher clear, more vivid, interesting and intelligent. With suitable laboratory equipments and appropriate teaching and learning materials, science education would be effective in extending the students range of experience and in

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helping the teacher to understand the basic structure of the subject in order to accomplish its general objectives.

Empirical Evidence

The abysmal performance of science students in practical examinations is becoming alarming and needs to be given a second look. Empirical evidence abound, tracing the cause of such unfortunate situation to the doorsteps of teachers‟‟ non-performance.

Ministry of Education (2001) and WAEC Chief Examiner‟s Report (2000-2009) indicated that the candidates more often than not are not familiar with the laboratory techniques and process skills needed to tackle such questions. It is the fervent hope of the researcher that this work would go a long way to expose the inadequacies of the teaching methods as far as biology practical work is concerned. It is therefore recommended that students should be given more exercises if possible on daily bases to expose them to the rudiments of practical and process skills. It is also advised that most ill-equipped laboratories in our Schools be revamped. Critical areas of practical works that the students were found wanting were the six process skills; observation, Classification, Communication, Measurement, Keeping of records and drawing of appropriate conclusions. With the World becoming more scientifical and technological, the necessary measures must be put in place in the earliest possible time so as not to put Ghana at a disadvantage in Scientific and technological advancement.

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CHAPTER THREE

METHODOLOGY

Overview

This chapter is devoted to the following, design of the study, population, sample and sampling procedure, research instruments, description of the questionnaire items and scoring the questionnaire items. It continues with reliability and validity of the main instrument, the pre-intervention stage, intervention stage; post intervention stage, data collection procedure and data analysis.

Research Design

This is an action research in which the researcher explores a single entity or phenomenon bound by time and collects detailed information by using a variety of data collection procedures during a sustained period of time (Creswell, 1994). Almost any phenomenon can be examined by means of the case study method.

The research was based on a case study of form three biology students of Osei Kyeretwie Senior High School, Kumasi. The case study was chosen because it ensures detailed study of the subject matter under investigation. Science process skills were employed in every aspect of their practical lessons but students performed poorly during examination, (WAEC 2009) Chief Examiner"s Report. There was therefore the need for in-depth study of the subject, so that the needed steps could be taken to address the situation.

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The research design made use of cooperative instructional approaches as an intervention, students journals, interviews as well as students questionnaire items. The design helped the researcher to use questionnaire to objectively measure how the students perceive the effectiveness of cooperative instructional approaches which could help students to improve process skills competencies in biology practicals. The study was carried out in three major phases. The first phase consisted of pre-intervention activities, the second phase was the implementation of intervention and the third phase was the post-intervention activities.

Research Population

The target population was science students and science teachers at Osei Kyeretwie Senior High School, Kumasi. The selected school was chosen because of its proximity to the researcher who made frequent visits and follow-ups, which were necessary for the study. Besides proximity, the school was also selected based on the cooperation by the school administration and the science teachers to accommodate the study and took advantage of the availability of a reasonable number of SHS form three students and a reliable means of transport to the school.

Sample and Sampling Procedure

Sample is the group of elements or single element from which data are obtained (McMillan, 1996).According to Borg, Gall and Gall (1993) a sample is a smaller group that researchers study. The purpose of sampling is to obtain a group of

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subjects that will be representative of the larger population or will provide specific information needed (McMillan.1996).According to McMillan (1996) there are two types of sampling procedures, probability and non probability sampling. Probability sampling procedures include simple random sampling, systematic sampling, stratified sampling and cluster sampling. Non probability sampling procedures include convenience sampling, purposive sampling and quota sampling. In this study all the fifty, third year elective biology students were used as an intact group based on purposive sampling. The sampled students were further divided into small groups. A simple random sampling technique was used to divide the students into groups; numbers were written on pieces of papers and placed in a box. The numbers were picked from the box one after the other by students. Students who picked same numbers constituted a group. There were ten groups with five members each. The sampled class was made up of thirty (35) males and fifteen (15) females of an average age of eighteen years.

Research Instruments

The instruments used for collecting data for the study were student journals, questionnaire and an interview schedule. The general benefits of a questionnaire which include consistency of presentation of questions to the respondents the assurance of anonymity for the respondents and the less time it takes to administer (Fraenkel & Wallen, 2000, Muijs, 2004) was appropriate for this study which was time bound.

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Questionnaires are probably the most common data collection instrument used in educational research which is more familiar to respondents (Muijs, 2004). However, the disadvantages are that they often have low response rates and cannot probe deeply into respondents opinions and feelings (Freankel & Wallen, 2000; Muijs, 2004; Alhassan, 2006). This was not the case with this study because the sampled size was well manageable.

Close-ended items made respondents to choose between answers of the researcher while open-ended items allowed respondents to formulate their own answers. The researcher used both open and closed ended items. The open-ended items provided a greater depth of responses since there was no standardized answer across responses (Oppenheim, 1992).

The sampled students were also interviewed orally by means of unstructured interviews to find out which process skills they found difficult to learn to pass their examination. This was done by using unstructured interviews.

Description of the Questionnaire Items

The items consisted of four (4) main parts (A, B, C & D).Part (A) contained four (4) items that elicited information on the demographic or background of the students. The variable in part (A) covered respondents‟ gender, age and highest qualification. These data are in tune with the purpose of this research since respondents‟ gender and age might have significant influence on their perceptions about cooperation instructional approaches.

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The second part (B) was a questionnaire which contained a list of process skills. Students were expected to tick (√) the required process skills specified by the designers of the SHS biology syllabus exhibited by students during practical lessons.

The third part (C) consisted of four items (i.e. 5-8). This aimed at finding out the causes of the inability of the students to apply all the science process skills specified in the SHS biology syllabus.

The fourth part (D) was made up of ten items (i.e.9-18) that elicited information on respondents" perception of the effectiveness of cooperative instructional approaches in improving process skills in biology practicals.

The questionnaire for teachers was used to find out the major courses the biology teachers read at the university, their teaching experiences and the methodologies teachers employed. Copies of the questionnaires can be found at appendices B and C respectively.

Scoring the Questionnaire Items

A Likert scale with five options (Strongly Agree (SA) Agree (A) Neutral (N), Disagree (D) and Strongly Disagree (SD) was used to score the questionnaire items. The items on the questionnaire were positively and negatively worded in order to minimize participant satisfying responses. Positively worded items (e.g. "Students are more enthusiastic about the subjects for whom they use cooperative instructional approaches were scored as follows:

Response Intensity	Symbol	Score
Strongly Agree	SA	5
Agree	A	4
Neutral	N	3
Disagree	D	2
Strongly Disagree	SD	1

Negatively worded items (e.g. "cooperative instructional approaches hinder students" ability with learning tasks") were scored as follows:

Response Intensity	Symbol	Score
Strongly Agree	SA	1
Agree	A	2
Neutral	N	3
Disagree	D	4
Strongly Disagree	SD	5

Likert scale was used to score the questionnaire items because it looks interesting to respondents and students often enjoy completing a scale of this type (Muijs, 2004). Again, Likert scale is easier to construct, interpret and also provide the opportunity to compute frequencies and percentages. Likert scales are often found to provide data with relatively high reliability (Oppenheim, 1992; Fraenkel & Wallen, 2000).

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Variable scores were obtained by averaging the numeric values of the responses for the related items on the variable. A mean score near five (5) was considered a very high level of knowledge, between three (3) and four (4) a high level of knowledge, and a score between one and two(1) and (2) was regarded as the low level of knowledge. For the Perception of the effectiveness of cooperative instructional approaches as instructional process, a mean score of 3.0 represents a „neutral position". This value representing a neutral position was used in this study to indicate a position that respondents neither agree nor disagree with a statement. A mean value below 3.0 gives a general picture of disagreement while a mean value above 3.0 gives a general picture of agreement with a statement. However, it must be noted that, a mean value above or below 3 does not imply that all respondents agreed or disagreed with a statement, but the majority did. Agreement or disagreement to a statement was therefore considered on majority basis. The percentages of the participants" response to the likert scale items were also used to indicate the extent to which participants agreed or disagreed with the items.

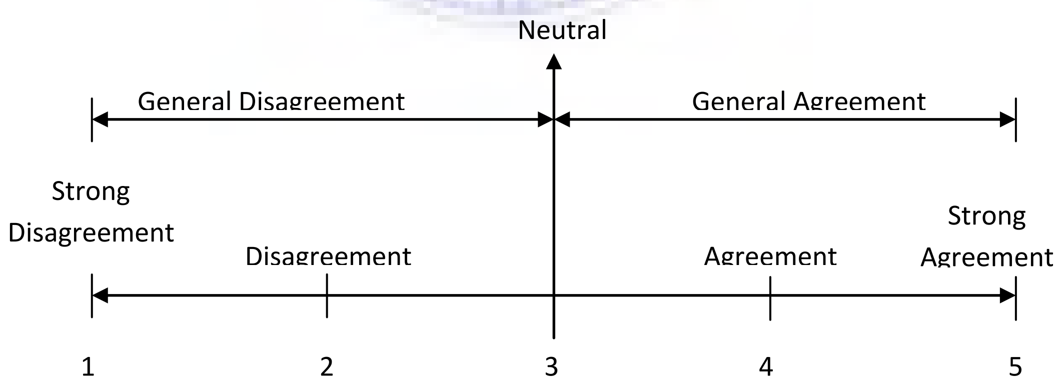

Fig. 1: The neutral position on the five-point Likert-type scale

Reliability and Validity of the Main Instrument

The issues of reliability and validity are vital in research because credibility of a research study depends on the reliability of the data, methods of data collection and also on the validity of the findings (Lecompte & Preissle, 1993, Cohen, Manion & Morrison, 2000). Fraenkel and Wallen (2000) cautioned that it is possible to design a questionnaire that is reliable because the responses are consistent, but may be invalid because it may not measure the concept it intended to measure.

Two experts who are WAEC Chief Examiners in the field of Biology were consulted to evaluate the research instruments.

The West African Examinations Council syllabus for Biology for Senior High Schools was used as a guide to ensure adequate reliability and validity of the research instruments. The required content materials for process skills were extracted from the Ghana Association of Science Teacher (GAST) biology, WAEC biology past questions and Ghana Education Service (G.E.S.) biology teaching syllabus for S.H.S. The questionnaires were pilot-tested at two different schools in the Kumasi Metropolitan Area. The findings helped to restructure some of the questionnaires. Those that were found suitable were retained. The instrument was also given to my supervisor for validation and test of reliability. The supervisor"s comment helped to restructure the questionnaire.

Pre-intervention Stage

This phase consisted of two activities which were done to ascertain the level of students" performance in process skills in biology practicals. The first activity was the revision of some of the topics and concepts learnt in the previous term. The concepts included biological classification of organisms, transpiration, photosynthesis and soils. The lesson took place in the first week, of the study with most of the learning activities being teacher-student centred.

Students were asked to classify the following animals and plants into (a) monocotyledonous Plant (b) dicotyledonous plant (c) vertebrates and invertebrates (i) sea anemones, (ii) jelly fish (iii) tape worm (iv) mudfish (v) snakes, (vi) grasses, (vii) cereals (viii) Mango (ix) Lilies (x) hibiscus

The second activity was also carried out. The researcher examined teachers and students workbooks. The teachers notebooks were examined to verify if the teachers had taught the students" with or without preparing scheme of work and lesson plans, and also if students lesson were guided by instructional objectives. Students" notebooks were examined to check if students were given enough practical activity on the topics treated and if they did enough assignments and class exercises in the previous term.

Intervention Stage

Intervention is a set of strategies planned and implemented to solve a specific problem or improve an educational practice located in an immediate situation. It

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involves a step-by-step procedure which is constantly monitored over varying periods of time and by a variety of mechanisms. It is a series of concrete measures, put in place to solve a specific problem. Weekly assignments were developed with respect to the Senior High Schools Biology Syllabus. Students were supposed to learn food test and dissection of a named mammal in the second term of the third year biology syllabus. Therefore teaching and learning activities about these two topics were developed systematically specifying the instructional objectives to be achieved each week. The lesson plans incorporated the practical activities to be performed for the week. These were done on four different days of two hours each day for the four weeks duration of the study.

During the first week the students were to test for carbohydrates (Examples: glucose, fructose and maltose) and observed the colour change. Students were taken through a lot of activities for them to grasp it well. A task sheet was given to them to work in groups of five. The task sheet used can be found in appendix A (Task sheet one)

In the second week, the students were to test for proteins, state the materials and apparatus used, method or procedure and observed the colour change. The students were again taken through the activities after which they were given a task to perform. The task sheet used can be found in appendix A (Task Sheet Two)

During the third week, the students were to test for fats and oils (lipids). They were taken through the activities to grasp the concept well, after which a task

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sheet was given to them to work on in groups of five. The task sheet used can be found in appendix A (Task sheet three).

The lesson plan for the fourth week was on dissection of a small animal. Before the commencement of the activities the students were taken through some of the dissection techniques, after which they were again taken through how to dissect a rabbit. They were asked to work in groups of five. The task sheet used can be found in appendix A (Task Sheet Four).

General discussions on the feedback on the practical activities were done after the lesson. Students‟ weaknesses and misrepresentation of scientific process skills showing less knowledge were addressed.

Post-Intervention Stage

This phase of the study involved monitoring the effects of the intervention approaches on the students learning and evaluation of the intervention approaches. This was done by monitoring students work output at the end of each week. Students output were monitored by the researcher based on their responses to questions during the practical activities. Their responses were judged whether they were related to the questions asked. The findings from these series of observations were used to modify the intervention approaches to achieve the desired learning outcomes. Responses from these activities served as bases for evaluating the performance of student process skills and the intervention approaches implemented.

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Data Collection Procedure

Data collection is the process in which data of the study was gathered. Data of this study was collected in three stages. The first stage was the collection of teaching and assessment information from the teachers and students workbooks. The teachers" notebooks were examined to ascertain the contents of their lesson preparation, whilst students" workbooks were examined to find out the frequency of tasks performed in the previous term. The second stage involved collection of data on the pre-intervention practical activities. Before the implementation of the intervention, concepts learnt by students in the previous term were revised and at the end of the revision period, students were given assignments and class exercises in groups.

The final stage involved collection of data on students output on practical activities. After the intervention stage, students were made to understand that the activities were designed to help them learn and improve their process skills in biology practical examinations. Students were taught for four weeks and at the end of each week, practical activities were given to them in groups. The assignments were marked and the data collected on student responses were used to answer some of the research questions.

Data Analysis

The responses from the questionnaire items were analyzed through the use of qualitative descriptive explanation making use of percentages.

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CHAPTER FOUR

RESULTS AND DISCUSSION

Overview

This chapter presents the results of the study conducted .It also discusses how the instrument and the intervention helped to arrive at the findings. Besides, it also deals with the presentation, analysis and discussion of the results. The results obtained were used to answer the research questions posed in the study.

Research Question One

Table 1: Which of the required process skills specified by the designers of the S.H.S biology syllabus do the students exhibit during biology practical lessons?

Please tick the required process skills specified by the designers of the SHS biology syllabus exhibited by students during practical lessons.

Science process skills							
S/N	**O**	**M**	**D**	**R**	**COM**	**CL**	**TOTAL**
1	-	√	√	-	-	-	2
2	√	√	-	-	√	-	3
3	√	√	-	-	-	-	2
4	√	√	√	-	-	-	3
5	√	-	√	-	-	-	2
6	√	-	-	-	-	-	1
7	-	-	-	-	-	√	1
8	-	-	-	-	-	√	1
9	-	-	√	-	-	-	1
10	-	-	√	-	√	-	2
11	-	-	√	-	-	-	1
12	-	-	√	-	-	-	1
13	-	-	-	-	-	√	1
14	√	-	-	-	-	-	1
15	√	√	-	-	-	-	2
16	√	-	-	-	-	-	1

Items continues

17	√	√	√	-	-	-	3
18	√	-	-	-	-	-	1
19	-	-	√	-	-	-	1
20	-	-	-	√	-	-	1
21	-	-	√	-	-	-	1
22	-	√	-	-	-	-	1
23	-	-	-	√	-	-	1
24	-	-	-	√	-	-	1
25	√	-	-	-	-	-	1
26	√	-	-	-	-	-	1
27	√	-	-	-	-	-	1
28	√	-	-	-	-	-	1
29	√	-	-	-	-	-	1
30	√	-	-	√	-	-	2
31	√	-	√	√	-	-	3
32	√	-	√	-	-	-	2
33	√	-	√	-	-	√	3
34	-	-	√	-	-	-	1
35	√	-	-	-	-	-	1
36	√	-	√	-	√	-	3
37	√	√	√	-	√	-	4
38	√	√	-	-	√	√	4
39	√	√	√	-	-	-	3
40	√	√	√	-	-	-	3
41	√	-	-	-	-	-	1
42	√	-	-	-	√	-	2
43	√	-	-	-	√	-	2
44	-	-	-	-	-	√	1
45	-	√	-	-	-	√	2
46	-	√	-	-	-	-	1
47	-	√	√	-	-	-	2
48	-	√	√	-	-	-	2
49	-	√	√	-	-	-	2
50	-	√	-	-	-	√	2
Total	**28**	**16**	**22**	**5**	**7**	**9**	**87**

KEY

O – Observation

M - Measurement

CL – Classification

R – Keeping of records

COM - Communication

D – Drawing

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Table 2: Summary of the science process skills exhibited by the students during biology practical lessons

S/N	Process skills	Frequency (%)
1	Observation	28
2	Drawing	22
3	Measurement	16
4	Classification	9
5	Communication	7
6	Keeping of records	5

The analysis in Table 2, shows that, among the science process skills identified in the study, Observation was rated highest with the frequency of 28 (32%) seconded by drawing with the frequency of 22 (25%), followed by measurement with the frequency of 16 (18%) and classification with frequency of 9 (10%) .Other science process skills were rated very low. These include communication with the frequency of 7 (8%), and keeping of records with frequency of 5 (6%). Again from Table 2 above, the implication was that only three out of the six process skills were exhibited by the students during biology practicals. It could be concluded that, the biology teachers in the school were not doing their best to help students in the acquisition of some of the science process skills.

The result presented in Tables 1 and 2 also indicated that the students acquired some process skills during their practical lessons. There was a steady emphasis in the requirement of the skills of observing. This was in line with the new approach to science teaching and learning which emphasises on observation rather than listening to talks and taking down notes (Akimbobola, 2008). Another obvious pattern was the increased emphasis on the skills of drawing and measurement. This might be due to the fact that in the SHS, emphasis has been shifted from the teacher-centred approaches to child-centred approaches of learning such as problem solving, discovering and inquiring methods.

Also it was from the manipulation of apparatus, materials and equipment during practical activity that lead to drawing, measurement and gave the result that was recorded and hence deduced to give the final result required.

However in the areas of the process skills of classification, communication and keeping records, there were scanty evidence of participation in lessons by students.

Research Question Two

What are the causes of the inability of the students to apply all the science process skills specified in the SHS biology syllabus?

The causes considered included:

- The inexperienced biology teachers.
- Infrequent laboratory work with adequate and appropriate equipment
- Inadequate supply of biology textbooks by the school.
- Low students‟ participation in biology practical lessons.
- Inappropriate instructional approaches utilised by the teachers.

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Table 3: Category of biology teachers at Osei Kyeretwie Senior High School, Kumasi.

Category of biology teachers	Frequency	Percentages
Biology teachers who majored in Science education	1	25
Biology teachers without education background	1	25
Biology teachers who did not major in biology	2	50
Total	**4**	**100**

Out of the four biology teachers at Osei Kyeretwie Senior High School, only one majored in science education. This forms twenty-five percent (25%) of the number of biology teachers. One majored in biology but had no education background. This constitutes twenty-five percent (25%) of the total number of biology teachers. Two of them did not major in biology at all; this also represents fifty percent (50%) of the total number of biology teachers at Osei Kyeretwie Senior High School. This implies that, half of the teachers who taught biology did not specilise in the subject at the University. These were the teachers who were often made to teach the final year classes. They majored in Computer science and physics.

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Table 4: Teaching Experience of Teachers at Osei Kyeretwie Senior High School, Kumasi

Teaching Experience	Number of teachers	Percentages
Between 16 to 20 years	1	25
Between 6 to 10 years	1	25
Between 1 to 5 years	2	50
Total	**4**	**100**

From Table 4, two had taught biology at the Senior High School between one and five years. This represents fifty percent (50%) of the respondents, but only one, which represents twenty-five percent (25%), has taught biology at the Senior High School between sixteen to twenty years. Those who had taught biology between one and five years had at the same time graduated from the University but are inexperienced when it comes to the teaching of the subject at the Senior High School. It implies that majority of the teachers who teach biology at the Senior High school leave the school for other schools. It also implies that majority of the biology teachers at Osei Kyeretwie Senior High School have little experience in teaching the subject. Bershon (1992) stated in his work that it is difficult to teach what you do not know.

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Table 5: Students responses to causes of the inability to apply all the science process skills specified in the SHS biology syllabus.

Items:	SD n (%)	D n (%)	N n (%)	A n (%)	SA n (%)
5. Students participation in Biology practical lesson is quite appreciable.	40(80.0)	5(10.0)	1(2.0)	2(4.0)	2(4.0)
6. There is adequate supply of biology textbooks by the school	40(80.0)	5(10.0)	0(0.00)	3(6.0)	2(4.0)
7. Adequate and appropriate equipment and instrument are used to perform laboratory activities.	35(70.0)	10(20.0)	1(2.0)	2(4. 0)	2(4.0)
8. Most students understand biology concepts	30(60.0)	10(20.0)	0(0.0)	5(10.0)	5(10.0)

From Table 5, out of the fifty respondents (50) who answered the questionnaire item 5, 90.0% (n = 45) strongly disagreed that they participated in biology practical lessons as against 8.0% (n = 8) who strongly agreed in participation during practical lessons, one was undecided. The differences in the percentages of those who do not participate may account for the kind of methods employed during the teaching of biology practical lessons. Teachers used methods of teaching that were mainly teacher-centred. It was easy to conclude that the kind of methods teachers employed in their teaching was not the best for their students.

However Reisman and Payne (1987) advocated that activity based method is more of child-centred approach and that students may learn better and faster when they are taught through activities conducted by them. This method according to Reisman and Payne (1987) takes full advantage of students‟ individual differences and abilities.

For item 6, on the issue of adequate supply of biology textbooks by the school. 90.0% (n = 45) strongly disagreed that they were supplied with textbooks by the school as against 10.0% (n = 5) who strongly agreed with the statement. Studies by Smith (1990) indicate that the use of science textbooks by students helps them to read ahead, have ideas about topics and know activities of coverage, depth and sequence.

Table 5, shows that only 8.0% (n = 4) of the participants in the study area indicated that they performed laboratory activities with adequate and appropriate equipment as against 90.0% (n = 45) who strongly disagreed with performing laboratory activities with adequate and appropriate equipment.

However, studies by Jenkins (1998) have shown that involving students in laboratory activities with adequate and appropriate apparatus does not only provide scientific literacy as well as preparing students for further study work, but also enable students get good results.

For questionnaire item 8, only 20.0% (n = 10) of the study area indicated that they understood what they were taught in biology practical‟s as against 80.0% (n = 40) who strongly disagreed when they were taught biology concepts. It was

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easy to conclude that teachers do not understand the concepts themselves or they were inexperienced and unqualified when it came to the teaching of the subject.

Research Question Three

Will the use of cooperative instructional approaches help the students to improve on their science process skills?

The results from the practical activities clearly shows that there was a significant difference in the performance of the students at the beginning of the study and after the interventional measures (Cooperative instructional approaches) had been introduced, to improve the acquisition of science process skills. The students demonstrated a better conceptual understanding of the skills which reflected in their practical activities. The students were able to classify objects, identify substances, take records correctly, draw, measure accurately, observe objects and manipulate figures and formulae appropriately. Most of the students felt that small group activities had been useful in;

i. Promoting student self esteemed.
ii. Helping students to develop social skills.
iii. Allowed them to discuss freely their work and almost everybody participated actively.

The finding means that cooperative instructional approaches is not gender sensitive and that with a determining concentration during teaching and learning process in class all students could benefit meaningful from it

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Table 6: Ratings of students on the effectiveness of cooperative instructional approaches in improving science process skills in biology practical lessons.

Items	SD n (%)	D n (%)	N n (%)	A n (%)	SA n (%)
9. I was more enthusiastic and motivated during the use of cooperative instructional approaches in the teaching and learning of science process skills	1(2)	1(2)	2(4)	4(8)	42(84)
10.The use of cooperative instructional approaches is an effective method for students of all abilities	0(0.0)	2(4)	1(2)	7(14)	40(80)
11. The use of cooperative instructional approaches reduces my personal interactions with my colleagues.	40(80)	5(10)	2(4)	2(4)	1(2)
12. The use of cooperative instructional approaches help develop students social skills.	2(4)	2(4)	1(2)	5(10)	40(80)
13. Cooperative learning strategies hinder students ability of improving some science process skills.e.g communication, measurement classification,observation etc	30(60)	12(24)	1(2)	2(4)	5(10)
14. The use of cooperative instructional approaches increase studetns retention.	2(4)	2(4)	1(2)	5(10)	40(80)
15. The use of cooperative instructional approaches promote positive classroom interactions.	1(2)	2(4)	2(4)	10(20)	35(70)
16. The use of cooperative instructional approaches help students' develop skills in oral communication	2(4)	4(8)	5(10)	7(14)	32(64)
17. The use of cooperative instructional approaches would enable me interact more with my colleagues to promote group discussion.	2(4)	2(4)	1(2)	5(10)	40(80)

18. I feel the use of cooperative instructional approaches promote students learning and academic achievement.	1(2)	2(4)	4(8)	5(10)	40(80)

From Table 6, majority of the students 92% (n = 46) strongly agreed with item nine (9), which indicates that, they were enthusiastic and motivated during cooperative instructional approaches in biology practical lessons as against 4% (n=2) who strongly disagreed while 4% (n= 2) was undecided.

For item 10, 94% (n=47) of the participants strongly agreed that cooperative instructional approaches were an effective tool for improving the ability and knowledge of the students. This was confirmed by one of the participants who asserted that"" cooperative instructional approaches could help improve the technical abilities of individual students""but 4% (n=2) strongly disagreed, while 2% (n=1) was undecided.

Item 11, which was negatively coded 90% (n=45) strongly disagreed with the statement while 6% (n=3) of the participants established that cooperative instructional approaches reduce their personal interaction with colleagues, 4% (n=2) was undecided.

Additionally for item 12, 90% (n=45) of the participants strongly agreed that the use of cooperative instructional approaches helped to develop students social skills but 8% (n=4) strongly disagreed while 2% (n=1) was undecided

Item 13, which was negatively coded 84% (n=42) of the respondents strongly disagreed, this shows that less than half of the respondents perceived that cooperative instructional approaches, enhance students ability of learning some science process skills such as communication, classification, observation and measurement for problem solving.

Notably with item 14, the high number of 90% (n=45) of the participants strongly agreed that the use of cooperative instructional approaches were an effective means of increasing students retention as against 8% (n=4) who strongly disagreed while 2% (n=1) was undecided

For item 15, 90% (n=55) of the participants strongly agreed that the use of cooperative instructional approaches promote positive classroom interactions as against 6% (n=3) who strongly disagreed while 4% (n=2) was undecided.

Then also for item 16, 78 % (n=39) of the participants strongly agreed that the use of cooperative instructional approaches helped students to develop skills in oral communication as against 12% (n=6) who strongly disagreed while 10% (n=5) was undecided. One of the participants indicated that „cooperative instructional approaches are tool for communication during practical activities‟.

For item 17, 90% (n=45) of the participants strongly agreed that cooperative instructional approaches enabled them interact with their fellow students to promote group discussion as against 8% (n=4) who strongly disagreed with the statement while 2 % (n=1) was undecided.

Exceedingly for item 18, 90% (n=45) of the respondents perceived that the use of cooperative instructional approaches promote students learning and academic achievement as against 6% (n=3) and 4% (n=2) were undecided, as one of the participants indicated that it would enhance the teaching and learning of biology practical lessons as we were actively involved in the teaching and learning processes. It would also improve our science process skills.

Discussion of the Results

The results of the study showed clearly that most of the science students especially those studying biology, did not have any meaningful and conceptual understanding of process skills in the study of biology practical activities.

The major revelation in research question one was that the major process skills exhibited by students was observation 28%, followed by drawing, 22% and then measurement, 16%. The implication of this is that out of about six process skills that should be exhibited by science students in biology, according to Akimbobola (2006), only about three were being exhibited. What this may mean was that biology science teachers were not endeavouring to teach these skills for effective acquisition by students. Process skills like classification, communication and keeping of records were lacking in students.

Teachers should therefore focus attention, on these areas in their teaching to overcome the deficiency in students" learning.

The results of the study also revealed a glaring deficit in the ability of applying all the science process skills, specified in the SHS biology syllabus. The study revealed that this lack was due to several causes. These causes included:

- Inexperienced teachers teaching biology

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- Low student participation in practical lessons.
- Inadequate biology textbooks in the school.
- Infrequent practical work with adequate and appropriate equipment.
- Inappropriate instructional.

There were findings that most of the biology teachers did not actually major in biology; they were also inexperienced in the teaching of biology theory and practicals. Quite apart from these which emanated from the teachers, the study revealed that the students themselves did not show enthusiasm in the application of science process skills in the school.

Biology teachers were also found to use methods which were teacher-centred and not student centred. Students therefore did not show enthusiasm in science, practical lessons which demanded application of science process skills. Unstructured interview of students on the side-lines showed that only about twenty percent indicated that they understood what they were taught in biology practicals. Eighty percent disagreed that they were taught biology concepts. These misunderstandings of scientific concepts are in consonance with Tamir and Lunetta (1981), who postulated the following excerpt which reflect the predicament of many Ghanaian science students in SHS!

„I‟ m trying to make sense of all this balancing stuff (i.e., the symbols for the elements, ions, and their respective states), but visually and mentally it is making me dizzy. I just don‟t understand! "(p.182).

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The findings on the use of cooperative instructional approaches showed that students were very receptive of this method of teaching. Indeed, all respondents (hundred percent) saw group activities in teaching as being very useful. It allowed them to share ideas and increased their understanding of the lesson. Cooperative instructional approaches also allowed for activity methods in teaching. A pre-observation and post-observation, using the cooperative instructional approaches encapsulating group work showed a marked improvement in the understanding of the topic taught. This showed that cooperative instructional approaches were much more effective ways of teaching that enhances students" learning. Cooperative instructional approaches make the students to understand the given task and its solution.

From the findings it became clear that students were in support of the adoption of cooperative learning approaches because they promote a sense of togetherness and teamwork. These in turn enhances exchange of ideas and views and encourage high level thinking skills such as classification,measurement and keeping of record. These findings are consistent with those of Brady.

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CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

Overview

This chapter presents a summary of the main findings and conclusions derived from the study as well as recommendations and suggestions for further studies.

The summary of the major findings made in the study are as follows:

- The students studying the subject did not have any meaningful and conceptual understanding of science process skills in their study of biology.
- Teachers recruited to teach biology in the school were also inexperienced.
- Inadequate supply of biology textbooks by the school.
- Low student participation in biology practical lessons.
- Infrequent laboratory work with adequate and appropriate instructional approaches by the teachers.
- Lack of understanding of biology concepts taught by the teachers.

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- Poor teaching and use of ineffective instructional approaches by the teachers.
- Cooperative teaching and learning approaches in the teaching and learning of biology practical lessons yielded positive results.

Conclusion

It was also clear from the series of practical activities conducted that, there was a significant improvement in the performance of the students after the intervention. They demonstrated high level of proficiency in the use of process skills during their biology practical activities. The students were able to classify objects, take records correctly, draw, measure accurately, observe substances well and communicate. It could therefore be concluded that, to improve process skills of senior high school students in biology practical activities, students must be allowed to have access to instructional materials. Science teachers must take into consideration the methodologies they often employ in the teaching of the subject. They must also supervise students work in order to ensure that, they are doing the right thing.

Recommendations

Based on the findings of this study, the following recommendations are made

i. Workshops on improvisation should be intermittently be organized for biology teachers in the school to enable them to improvise and supplement the few available science materials.

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ii. Effective supervision must be performed by the head of the science departments, during biology practical lessons to ensure that their science teachers teach as required of them.

iii. The Ministry of Education, Ghana Education Service, Stakeholders, policy makers, philanthropists, organizations and school authorities should help provide more laboratories and equipment for the school to enhance effective teaching and learning of biology

iv. In view of the immense versatility of cooperative, instructional approaches it should be encouraged in the school to ensure that the biology teachers teach effectively

Suggestions for Further Studies

From the findings made in this study, the following research activities are suggested.

1. Other researchers should conduct district-wide action researches on related topics.
2. Identical studies should be conducted in other schools to promote effective biology teaching.
3. Other researchers should tap the views of the learners about their preferred instructional approaches.
4. Studies focused on the separate concerns of male and female biology students should be conducted.

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5. The training needs of senior high school biology teachers should be investigated.

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APPENDIX A

Task Sheet One

Test for carbohydrates.

Experiment One

Aim: To test for reducing sugars (Example: glucose, fructose and maltose).

Apparatus & Materials: Water bath, tripod stand, Bunsen burner, wire gause, test tubes, Benedict or fehlings solution and sugar solution.

Method

1. To about $2cm^3$ of the test solution (5% glucose) in a test tube, $2cm^3$ of fehlings solution is added.
2. The mixture is then boiled for five minutes. An orange or brick-red precipitate is formed.

Results: A red, orange or yellow precipitate is formed.

Conclusion – Reducing sugar present.

Precaution – The source of heat should be turned down once the water bath has reached the boiling point. The reaction will take place even if the temperature is slightly below 100^0C.

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Task Sheet Two

Test for Proteins

Experiment Two.

Aim: To test for protein (Biuret lest)

Apparatus and Materials: Test tubes, sodium or potassium hydroxide solution, copper sulphate solution, water, egg or milk or meat.

Method or Procedure

a. To the test solution (egg albumin or milk or ground meat mixed with water) in a clean test tube.
b. About 1cm^3 of dilute caustic soda (NaOH) solution is added and then 1% copper (II) sulphate solution is added drop by drop.
c. The test solution is shaken thorough after each drop.

Result: A violet or purple colouration is formed.

Conclusion: Protein Present.

Precaution:

1. The test must be carried out at room temperature; the solution must not be heated.
2. Excess copper (11) sulphate will produce negative result. It should be used sparingly.

Experiment Three

Aim: To test for protein (Millon‟s test)

Apparatus & Materials: Test tubes, water bath, Bunsen burner, Millon‟s reagent. water, egg or milk or Meat.

Method or Procedure:

To the test solution in a clean test tube Millon‟s reagent in a mixture of nitric and nitrous acids is added and heated.

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Results: A deep red colour or precipitate appears.

Conclusion: Protein present.

Task Sheet Three

Test for Fats, and Oils (Lipids)

Experiment four.

Aim: To test for fats and oils (lipids)

Apparatus and Materials: Test tubes, Sudan III

Solution, oil or fat

Method or Procedure:

To the test solution in a clean test tube, a few drops of Sudan III solution is added

Results: A distinct red colouration appears

Conclusion: Fats or oil present.

Experiment Five:

Aim :To test for fats and oils (Lipids)

Apparatus and Materials: Test tubes, oil or fat, Osmic acid.

Method or Procedure:

1. To about 1 cm^3 of oil or fat in a clean test tube, a few drops of Osmic acid is added.
2. The mixture is then boiled.

Results: A black precipitate is formed

Conclusion – Fat or oil present.

Experiment Five

Aim: To test for fats and oils (Lipids).

Apparatus and Materials: A clean sheet of absorbent paper (filter paper) fat or oil.

Method or Procedure:

Grease Spot Test

1. Place a spot of oil on a clean sheet of absorbent paper, e.g. filter paper.

Alongside the spot , place a spot of water

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2. Leave the sheet of paper for ten minutes then hold the paper to the light.

Result: The oil spot remains on the paper, and the paper becomes translucent.

Conclusion: Fat or oil present.

Task Sheet Four

Dissection of a small animal

Example (guinea pig)

Aim: To dissect and study the functions of the internal organs of a guinea pig.

Apparatus and Materials: A pair of scissors, razor blade, pins, forceps, knife, scalpel and a wooden board

Method or Procedure

DISSECTION OF THE ALIMENTARY CANAL

- Lay the freshly killed guinea pig on its back, with the head pointing away from you. Stretch the legs out and pin through the feet at an angle away from the animal
- Pinch the skin over the abdomen with forceps and lift up away from the body wall. Snip the skin to make a small hole.
- Extend this cut longitudinally up to the ribcage and down to the penis or clitoris, keeping the scissor blade horizontal and pulling the skin upward with the forceps.
- Make horizontal cuts above the ribcage and above the penis or clitoris.
- Gently separate the skin from the body wall with a blunt seeker and pin out the skin flaps.
- Lift the abdominal wall with the forceps and snip with the horizontally held scissor blades.
- Continue the cut up to the ribcage and down to the penis or the clitoris, keeping the scissor blades horizontal and pulling the abdominal wall away from the gut with the forceps.
- Cut along the abdominal wall below the ribs and above the penis or clitoris and pin the flaps to either side.

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- With the fingers and gently spread out the alimentary canal. Push the liver toward the stomach to the right, deflect the duodenum downwards and spread the ileum to the left.

APPENDIX B

Questionnaire for Biology Teachers at Osei Kyeretwie Senior High School, Kumasi

Thank you for taking time to complete this questionnaire. Please answer each question to the best of your knowledge. Your thoughtful and truthful responses will be greatly appreciated.

Your name or any identification number is not required and will not at any time be associated with. Your responses will be kept completely confidential.

Please read the following statements and kindly provide the information required.

1. Name of School…………………………………………………………..
2. University attended……………………………………………………….
3. Faculty at the University………………………………………………….
4. Course read at the University……………………………………………..
5. Year of completion…………………………………………………….
6. Number of years taught…………………………………………………..
7. Highest Professional qualification……………………………………..
8. Subject(s) being taught in the present school…………………………….
9. Number of years you have taught biology.

   (Tick any one)

   a. ☐ Over 20 years and above

   b. ☐ Between 16 to 20 years

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c. [ ] Between 11 to 15 years

d. [ ] Between 6 to 10 years

e. [ ] Between 1 to 5 years

APPENDIX C

STUDENTS' QUESTIONNAIRE

INSTRUCTIONS:

Thank you for taking time to complete this questionnaire. Please answer each question to the best of your knowledge. Your thoughtful and truthful responses will be greatly appreciated.

Your name or any identification number is not required and will not at any time be associated with. Your responses will be kept completely confidential.

Please read the following statements and kindly provide the information required.

A. Background information

Please tick [√] in the appropriate space provided below and supply answers where required.

1. Sex [ ] Female [ ] Male

2. Age …………………..years

3. What is your pre-entry qualification?

[ ] BECE

Please, tick [√] the option that best reflects how you associate with each of the following statements.

Please other, specify

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4. At what level were you taught the use of cooperation learning strategies?

Please, tick [√] only one level.

Nursery Level	
Kindergarten Level	
Junior High School level	
Senior High School level	
Other, please specify	

B. Please tick [ ] in the appropriate space provided below, the required process skills specify by the designers of the SHS biology syllabus exhibited by students during practical lesson.

1. Observation [ ]
2. Classification [ ]
3. Communication [ ]
4. Measurement [ ]
5. Keeping of record [ ]
6. Drawing [ ]

C. Some causes of the inability of the students to apply all the science process skills specified in the SHS biology syllabus.

Please, tick [√] the option that reflects how you associate with each of the following statements.

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Rating Scale: strongly Agree (SA = 5), Agree (A = 4), Neutral (N = 3), Disagree (D = 2), strongly Disagree (SD = 1).

Statement	SA	A	N	D	SD
5. Student participation in biology practical lesson is quite appreciable					
6. There is adequate supply of biology textbooks by the school.					
7. Adequate and appropriate equipment and instrument are used to perform laboratory activities.					
8. Most students understand biology lessons					

C. Perceptions of the effectiveness of cooperative learning strategies in improving science process skills in biology practicals.

Please, tick [√] the option that reflects how you associate with each of the following statements.

Rating Scale: strongly Agree (SA = 5), Agree (A = 4), Neutral (N = 3), Disagree (D = 2), strongly Disagree (SD = 1).

Statement	SA	A	N	D	SD
9. I was more enthusiastic and motivated during the use of cooperative instructional approaches in the teaching and learning of science process skills.					

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10. The use of cooperative instructional approaches is an effective method for students of all **Items continues**					
11. The use of cooperative instructional approaches reduces my personal interactions with my colleagues.					
12. The use of cooperative instructional approaches help develop students" social skills.					
13. Cooperative instructional approaches hinder students ability of improving some science process skills e.g. Communication, measurement, classification, observation etc.					
14. The use of cooperative instructional approaches increase students retention.					
15. The use of cooperative instructional approaches promotes positive classroom interactions.					
16. The use of cooperative instructional approaches help students develop skills in oral communication					
17. The use of cooperative instructional approaches would enable me interact more with my colleagues to promote group discussion.					

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18. I feel the use of cooperative instructional approaches promote students‟ learning and academic achievement.					

APPENDIX D

Marking Scheme used for the pre-intervention activities.

Monocotyledonous Plant: (VI) Grasses, (VII) Cereals, (VIII) lilies.

Dicotyledonous plant: (IX) Mango, (X) Hibiscus

Vertebrates :(IV) mudfish, (V) snake

Invertebrates: (I) Sea anemones, (II) Jelly fish (III) tapeworm