DEPARTMENT OF SCIENCE EDUCATION

BIOLOGY TEACHERS' ATTITUDES TOWARDS TEACHING SCIENCE PROCESS SKILLS IN SELECTED SHS IN ATEBUBU-AMANTIN AND PRU DISTRICTS

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2014

UNIVERSITY OF EDUCATION, WINNEBA

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

DECEMBER, 2014

DECLARATION

Student's Declaration

I,GABRIEL YAWSON EFFAH, declare that this Dissertation, with the exception of quotations and references contained in published works which have all, to the best of my knowledge, been identified and acknowledged, is entirely my own original work, and it has not been submitted, either in part or whole, for another degree elsewhere.

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Gabriel Yawson Effah   **Date**

Supervisor's Declaration

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

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Dr. Ernest I.D.N. Ngman-Wara   **Date**

(Supervisor)

ACKNOWLEDGEMENTS

I would like to thank Dr. Ernest I.D.N. Ngman-wara for his expertise and support throughout this study. Without your guidance and encouragement this dream would not have been fulfilled. I would also like to thank the teachers and learners who allowed me into their classrooms and participated so enthusiastically. Finally , I thank the headmistress of prang senior high school, Madam Grace Hawa Ziida and the entire staff of Prang Senior High School for their patience, love and understanding.

DEDICATION

I dedicate this dissertation to my dear parents, Mr. G.Y Effah and Madam Elizabeth Awuah, my brother Effah Francis and my entire family.

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ABSTRACT

This study sought to assess the attitudes of biology teachers towards the teaching of practical work and science process skills. It specifically investigated how science process skills were taught in 5 Senior High Schools in the Pru and Atebubu-Amantin Districts of the Brong Ahafo Region. It also sought to find out the attitude of biology teachers towards practical work and the factors that influence these attitudes. A mixed method approach was adopted for this study. The data collection instruments employed for the study were interview guide, observation scale and attitude scale. In all, ten biology teachers in the Pru and Atebubu -Amantin districts participated in the study. The findings of the study revealed that biology teachers do not entirely teach the science process skills of observing and comparing, questioning, predicting, conducting investigations, recording results and evaluating and communicating findings although many of them had knowledge of these process skills. The attitude of biology teachers was such that despite their conviction that science process skills are important aspects of biology lessons, they still adopted the conventional method of teaching instead of the enquiry based approach. The attitude of teachers was found to be influenced by the teachers' understanding of science process skills and the resources available to teach practical work and process skills. Teachers' attitude was also influenced by learner attitude and the school environment. The study concluded that biology teachers are apathetic towards the teaching of process skills in spite of the relevance of practical work. Meanwhile, this attitude of teachers is influenced by intrinsic and extrinsic factors that need to be addressed to improve their attitude towards process skills.

CHAPTER ONE

INTRODUCTION

1.1 Overview

The chapter presents the background to the study, statement of the problem, the purpose of the study, objectives of the study, research questions, and the significance of the study. The chapter also presents the limitations and delimitations of the study. It ends with the organization of the study.

1.2 Background to the Study

Attitude is an important concept in social judgments and behaviours and thus, is one of the most important concepts in decision making. Petty and Cacioppo (1986) describe attitude and behaviour comprehensively as individuals' general evaluations about themselves, others, other objects, events and problems. Based on a lot of behaviour, affective and cognitive foundations, these general evaluations affect developments, alterations and formations. Constituting positive attitude is important for science teachers. Thus required qualifications should be determined through measuring acquired attitudes and behaviors during teacher education. Changing time and social structure require teachers' having much more skills in order to perform their jobs effectively.

A lot of research activity in teacher education has been carried out to specify teachers' professional knowledge, attitudes and teaching environment (Fraser & Walberg, 1991; Fraser, 1998). These expose classroom management as the most important skill teacher must have. As a result, a lot of research on the attitude of both students and teachers towards the use of science process skills in teaching and learning had been done with outcome being either positive or negative.

The acquisitions of science process skills are the basis for scientific inquiry, development of intellectual skills and attitudes that are needed to learn concepts. Science process skills are cognitive and psychomotor skills employed in problem solving. They are the skills which the sciences use in problem-identification, objective inquiry, data gathering, transformation, interpretation and communication. Science process skills can be acquired and developed through science practical activities. They are the aspects of science learning which are retained after cognitive knowledge has been forgotten. Using science process skills is an important indicator of transfer of knowledge which is necessary for problem-solving and functional living (Dikmenli, 2007).

The knowledge of process skills in science is very important for proper understanding of concepts in science and can be achieved through laboratory work. Currently, science educators and teachers agree that laboratory work is indispensable to the understanding of science (Cardak, Onder, & Dikmenli, 2007; Ottander & Grelsson, 2006; Tan, 2008). The role of laboratory work in science education has been detailed by some researchers (Lazarowitz & Tamir, 1994; Lunneta, 1998). They assert that the main purpose of laboratory work in science education is to provide students with conceptual and theoretical knowledge to help them learn scientific concepts, and through scientific methods, to understand the nature of science. Laboratory work also gives the student the opportunity to experience science by using scientific research procedures.

Practical work is a key factor in engaging, enthusing and inspiring students, thus stimulating lifelong interest in science. It

1. Stimulates creativity, curiosity and critical thinking
2. Underpins and illustrates concepts, knowledge and principle.
3. Encourages active learning and problem solving
4. Allow collaborative working
5. Provides opportunities to collect and analyze data and apply mathematical skills.

Practical work is not just the putting of apparatus together, but it needs planning, designing a problem, creating a new approach and procedure and also putting familiar things together in the new arrangement. This implies that the knowledge of creativity exhibited by candidates in any practical class helps them to manipulate some practical equipment.

All these benefits may not be acquired if biology teachers do not implement the basic science process skills. Therefore there is the need to investigate the attitudes of biology teachers towards teaching process skills.

1.3 Statement of the Problem

According to Ampiah (2012), practical work in developing countries like Ghana is organised in the form of less fancied teacher demonstrations or large group experiments. As a result students are unable to properly develop process skills. This affects students' academic performance in the final Elective biology examination (Otami, 2009). Evidence also shows that many students feel science is difficult and inaccessible because most teachers do not help students to harness the required skills necessary to understand scientific concepts (Monk & Osborne, 2000).

The biology syllabus (CRDD, 2010) advocates for the use of practical approach in teaching and learning but most teachers employ lecture method.

Teachers play a big role in helping children to develop their science process skills: provide opportunity for children to encounter materials and phenomena to explore at first hand; arrange for discussion in small groups and the whole class; listen to their talk to find out what processes of thinking have been used in forming their ideas; encourage them through comment and questioning to check that their ideas are consistent with the evidence available; encourage critical review of activities and activities and findings as a habit (Harlen, 2000). In addition, the teacher has to provide the children with ideas from books, displays and other sources, and to teach them techniques of using science apparatus, measuring instruments and conventional symbols. By observing the processes used in scientific investigation and talking to children about their activities, teachers can gain a much greater insight into how children learn through investigation (Wenham, 2005).

Many students are also reported to lack the science process skills necessary to conduct scientific inquiry because of the attitude of teachers and the approach to teaching (Wilkes & Straits, 2005). Meanwhile, science process skills are necessary for academic sources in the sciences and also for pursuing a career in the field of science. In the light of this, the study investigates the attitudes of biology teachers towards teaching practical work and process skills.

1.4 Purpose of the study

The purpose of this study was to ascertain the attitudes of Senior High School Biology teachers of Pru and Atebubu-Amantin districts towards the teaching of science process skills.

1.5 Objectives of the Study

The objectives of this study is to;

1. Ascertain how science process skills are being taught by the Senior High School biology teachers.
2. Examine the Senior High School biology teachers' attitudes towards teaching science process skills.
3. Identify the factors that influence senior high school biology teachers' attitudes towards the teaching of science process skills.

1.6 Research Questions

This research sought to answer the following questions:

1. How are the science process skills being taught by Senior High School biology teachers in Pru and Atebubu-Amantin districts?
2. What is biology teachers' attitude towards the teaching of science process skills in senior high schools in Pru and Atebubu-Amantin districts?
3. What factors influence biology teachers' attitudes towards teaching of science process skills senior high schools in Pru and Atebubu-Amantin districts?

1.7 Significance of the Study

The findings of this study could serve as a feedback to encourage senior high school biology teachers in the study area to reflect upon their existing conceptions. The findings of the study might also help biology teachers to change their attitudes towards the use of process skills in the teaching and learning of biology.

The findings' recommendations and suggestions could be an important source of information to the teachers in the selected schools and other teachers who teach biology. This study could also serve as a source of information for further research work on the topic. Additionally, findings from this study could help institutions that are involved in teacher training evaluate the need to develop positive attitudes in teachers towards teaching science process skills.

1.8 Limitation of the study

Ideally a large number of Senior High Schools should be targeted in this study. However time and cost constraints prevented the extension of this study to institutions in other districts in the Brong Ahafo Region. Therefore, the results of the study would be strictly applicable to Senior High Schools in the Atebubu-Amantin and Pru districts.

1.9 Delimitation

This study was delimited to five Senior High Schools (SHS) in the Pru and Atebubu-Amantin Districts in the Brong Ahafo Region of Ghana. Some selected science process skills were investigated. These included; Observing and comparing, Questioning, Predicting, and conducting investigations. Others are recording results and evaluating and communicating findings.

1.10 Organization of the study

The research was presented in five chapters. Chapter one presents the background to the study, statement of problem, purpose of the study, objectives, research questions, limitations, delimitations and organization of the study. The second chapter of the study constituted the review of relevant literature on the study. Chapter three dealt with the methodology of the study. The methodology comprised designs of study, population sample and sampling techniques used, instrument and data collection procedure as well as the procedure for analyzing data.

CHAPTER TWO

LITERATURE REVIEW

2.1 Overview

This chapter discusses the relevant literature on the area of study. The literature review is categorised under the following main themes; practical work and process skills, biology teachers' attitude towards science process skills and the factors influencing biology teachers' attitude towards teaching science process skills.

2.2 Practical work and Process skills

Practical work is defined to be any science teaching and learning activity which involves students working individually or in small groups, manipulating and/or observing real objects and materials as opposed to virtual world (Science Community Representative Education [SCORE], 2008). Process skills may be considered as those skills the mastery of which increases a student's competence to undertake any type of science learning activity in which they are involved in manipulating and/or observing real objects and materials (Reiss & Abrahams, 2012).

Whilst the value and purpose of practical work has been continuously debated, it has nevertheless remained a core component of school science education. Indeed, the inclusion of practical work within academic subject is a significant feature that distinguishes science from the majority of other subjects in Senior High Schools. The use of practical work is clearly recognized as important, yet remains atypical in terms of the quantity and amount of time devoted to it. For most teachers practical work encompasses what teaching and learning is all about (Woodley, 2009). However, there is a growing debate surrounding the effective and affective value it has on students and their learning (Abrahams, 2009; Abrahams & Millar, 2008; Hodson, 1991; Millar 1998).

As is currently practised, students claim to find practical work an enjoyable and effective way of learning science (Hodson, 1992). As Abrahams and Millar (2008) indicate, many teachers view practical work as central to the appeal and effectiveness of science education. Practical work is an important part of science as cooking is in the kitchen. Practical work promotes aspects of thinking and the scientific method, example formulating hypotheses and making assumptions. It also fosters knowledge of the human enterprise of science as to enhance students' intellectual and aesthetic understanding

Many teachers view practical work as an essential feature of the adage “I hear and I forget, I see and I remember, I do and I understand”, which was written originally by Confucius. However, Driver (1983) indicated that doing practical work does not indicate progression in learning science. Indeed practical work does not always produce the result desired by the teacher. It has the potential either to confuse or disengage the students as the may think the practical is providing them with wrong or contradictory results to the predicted results by the scientific theory. This then shapes the adage, I do and I am more confused (Driver, 1983). Yet despite the debates about the affective and effective value of practical work, it continues to be integrated into science lessons.

2.3 Science Process Skills

Science process skills are involved in the processes of interacting with materials and in the processing of information so gained (Harlen & Qualter, 2004). Rezba, Sprague, Fiel and Funk (2003) view science process skills as the basic skills people employ when they do science. They are related to the proficiency in using various aspects of science and are associated with cognitive investigative skills (Bilgin, 2006). It is through these skills scientists collect data, put experiments together, analyze data and formulate results. Using these fundamental skills are important for meaningful learning, because learning continues through life and individuals need to find, interpret and judge evidence under different conditions they encounter (Bilgin, 2006). They are also essential in enabling learners to develop understanding and the ability to identify and use relevant scientific evidence in solving problems and making decisions (Harlen, 2000).

Research suggests that science process skills may be one of the most important tools for producing and arranging information about the world around us and there is a strong research base and science education documents that support the teaching of these fundamental skills. From a teaching point of view these skills should be used in all science activities covering the content, and not as an exception or addition to it (Harlen & Qualter, 2004; Wilke & Straits, 2005; Carin, 1997). Similarly, Millar and Driver (1987) argue that the process approach should be seen as the means involved in learning science concepts and not as the product of science. On philosophical grounds, they also argue that science process skills such as hypothesizing and predicting are intuitive and cannot be learned and transferred.

However, studies such as those of Harlen and Qualter (2004) and Herman (2009) suggest that integrated science process skills could be taught directly to primary school children with some form of training or intervention. Accordingly, the works of Monhardt and Monhardt (2006) also reveal that research has shown that once students have been taught these skills, they are broadly transferable from one situation to another, are appropriate for many science disciplines and accurately reflect the skills used by scientists. Herman (2009) believes that globalization, rapid change, the explosion and specialization of knowledge and the transformation of the nature of work demand the so-called 21st century skills.

A set of process skills have been identified which are essential in creating-inquiry based activities. These include observing and comparing, questioning, predicting, conducting investigations and collecting data, recording results, and evaluating and communicating findings. These are discussed in the next section.

2.3.1 Observing and Comparing

These may involve the learner in noting details about objects, organisms and events with and without prompting by the teacher, noting similarities and differences, describing them in general terms, or describing them numerically. This is the most basic skill of all process skills and the primary way in which children obtain information (Martin, Sexton, Wagner & Gerlovich, 1994; Monhardt & Monhardt, 2006). The information learners gain from this process skill may lead to curiosity, interpretations about the environment and further investigation. It may also lead to the development of other science process skills such as inferring, communicating, predicting, measuring and classifying (Ward, Roden, Hewlett & Foreman, 2008; Rezba, Sprague, Fiel & Funk, 2003).

2.3.2 Questioning

Science is concerned with investigable questions, ones which can be answered by scientific enquiry (Harlen, 2000).Therefore, raising questions about a situation involves thinking of questions which could be asked about the situation, recognizing a question which can be answered by scientific investigations (as opposed to a question which science cannot answer), or re-wording the question to make it investigable. Asking investigable questions could be useful, since these questions show gaps that the children feel they need to fill in their understanding, they can provide the basis for children's investigations and they give children the opportunity to realize that they can find things out for themselves and satisfy their curiosity (Harlen & Qualter, 2004).

2.3.3 Predicting

Predictions are statements about what might happen or could be expected to happen in the future (Wenham, 2005), but they should be based on some relevant prior knowledge in a form which can be investigated (Rowland, 1992). A prediction is therefore not a wild guess. It has been said that the most important question science teachers can ask their learners is what would happen if? When this question is asked, it seems to require an answer. These types of questions stem from observations, interpretations and curiosity, or pre-existing knowledge which might lead to a question that someone wants to investigate.

These are the processes involved when making a prediction (Martin, 2003). In this way children learn to compare what actually happens with what they thought would happen, rather than merely accepting what happened without thinking about it. The discrepancies between predicted and actual occurrences are areas worthy of further investigation. For example, if a child predicts that sunlight is necessary for photosynthesis and then finds out that it is necessary, the child may want to investigate why this is so.

2.3.4 Conducting investigations and collecting data

The learner carries out instructions and procedures involving a small number of steps. H/she follows a simple worksheet to set up equipment in order to observe and collect data as the investigation purpose requires. Conducting an investigation is a complex process skill that requires the learners to persevere until the phenomena happen, using observations, collecting and analysing data and drawing conclusions in order to solve a problem situation (Martin et al., 1994). The idea of teaching science as an investigative discipline is a core tenet because:

1. it reduces the emphasis on drilling and memorizing
2. increasing the emphasis on applying knowledge to the students environment
3. fostering scientific reasoning
4. promoting scientific literacy among all children
5. Tailoring instruction to student's prior knowledge and emerging understanding (King, Shumow & Lietz, 2001 p.18).

2.3.5 Recording results

Learners' recording is their own communication of ideas and understanding using a medium that can be saved and stored (Ollerenshaw & Richie, 1997). It may also involve the learner in recording on a form which is prescribed (sentences, lists, tables, labelled diagrams), selecting a suitable form in which to record the information when asked to do so, knowing when it is important to record, and doing so without being prompted by the teacher. Any form of recording, according to Ollerenshaw and Richie (1997), has many functions, such as:

1. it can help the learner to clarify his or her thinking
2. it can be used as a personal record by the learner
3. it can be used as a vehicle for discussion between the teacher and the child
4. it can be a source of evidence of educator assessment
5. it can contribute to a child's portfolio or profile.

2.3.6 Evaluating and communicating results

The skill of evaluating and communicating results needs to be mastered as a process skill when learners report on the group's procedure and the results obtained. This process skill may also involve a situation in which the learner comments on observations and responds to the focus question. When learners have completed an investigation it is important that they reflect on the procedure and experimental design by identifying the difficulties they experienced in doing the investigation and reflecting on how they could improve the same investigation in terms of fairness and accuracy (Dawson & Venville, 2007; Harlen, 2000; Ward, Roden, Hewlett &

Foreman, 2008). Ward et al. (2008) concur that this process skill allows the learner to actively evaluate their own and others learning.

Communicating can take many forms including using words, actions, posters, diagrams, pie-charts or graphic symbols to describe an action or event (Monhardt & Monhardt, 2006). Monhardt and Monhardt (2006) also state that it requires learners to share the information they have gathered from observations with the rest of the class. This process skill helps the learners to reflect on their own learning and to build confidence as a person.

On the surface the above process skills may appear to be reasonably uncomplicated, but the complexity comes in during the implementation in the classroom during the biology lessons.

2.3.7 Implementation

Implementation or delivery of educational change consists of the process of putting into practice an idea, programme or set of activities, and structure new to people attempting or expected to change (Fullan, 2007). However, according to Bishop (1991), this process is not simply a matter of supplying technical information (e.g. a syllabus, textbook or teachers' guide), but rather a matter of changing attitudes, skills, values and relationships. These changes are not easy to achieve, but successful implementation requires that the process be steered and managed properly.

The implementation of a new programme or curriculum must ultimately be put into practice at micro level, that is at school and classroom level with the support of an educational authority. Heck, Stiegelbauer, Hall and Loucks (1981) identified three key variables regarding the implementation of a new programme, namely the concepts of Stages of Concern, Levels of Use, and Innovation Configurations that a change facilitator (anyone responsible for assisting users in implementing an innovation) can use to conceptualize the progressive actions of the users. 'Stages of Concern' addresses the person's perception, feelings and motivations relative to the innovation, while the 'Level of Use' focuses upon the behaviors of the individual as he or she approaches and uses an innovation. 'Innovation Configurations' refer to the variations or different patterns of an innovation which occur when it is put into practice by the users (Heck et al., 1981).

Concerns, representing the users' feelings, understanding, motivations, attitudes and level of use regarding the particular topic under study, could both be used diagnostically to determine the type of assistance the teachers need to implement the use and development of science process skills successfully.

Ampiah (2012) observes there is general agreement among some science teachers on the significance of science practical activities in the teaching and learning of science. However, what seems to differ among science teachers is how science teachers perceive the purposes of science practical activities in the teaching and learning of science and their attitude to science. This study follows the assertion of Ampiah (2012) and seeks to investigate the attitude of biology teachers towards process skills and practical work as the researcher (Ampiah, 2012) further opined that the organisation of science studies and practical work has is taken for granted in Ghanaian Senior High Schools.

2.4 Practical work and Process Skills in Science Education

In practice, science is a process which involves an integration of knowledge, skills and attitudes to developing scientific understanding during investigation. As students learn science, teacher should encourage developing the knowledge and attitudes on which scientific investigations depends on. As a resourceful person, teachers are the determining factor that must have the investigative skills and positive attitudes towards science process skills (Aluko & Aluko, 2008).

Olufunminiyi and Afolabi (2010) contends that for science teaching to be relevant, it must sufficiently mirror the nature of science. Thus, it must not only be process-oriented, but it should also underscore the products of science. It should support affective reaction to science and stress the attitudes such as honesty, open and critical mindedness, curiosity, suspended judgment and humility which are features of scientists and the scientific enterprise.

Practical work and process skills are valuable in promoting the development of meaning and understanding. Practical work enhances the quality of a student's learning. It creates a discovery-reception continuum, as opposed to a meaningful rote learning experience. In effect, process skills, such as measuring, observing, classifying and predicting, are crucial for the development of a fruitful understanding of scientific concepts and propositions and for a meaningful use of scientific procedures for problem solving and for applying scientific understanding (Ango, 2002).

Another important role of process skills and practical work is that it enhances the development of understanding. The role of the process skills in this development of understanding is crucial. If these skills are not well developed among young people and, for example, relevant evidence is not gathered, or conclusions are based selectively on those findings which confirm initial preconceptions and ignore contrary evidence, then the emerging concepts will not help understanding of the world around and would be inconsistent with scientific enquiry. In the light of this, the development of scientific process skills has to be a major goal of science education.

Teachers have far greater control over how the scientific content or knowledge is taught. In particular, teachers also have great control over the process skills students develop. Teachers should select hands- on, minds –on investigations which involve the process skills to challenge students through problem solving. Teachers also completely have control over two of the areas of science: the scientific attitudes and values as they are presented to students in classroom. In many countries, practical work is an essential feature of the teaching and learning of science, and considerable time and money spent on teaching science through practical work and it is therefore important to be clear about the aims of practical work.

Biology is one of the elective subjects in the key learning Areas (KLA) of science education. It is a unique discipline where experiments with living organisms do take place in the laboratory and in the field. It provides a range of balanced learning experiences through which students develop the necessary scientific knowledge and understanding, skills and processes, values and attitudes embedded in the 'Life and Living' strand and other strands of science education for personal development and for contributing towards a scientific and technological world.

The emergence of a highly competitive and integrated economy, rapid scientific and technological innovation, and a growing knowledge base will continue to have a profound impact on our lives. In order to meet these challenges, the Biology

Curriculum, like other science electives, provides a platform for developing scientific literacy and building up essential scientific knowledge and skills for life-long learning in science and technology. Through the learning of biology, students will acquire relevant procedural and conceptual knowledge to help them to understand many of today's contemporary issues, and they will become aware of the interconnections between science, technology and society.

2.5 Attitude of Biology teachers towards the teaching of process skills

Saribas and Bayram (2009) observe that many science teachers have a low attitude towards science and this affects their confidence and self-efficacy beliefs in teaching science. According to Triandis (1971), Ma'rof Redzuan (2001) and Burns (2000), attitude is a set of affective reactions towards the attitude object, derived from concepts of beliefs that the individual has concerning the object, and predisposing the individual to behave in a certain manner towards the object. Humans' attitude, belief and behaviors are very complex, each components having their own relationship and have different level of organization (Abdullah & Mohd, 1997); attitudes showed or explained the mental and nerves readiness which organized through experiences (Allports, 1967). Scientific attitudes guide the thinking skills of children as they search for meaning in the world around them; the scientific attitudes are derived from the scientific values (Wolfinger, 2000).

Another attitude of teachers towards the teaching of process skills and practical work is the approach to teaching. The inquiry approach, incorporating thinking skills, thinking strategies and thoughtful learning, should be emphasized throughout the teaching-learning process. For instance, the science laboratory is regarded as the place where students could learn science process skills. Ideally, students should be able to go through the science practical lessons on their own but teachers usually adopt the use of groups to undertake this activity (Abdullah, Mohammed & Ismail, 2010). Whilst study groups are appropriate, in some contexts, in the laboratory all students require adequate personal attention.

The role of practical in science education has been widely discussed (Millar, 2002; Lundberg, 2003; Clough, 2007). Science process skills are a prerequisite to learning about science. It is therefore necessary for science (Biology) teachers in the Senior High Schools to have positive attitudes towards the implementation of the science process skills. Many studies have noted that science process skills are effective on teaching and learning about science (Harlen, 1999; Wilkes & Straits, 2005).

Science is a process which involves an integration of knowledge, skills and attitudes to develop scientific understanding which means that the teaching of science include the teaching of the science process skills. Senior High School Biology teachers usually have to teach a wide and demanding curriculum. Teachers are encouraged to incorporate practical work systematically in their practice. Teachers however, develop their own perceptions and attitudes towards the implementation of the science process skills; those perceptions intern might interact with curriculum demands.

Moreover, such attitudes are likely to be reflected in their discourse and actions and may have influence on the activities they provide for students, how they organize and manage their classroom, what role they adopt, the way they use equipment and materials, and the criteria they use in assessing the success of practical work (Abrahams & Saglem, 2010). The Governments of developing nations believe that the well-being of a nation is extricable linked with scientific capability (Skamp, 1998);

while people believe that reaching the level of developed and civilized countries can only be accomplished through education especially science education (Turkmen, 2007)

Therefore science teachers, particularly Biology teachers should have their own knowledge such as scientific facts, concepts and theories to encourage children's learning through hands–on setting experiences or through the process-oriented inquiry methodology.

Also, some teachers focus primarily on meeting the needs of the assessed types of practical work and process skills rather than using it as a method of learning science. In effect, many teachers now teach to pass the exam, and not for enjoyment. More recently, attempts are being made by educators to address the changes in the way practical work is assessed in order that this would change the way teachers see practical work, from being on the one hand, entirely focused on meeting the needs of assessment, and on the other, using it as a teaching method to aid general learning of science (Sharpe, 2012).

According to Otami (2009) in Ghana, studies of attitudes towards biology have often focused on students attitudes towards the subject. In many of such instances, gender has been investigated as important determinant of attitude towards biology. Moreover, such studies probe the attitude to biology as an entire course. This study however investigates teachers' attitudes towards teaching of process skills and practical work which are aspects of biology.

2.6 Factors influencing Biology teachers' attitude towards teaching of Science Process Skills

Teachers' attitude to teaching science process skills is influenced by a number of factors. In the first place, skills have to be taught and used in relation to some content and context. This usually presents difficulties for students in assessing these skills. The setting or context of the task also influences teaching, as it does in the assessment of the application of concepts, since a school or laboratory setting may signal that a particular kind of thinking is required whilst an everyday domestic setting would not provide this prompt (Harlen, 2010).

Motivation and interest are also significant determinants of teachers' attitude towards teaching science process skills. Fishbein's expectancy-value theory suggests that an individual's attitude toward any object is a function of her beliefs about the object as well as the implicit evaluative responses associated with those beliefs. Beliefs affect attitudes and these attitudes then affect intentions and behaviours. A close examination of teachers' attitude towards biology laboratory experiences would reveal that teachers, who have positive beliefs about the usefulness of laboratory experiences, tend to report positive attitude toward working in the laboratory (Saribas & Bayram, 2009).

Furthermore, teachers attitude to the teaching of process skills is also influenced by the lack of resources (e.g. the lack of equipment to do experimental work, shortage of textbooks and inappropriate furniture), monitoring of the implementation of policies as well as the lack of continuous professional support (Kriek & Basson, 2008). Blignaut (2009) states that if educators do not feel a sense of identification with policy its goals may be undermined by practitioners. Such conditions, according to Shalem and Slonimsky (as cited in Blignaut, 2009), create a facade (an appearance that is false) of reform as educators ignore or even resist what is asked of them.

Teachers' knowledge level of science processes also influences their teaching of practical work and process skill. Studies conducted on primary science education by researchers such as (Murphy, 2009; Peacock, Serret & Lindsay, 2009; Sharp & Hopkins, 2007) view the lack of confidence and knowledge of a number of educators when teaching science as well as the lack of appropriate professional development as major constrains in pursuance of the implementation a new programme. One critical concern highlighted by Sharp and Hopkins (2007) is the fact that some educators feel less prepared to teach science through inquiry. Sharp and Hopkins (2007) further state that although the constraints mentioned above were cited by many researchers certain issues (obstacles and hindrances) remain unresolved, and the status of science remains problematic.

Furthermore, teachers' attitude towards the teaching of practical work and process skills is influenced by their understanding and perception of these process skills. There are at least three major domains of educators' professional knowledge: subject matter knowledge; general pedagogical knowledge (knowledge of the learner, class management learning and instruction, curricular knowledge, knowledge of educational philosophy) and pedagogical content knowledge (that which contains the best ways, strategies, and means to help students learn or the best ways for the instruction of specific content of knowledge) (Shulman, 1987). Therefore, the use and development of science process skills at classroom level will be influenced by the teacher's views of these domains as well as his/her understanding about the basic skills to be taught, since a teacher with a particular understanding of these skills, for example, will consciously or unconsciously shape his or her teaching in line with this understanding or view (Wenham 2005). The danger, according to Wenham (2005), is that this understanding will, in turn, shape the children's perception. In support of Wenham's (2005) arguments, Wessels (1998) concurs that what a teacher knows is one of the most important influences about what is done in the classroom and ultimately what the children learn. Webb and Glover (2004) for example raise the question about what happens when teachers do not have the appropriate understanding of any area of science. Research shows that they cope in ways that impoverish children's learning opportunities (Webb & Glover, 2004). These include:

1. Sticking to the areas where they are most confident
2. Relying heavily on work cards which give step by step instructions
3. Avoiding anything that might go wrong
4. Using expository teaching (telling) and
5. Not allowing questioning

For educators to teach these science process skills effectively requires that they should have a good understanding of and be able to identify the different science process skills that make the procedural understanding as well as to plan and provide opportunities for learners to practice these skills individually within activities where learning intentions are related explicitly to the chosen process skills (Ward, Roden, Hewlett & Foreman, 2008).

Another factor that influences educators' classroom practices is the belief held by those educators (Roehrig, Kruse & Kern., 2007; Lotter, Harwood & Bonner, 2007). A study conducted by Hewson and his colleagues (as cited in Lotter, Harwood & Bonner, 2007) have shown how educator beliefs of science instruction, science knowledge, and science learning influence educators' use of conceptual change strategies. Educator beliefs are often difficult to change since this belief about their teaching has been formulated over many years of classroom teaching (Lortie, 1975). Although beliefs can persist, they can be changed through intensive one-on-one professional development, over an extended period (Krajick, Blumenfeld, Marx & Soloway, as cited in, Roehrig, Kruse, Kern, 2007).

To cope with curriculum reform and to deal with the factors mentioned above , it is important that teachers are supported and developed in a professional manner since they (teachers) play a pivotal role in the successful implementation of a new curriculum (Fullan, 2007). Support or rather lack thereof, according to Blignaut (2009), is one of the most common cited reasons why educational innovations fail.

CHAPTER THREE

METHODOLOGY

3.1 Overview

The chapter presents the methodology employed to gather data for this study. This includes a brief description of the approach adopted for the study and the data analysis procedure. This chapter also details the sampling strategies employed and the data collection instruments used. The chapter ended with the description of the validity and reliability of the instrument used to collect the data and the data analysis method used.

3.2 The Study Area

The study was carried out in two selected districts in the Brong Ahafo Region of Ghana; namely, Atebubu-Amantin and Pru. The Brong Ahafo Region lies within longitude 0°15'E to 3°W and latitude 8 °45"N to 7 °30'S. The region shares common boundaries with five others; Northern Region to the North, Ashanti and Western Regions to the South, the Volta Region to the East and the Eastern Region to the South East. It has an international boundary to the West which it shares with La Cote d'Ivoire. It is the second largest Region in Ghana and has an area of 39,557sq. kilometers.

3.3 Research Design

A research design is a plan or blueprint of how one intends conducting the research (Mouton, 2001). The purpose of this study was to ascertain the attitudes of Biology teachers towards the teaching of science process skills.

A mixed method approach was adopted for the study. The mixed method approach emerged in response to the need to merge some elements of qualitative and quantitative research methods to undertake some studies. This approach also addresses the contrived situations created by traditional quantitative researchers when they detached participants from their socio cultural contexts and investigated them under laboratory conditions; at the same time, the method ensures the collection of significant numerical data to support qualitative results (Creswwell, 2003). The strength of qualitative research is its ability to pool together qualitative and quantitative elements to complement each other. It offers quantifiable information about the human side of an issue such as beliefs, opinions, emotions, and relationships of individuals. Mixed methods are also effective in identifying intangible factors, such as social norms, gender roles, ethnicity, and religion among others (Gay, 1997). This method is suitable for this study as it allowed the researcher to gather both qualitative and quantitative data to adequately address the research questions.

3.4 Population

The population consisted of all the Senior High School biology teachers in the Pru and Atebubu-Amantin Districts in the Brong Ahafo Region of Ghana. The total number of biology teachers in the Pru and Atebubu-Amantin Districts is 10. The total number of Senior High Schools in the Pru and Atebubu-Amantin Districts and the programmes offered in each school are displayed in Table 1. Out of this number of schools, only those offering General Science and Home Science had biology teachers.

Table 1: Schools in Pru and Atebubu- Amantin districts and programmes offered

SCHOOL	PROGRAMMES OFFERED	DISTRICT
1. Yeji Senior High Technical School	General Science, General Arts, Home Science, Business, Technical	Pru
2. Prang Senior High School	General Science, General Arts, Home Science, Business, Agricultural Science	Pru
3. Mist Senior High School	Business, General Arts	Pru
4. Victory Business School	General Arts, Business	Pru
5. Abeaseman Senior High School	General Arts, Home Science, Business	Pru
6. Atebubu Senior High School	General Science, General Arts, Home Science, Business	Atebubu-Amantin
7. Amantin Senior High School	General Science, General Arts, Home Science, Business	Atebubu-Amantin

3.5 Sampling

The study sample consisted of ten biology teachers selected from the Pru and Atebubu Amantin Districts. The sample consisted of eight males and two females. The

Purposive sampling technique was used to obtain the sample for the study. The Purposive sampling technique is also known as judgment sampling. This is a non-probability sampling approach involving the choice of subjects who are most advantageously placed or in the best position to provide the information required (Kusi, 2012). This method was suitable for the study as it enabled the researcher to obtain information from respondents (biology teachers) who are in the best disposition to offer the information.

3.6 Instrumentation

The major instruments used to gather data for the study were interview (Appendix A), Science Process Skill Observation- Scale (Appendix B) and attitude scale (Appendix C).

3.6.1 Interview

Johnson and Christensen (2004) point out that a qualitative measure, such as interviews, allows researchers to enter the inner world of another person and to gain an understanding of that person's perspective. The researcher therefore designed a semi-structured interview to have a greater understanding of the biology teacher's understanding of science process skills, their practices with respect to the teaching of science process skills. Semi-structured guide provides a clear set of instructions for interviews and can provide reliable, comparable qualitative data. The guide consisted of five items. Item 1 was to explore the biology teachers' understanding of science process skills. Item 2 was to investigate how biology teachers employed the basic science process skills in their biology lessons. This was done by asking the teachers how often they used these skills during their lessons. Item 3 sought to find out the problems facing teachers in the teaching of science process skills. Item 4 of the guide was to ascertain the views of biology teacher on how they could be supported to teach the science process skills effectively. The fifth item of the guide investigated the educational background and experiences of biology teachers concerning the teaching and learning of biology.

3.6.2 Science Process Skill Observation Scale

The purpose of classroom observation in educational research, according to Johnson and Christensen (2004), is to observe educators in their natural settings as it normally occurs. Much can be gained by observing the interaction between educator and student, materials, problems and procedures (Lewy, 1979). Johnson and Christensen (2008) defined observation as the watching of behavioral patterns of people in certain situations to obtain information about the phenomenon of interest. In all, the researcher visited each school twice to undertake the classroom observations.

Each biology teacher was observed for four periods of 45 minutes each. To clarify certain issues, a brief discussion was held with each biology teacher to determine the topic, the learning content to be covered, the assessment standards as well as the Learning Outcome to be achieved. The teachers were also informed that the researcher was only interested in observing the actual nature of their practices.

A Science Process Skill Observation Scale (Appendix B) was used to find out how often science process skills were used by the teachers in their biology lessons. The instrument evaluated the following descriptors regarding the implementation of the different science process skills:

1. Observing and comparing
2. Questioning
3. Predicting
4. Conducting investigations
5. Recording results and
6. Evaluating and communicating findings.

3.6.3 Attitude Scale

In order to investigate the attitude of teachers towards the teaching of practical work and process skills, a three Likert-type attitude scale was used. It consisted of 14 items. This scale was originally used by Sharpe (2012) to ascertain the attitude of teachers and students towards practical work in biology. The scale was suitable for the study as it was originally used for a similar purpose of measuring teacher's attitude towards teaching practical work and science process skills.

Each item of the attitude scale consisted of a statement followed by three options namely, Agree, Disagree, and Neither Agree nor Disagree. Some of the items were to ascertain whether teachers enjoyed practical work, whether their students are able to learn from practical work in biology lessons and whether they preferred practical work in biology to non-practical work. However, attached to the attitude scale also were brief questions purposed to obtain the demographic data of respondents. These additional questions were the researchers own additions.

3.7 Validity and Reliability of the Instruments

3.7.1 Validity of the Instruments

Validity refers to the degree to which a study reflects on the specific concepts the researcher is attempting to measure (Brown & Dowling, 1998). It is concerned with the meaningfulness of research components (Drost, 2000). Thus, validity of research instruments implies the extent to which the instrument is able to adequately collect the information it seeks to or measure the phenomenon it was designed for. Two important elements of validity ensured in this study were internal validity and face validity.

Internal validity is about designing appropriate controls to do away with extraneous variables that may offer to alternative interpretations. Anything that contributes to the control of a design contributes to internal validity. In this study, the conduct of the observations and interviews all involved varied degrees of controls to restrict lowering the internal validity of the study. This was primarily ensured by submitting the research instruments to the study supervisor for comments which were later incorporated into the final instrument design.

Again, to prevent instrumentation threats to the internal validity all observations and interviews were carried out by the same researcher. Furthermore to avoid maturation which refers to changes (biological or psychological) that may occur within the subjects simply as a function of the passage of time teachers were questioned and observed within the same time period of the academic calendar.

According to Miller (1995), face validity is another component of validity and is established when a research instrument is confirmed to measure the characteristic or trait of interest. Put simply, this is when a research instrument looks as if it is indeed measuring what it is designed to measure. In ensuring face validity, the research instruments were given to the research supervisor for comments.

3.7.2 Reliability of the Instruments

Reliability refers to the extent to which a test or procedure produces similar results under constant conditions on all occasions (Sharpe, 2012). In this study, data was collected from 5 different schools, across 2 different districts of the Brong Ahafo region. However neither the school, nor the District nor the time that the data was collected in the academic year had any significant influence on the findings. This suggests that the broad themes that emerged from the interview – are in terms of reliability likely to be the same if collected from other schools that were broadly similar in the sense.

3.8 Pilot Test

A pilot test is usually carried out in an attempt to avoid time and money being wasted on an inadequately designed project. It is usually carried out on members of the relevant population, but not on those who will form part of the final sample.

A pilot test of the instruments (Appendices A, B & C) was carried out with 2 Biology Teachers in Istiqaama Senior High School in the Wenchi district of the Brong Ahafo Region of Ghana. The teachers used for the pilot test did not form part of the sample for the study. Istiqaama Senior High School shares similar characteristics with senior high schools in the selected districts. It was realised at the end of the pilot test that some of the interview questions had to be reworded to avoid ambiguity. The number of questions was also reduced because there were repetitions. The pilot test enabled the researcher to restructure the instruments to help elicit the right responses. The alpha values of the pilot test were 0.84, 0.72, and 0.80 for instruments in appendices A, B and C respectively. These indicated that the instruments were consistent and could be relied upon for this study.

3.9 Data Collection Procedure

The researcher observed the lessons of ten biology teachers in five Senior High Schools. Two lessons each were observed for each of the ten teachers. In all, a total of 20 lessons were observed. The observations took place between May and July 2014. During each visit, notes were taken. The notes were descriptions of what happened in the classroom, for example the type of learning strategies the teachers used. As a non-participant observer, the researcher tried to be objective and not get involved in the dynamics of the class.

There were 10 semi-structured interviews held between May and July 2014 to ascertain the understanding of the teachers' knowledge of the science process skills, its implementation, and the support teachers need to improve their practices with regard to the teaching of the science process skills. The interviews were after the observation. Each teacher participated in a semi-structured interview consisting of a series of prescribed questions. Informal discussions between the teachers and the researchers in and outside the classroom were also regarded as a form of interview. The dates for each interview were determined by each teacher and lasted between 25 and 30 minutes. There were ten interviews in all; each teacher was interviewed once for a period of 25-30 minutes. In addition to this, the attitude scale was completed by teachers; it took approximately seven minutes for each teacher to respond to the attitude scale.

3.10 Data Analysis

Emerging patterns and prevailing practices from the qualitative research methods were recorded according to participant's response in order to give appropriate and relevant descriptions about the teachers' views, perceptions and practices regarding the topic under study. A thematic data analysis was adopted. This entailed the transcription of recorded interviews, close reading of the text and the identification of patterns which were used to generate themes for the analysis. The analysis of data helped the researcher to gain an understanding of the social world of each participant in terms of their experiences, perspectives and perceptions.

The results of the attitude scale were analyzed through the computation of frequencies that showed the total tallies, which is the number of times something happened (Heck et al., 1981). The frequency used within a descriptor was tallied. Raw tallies then illustrated to what extent the use and development of science process skills were employed by teachers and their attitude towards it.

3.11 Ethical Considerations

The headmasters of the participating school as well as the teachers of the selected schools were informed about what the study sought to find. The teachers were informed that their identity would not be revealed and that they could withdraw at any time of the project if they chose to.

In addition, honesty was ensured through conveying information truthfully and honouring commitments. Accuracy meant reporting findings precisely and taking care to minimize or avoid errors. Also, using resources wisely and avoiding waste ensured efficiency. Again, for the purpose of objectivity, the facts of the research were allowed to speak for themselves and improper bias and misrepresentation were avoided. Finally, respondents' anonymity and the confidentiality of the information volunteered by them were ensured throughout the research.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Overview

This study assessed the attitude of biology teachers towards the teaching of practical work and process skills. This chapter presents the results of the field research and the analysis of findings. The results are presented in frequency tables and discussed to satisfy the objectives of the study. The analysis of the findings is categorised under the various research questions of the study. This chapter is divided into two sections. The first section presents the demographic characteristics of respondents and the second contains the results of the study with regard to the specific research questions.

4.2 Demographic Characteristics of Respondents

This section reports the demographic characteristics of respondents. The demographic variables of interest to the researcher were age, gender and the period served in the teaching service to ascertain whether any of them influences the attitudes of the biology teachers.

4.2.1 Gender

The gender distribution of biology teachers is captured in Table 2.

Table 2: Gender Distribution of Biology teachers

Gender	Frequency	Percentage
Male	8	80
Female	2	20
Total	**10**	**100**

As shown in Table 2, majority of respondents were males. There were 80% (8) and 20% (2) male and female teachers respectively.

4.2.2. Age

The age distribution of respondents is presented in Table 3

Table 3 Age Distribution of respondents

Age	Frequency	Percentage
20-29 year	1	10
30-39 years	7	70
40-49 years	2	20
Total	**10**	**100**

As shown in Table 3, most (70%) teachers were between 30-39 years. There were 20% (2) whose ages were between 40-49 years and one respondent's age was between 20-29 years.

4.2.3 Number of years spent in the teaching service

The number of years spent in the teaching service is depicted in Table 4.

Table 4 Number of Years spent in teaching service

Number of years	Frequency	Percentage
0-3 years	3	30
4-6 years	6	60
7-10 years	1	10
Total	**10**	**100**

It is evident from Table 4 that majority (60%) of respondents have taught between 4-6 years. There were 3 respondents who had served for about three years whilst one respondent had served for between 7-10 years.

The following sections present the analysis of findings with regard to the research questions.

4.3 Research Question One: How are the science process skills being taught by the senior high school biology teachers?

This research question was concerned with how teachers teach the science process skills. Data was collected to through interview and observation.

It was found out that 4 (40%) teachers viewed themselves as facilitators and as people who always attempted to employ a teaching approach in their biology lessons in which the learners are given the opportunity to make observations, predictions, recognize patterns and make drawings. These four teachers said that they always encourage the learners to share their observations with one another, even though it often disrupts the flow of the lesson sometimes.

During the interview these four teachers mentioned that they used the biology syllabus as a guide when they plan their lessons. Similarly, 20% (2) of teachers stated that they depend on the of the inquiry approach as outlined by the biology syllabus, since this approach plays an important role in the development of higher order thinking and motivates the learners to employ different strategies when they are confronted with a problem. One respondent noted that;

> Lessons vary from time to time and as such, some lessons require the traditional approach to teaching in which information is imparted to learners, while other lessons lean more towards an inquiry approach in which learner independence is promoted in that they are required to use their senses, ask questions about a phenomenon, seek patterns and make inferences.

The biology teachers also mentioned that they have a better understanding of inquiry-based teaching due to their studies in biology and other sciences at their various universities. Two other teachers (20%) stated that they rely mostly on the traditional approach in their biology lessons in which they primarily impart information to the learners.

This finding is in agreement with Bennet (2003) who noted that simply telling or explaining concepts to the learners is no guarantee that they will receive the message or understand it. During the interview it transpired that these teachers structured their biology lessons mostly around teacher talking and the learners responding to his/her questions. Some teachers also feel that their learners learn best through memorization, an approach they claimed to have used since the commencement of their teaching career.

The teachers who adopted the conventional approach also indicated that they ensured that they are always in control of the content to be learned and that their learners are always up to the task and able to perform it. The teachers felt that their teacher-centered approach was an effective one to use.

Furthermore, two other teachers claimed that they preferred a learner-centered approach in which they guide and then redirect learners' ideas, making science more active, realistic, challenging and developing certain skills as outlined by the critical and developmental outcomes. However, they acknowledged that much of their practice involved knowledge transfer with an emphasis on the mastery of content and that this was quite traditional.

The results of the interviews that transpired showed that 4 (40%) of the teachers believed their learners learn best when the science content is explained to them. They indicated that they are satisfied and pleased when the learners are able to answer the questions related to the content they had been taught. The beliefs held by these teachers might be considered to contradict the learner-centered approach. Several researchers (Lotter et al., 2007; Roehrig et al., 2007; Webb & Glover, 2004) have found that the so-called traditional approach is very common amongst educators but that these beliefs can be changed through intensive professional development over an extended period of time.

Aside the interviews, classroom observations were also conducted to ascertain how biology teachers taught science process skills.

4.3.1 Observing and comparing

Teachers were rated against the first descriptor of the Science Process Observation Skill Scale, namely observing and comparing.

This descriptor illustrates the degree to which the learners were given the opportunity to make observations and comparisons. Table 5 shows how teachers were rated.

Table 5 Level of use of Observing and Comparing skills

Criterion	Frequency	Percentage
Performed in outstanding manner	0	0
Performed well	6	60
Performed satisfactorily	2	20
Not used	2	20
Total	**10**	**100**

It can be seen from Table 5 that majority (80%) of the teachers gave the learners the opportunity to observe and compare a phenomenon or substance. Specifically, 60% of the teachers who gave learners the opportunity to observe and compare a phenomenon and performed well in doing that, presented a lesson on the caste of termites in a nest, that is the reproductives, the workers and the soldiers. Thereafter the learners were asked to describe and compare each caste in terms of color, size, shape and role. The learners were very enthusiastic and excited to participate since it was a simple activity.

There were two (20%) of teachers who also performed satisfactorily. One of these teachers presented a lesson on life processes in flowering plants and asked the learners to look at the different plants such as mango, cashew, grass, sunflower and some other shrubs around them and asked them to compare and describe the similarities and differences between them. Again, Data from this observation revealed that learners participate more effectively when working with real objects. In contrast to the eight teachers, one of the remaining two teachers presented a lesson about respiration in mammals and data from this observation revealed that this particular teacher did not provide the learners with opportunities of observing and comparing of substances. The teacher introduced the researcher, outlined the purpose of the class visit, laid down a few ground rules and started the lesson with a few questions.

4.3.2 Questioning

The researcher rated each teacher against the second descriptor of the Science process Observation Skill Scale, namely questioning:

Questioning identifies the degree to which the educators asked investigable questions and this included the extent to which the learners were encouraged to raise questions which can be answered by scientific investigation as well as questions that may arise from curiosity and the desire to understand.

Data gathered through this observation revealed that the biology teachers' knowledge of the nature of investigable questions was at best limited as none of them asked anything remotely related to an investigable question. Learner independence was not promoted in asking investigable questions. Instead, the questions asked by each teacher were direct, simple, to the point and mostly focused on content and knowledge. The questions were closed questions and rarely inquiry-orientated.

4.3.3 Predictions

The researcher's aim was to measure the degree to which the learners were given the opportunity to respond to 'what if' questions. Table 6 illustrates how the teachers were rated against the descriptor of the Science Process Skill Observation Scale, namely predictions:

Table 6 level of use of Prediction Skills

Criterion	Frequency	Percentages (%)
Performed in outstanding manner	0	0
Performed well	6	60
Performed satisfactorily	2	20
Not used	2	20
Total	**10**	**100**

Table 6 displays data from this observation. It revealed that a total of 8 (80%) of the teachers asked their learners to predict what would happen next in a given situation whilst 2 (20%) were not seen to have engaged students in any form of prediction. One of the teachers who performed well, asked the learners to predict what would happen to the remaining caste of termites if any of the three caste is absent in, the nest .

Responses to this question varied, but the learners were very eager to make a prediction.

One of the 2 (20%) teachers who performed satisfactorily asked his students to predict what would happen to plants in the absence of sunlight for days. Data from this descriptor (predictions) revealed that the teacher focused too much on 'correct answers' instead of allowing the learners to find out using control experiments. Since the educator focused on the correct answer the learners were also anxious to predict the correct answer.

Pre-judging an outcome of any prediction according to Ward et al. (2008) is problematic because it promotes the idea that there is only one answer. Meanwhile 2 (20%) biology teachers did not display any evidence related to predictions.

4.3.4 Conducting investigations and collecting data

The researcher also sought to measure the degree to which the learners were given the autonomy to carry out instructions and procedures involving a small number of steps. The researcher rated biology teachers against this descriptor of science process skill namely conducting investigations and collecting data and the results are summarized in Table 7.

Table 7 Level of Use of Investigations and Data Collection Skills

Criterion	Frequency	Percentage (%)
Performed in outstanding manner	0	0
Performed well	0	0
Performed satisfactorily	5	50
Not used	5	50
Total	**10**	**100**

Data from this observation revealed that 5 (50%) biology teachers displayed evidence of this approach to experimental procedure. A worksheet was handed to each learner in which the procedures of the investigation were outlined. Although the learners were actively involved in the lesson to a certain extent, data from this observation revealed that the biology teachers controlled the class and the new learning content to be learned.

The learners were rarely given the autonomy to manipulate the learning content on their own or to discover new content on their own. Instead, data collected from the experiments were orally explained and new terms were recorded on the board. The remaining 5 (50%) teachers explained in details new learning content and learner independence with respect to carrying out instructions and procedures was not observed.

4.3.5 Recording results

The researcher looked at the ability of the learners to record information they have gathered from the investigation. The result of this is summarized in Table 8.

Table 8 level of use of results recording skills

Criterion	Frequency	Percentage (%)
Performed in outstanding manner	0	0
Performed well	2	20
Performed satisfactorily	6	60
Not seen	2	20
Total	**10**	**100**

The data gathered from this observation reveals that, 2 (20%) of the biology teachers performed well as their learners were able to record results. One of these two biology teachers had his students record their results on daily basis by means of drawing, labeling and short descriptions. This teacher assisted the learners with certain terms relating to the development of the eggs of termites into adults. There were 6 (60%) other teachers who performed satisfactorily.

One of these six teachers had his students record their results on a work sheet after the experiment had been conducted. A word bank was provided to assist the learners to record the results since they struggled to draw conclusions based on the things they had seen. The skill of recording results was not observed in the lessons of two (2) teachers (20%). One of these two teachers asked his learners to describe aerobic and anaerobic respirations.

4.3.6 Evaluating and communicating results

Biology teachers were rated against the science process skill observation scale, evaluating and communicating results based on the degree to which the learners were encouraged to reflect independently on the way the experiments had been conducted, the results obtained and if they should repeat the experiment, how these results could be improved.

Data gathered from this observation revealed that learner independence was not encouraged and the reviewing of procedures and experimental designs by learners did not take place with respect to the lessons of all the ten biology teachers. This lack of what might be considered an essential part of any investigation is not uncommon in the science education literature on investigations and inquiry-based learning and teaching (Dawson & Venville, 2007; Harlen, 2000; Ward et al., 2008).

In this present study learners were not requested to report on their results, share the information they had gathered, report on patterns found or draw inferences. Instead, each biology teacher gave a summary of the learning content rated against the sixth descriptor of the Science Process Skill Observation Scale, namely evaluating and communicating.

The finding of the study with regard to the first objective widely supports the assertion of Ampiah (2004) that practical work and process skills in resource constrained countries is organised in the form of less fancied teacher demonstrations or large group experiments. Hence the development of process skills by students through the use of these methods is however, very limited and may even be insignificant.

4.4 Research Question Two: What is Senior High School biology teachers' attitude towards the teaching of science process skills?

The second research question was purposed to ascertain biology teachers' attitude towards the teaching of science process skills. This research question was addressed by using an attitude scale developed by Sharpe (2012). This was a 14-item scale that rates the attitude of biology teachers. These attitudes are self-reported and biology teachers have to rate their responses on a three point likert-type scale. The gradations on the scale are as follows; Agree =3, Neither agree nor disagree= 2, Disagree= 1

The teachers' attitude to the teaching of science process skills is summarised in Table 9.

Table 9: Percentage Score of Attitude scale

Statement	Agree	Neither Agree nor Disagree	Disagree
1. I enjoy teaching practical work and process skills in biology lessons	70	30	0
2. My students are able to learn from practical work and process skills in biology lessons	60	20	20
3. I prefer teaching practical work to non-practical work in biology lessons	30	50	20
4. Teaching practical work and process skills is my favourite part of biology lessons	30	40	30
5. Practical work and process skills help students understand biology	80	20	0
6. I find practical work in biology easy to do	20	30	50
7. What is taught in biology practical work will be useful when students leave school	40	60	0
8. What I teach in biology practical work is always useful for when I leave School	30	70	0
9. I find practical work a way of showing students how biologists work in the real world	100	0	0
10. I think we should teach more practical work and process skills in biology lessons	80	20	0
11. For me to teach biology lessons, I need to do teach practical work and process skills	50	10	40
12. My students have freedom during practical work in biology lessons	40	20	40
13. My school science environment makes teaching practical work and process skills easy in my Biology lessons	20	10	70
14. I do find practical work and process skills help my students learning in biology	40	20	40

It is evident from Table 9 that majority (70%) of teachers agreed that they enjoyed teaching practical work and process skills in their biology lessons, there were 30% of teachers who neither agreed nor disagreed to this. Most teachers (60%) also agreed that students are able to learn from practical work and process skills in biology lessons, 20% of teachers neither agreed nor disagreed whilst 20% disagreed.

Again, 30% of biology indicated that they preferred teaching practical work to non-practical work but 50% were not sure of this whilst 20% disagreed. Meanwhile, most (80%) teachers agreed that practical work and process skills helped students to understand biology lessons. There were 50% of teachers who disagreed that practical work is easy to do, 30% neither agreed nor disagreed whilst 20% agreed. In addition, 60% of teachers neither agreed nor disagreed that what is taught during biology practical work sessions is relevant to students when they leave school, 40% agreed.

Notwithstanding these, all teachers (100%) agreed that practical work and process skills are a way of showing students how biologists work in the real world. Nearly all (80%) of teachers also agreed that students should be thought more practical work and process skills. Majority (50%) of teachers agreed that for teachers to teach biology lessons, they need to do teach practical work and process skills, 40% disagreed and 10% of teachers neither agreed nor disagreed.

With regard to the freedom students have during practical work, 40% of respondents indicated that students have enough freedom during practical work and process sills lessons, 40% disagreed and 20% neither agreed nor disagreed. However, most teachers (70%) disagreed that their school science environment makes teaching practical work and process skills easy Biology lessons. There were 20% of respondents who agreed and 10% neither agreed nor disagreed. Also, 40% of respondents agreed that they find practical work and process skills helps their students in learning biology lessons, 40% disagreed and 10% neither agreed nor disagree. The raw scores and standard deviation of the responses are also presented in appendix D

As showed in appendix D, responses on the attitude scale deferred. The statement "I do find practical work and process skills help my students learning in biology" had the least standard deviation of 1.2 whilst the statement "I find practical work a way of showing students how biologists work in the real world" recorded the highest standard deviation value of 5.8.

The findings with respect to the second objective are in line with Saribas & Bayram (2009) who posited that the attitude of teachers is motivated by the teachers own nature among others. Thus, teachers' attitudes largely determine the actual outcome of their approach to science processes, but their beliefs about outcome expectations are dependent on self-efficacy judgments. According to Saribas & Bayram (2009), teachers who are not confident about their capability to foster student learning through practical work may dwell on negative images about their classrooms; those with greater confidence are apt to think of their students as motivated to learn. Thus, teachers with the right beliefs about their abilities and about practical work would look beyond the challenges and still teach practical work effectively.

4.5 Research Question Three: What factors influence Senior High School biology teachers' attitudes towards teaching of science process skills?

The third research question of the study sought to examine the factors responsible for the attitude of biology teachers towards the teaching of science process skills. The research question was addressed by finding out from teachers the reasons driving their attitudes towards teaching practical work and process skills. A number of themes were identified during the analyses of qualitative data that related to factors responsible for the attitudes of biology teachers towards teaching practical work and process skills. These themes are outlined and discussed appropriately.

It was found out during the interviews that one of the main factors driving the attitude of biology teachers towards teaching biology lessons was the teachers' understanding of science process skills. The researcher probed for teachers understanding of science process skills and the results of this are summarised in Table 10.

Table 10: Teacher's understanding of science process skills

Response	Frequency	Percentage (%)
Skills that learners use when they do science	4	40
Skills that the learners use when they conduct investigation	3	30
No idea of what science process skills is	3	30
Total	**10**	**100**

From Table 10, 40% of the biology teachers viewed science process skills as the skills the learners use when they do science and they associated the development of science process skills with "hands-on" experiences, critical and creative thinking. They stated that their studies in biology and other sciences at the university influenced this understanding. One teacher eloquently pointed out that; "The poor pre-service training programmes we received from the Ministry of Education did not change any of our science practices."

Furthermore, biology teachers were of the opinion that science process skills should not only be confined to biology, but that these skills should be developed in other science fields during problem-solving or in a learning area such as life orientation. However, 30% of the biology teachers described science process skills as the skills that learners use when they conduct an investigation or solve a scientific problem. It was also pointed out that "science process skills are related to predictions, observations and the recognition of patterns and inferences."

The remaining 30% of the biology teachers appeared to have a limited understanding of science process skills. When prompted to give an example of a science process skill, neither was able to do so. This finding is in agreement with the work of (Webb & Glover, 2004). However, Webb & Glover, (2004) further cautioned that if educators do not have an appropriate understanding of the processes of science, they cope in ways that impoverish children's learning opportunities and hence affects their academic achievement.

Also, some of the teachers described their lack of understanding of the concept "science process skills" as well as their lack of confidence as to how to go about teaching these skills as primary obstacles. Several researchers (Murphy, 2009; Peacock, Serret, Lindsay, 2009; Sharp & Hopkins, 2007) have commented on the worldwide problem of educators' confidence or rather lack of confidence to teach inquiry-based science. In an extensive review of the constraints on science inquiry, Murphy (2009) concluded that one of the major issues in primary science teaching that places a damper on inquiry-based learning may be attributed to the educators' lack of confidence in running "inquiry-driven lessons" and that this lack of confidence could be because of the severe lack of appropriate professional development in this area.

Two teachers stated that they have to prepare their SHS 3 learners for the West Africa Senior School Certificate Examination. Therefore, letting the learners work in groups and discussing a problem would just take up too much of their teaching time. They felt that they woul be held responsible for poor examination results

Impediments to teaching of science process skills

It was also found out that the impediments to teaching science process skills influenced teachers attitudes to the teaching. The biology teachers' responses to the impediments of science process skills were similar and related. They perceived a number of barriers preventing them from adopting an inquiry based approach to teaching. Some of these impediments were structural (e.g. lack of science equipment, lack of appropriate furniture and laboratory space) while another group of barriers involved the support of people (e.g. lack of collegiality and support from school colleagues, lack of parental and home support) and lastly, they identified the curriculum as a potential barrier (e.g. the poorly constructed curriculum with respect to content to be taught).

One of the respondents, in describing his primary perceived impediment stated:

> "I really do not have much confidence in my learners to describe an event they observed verbally as well as in writing because their descriptions sometimes do not match what actually happened."

This brief description captures one of the impediments of teachers beyond the physical materialistic challenges that are well known.

Learner attitude

Another impediment reported was that when the learners are asked to make a prediction, they merely make wild guesses without consideration to the subject matter under discussion. Teachers mentioned that some learners' lack of interest in science and their lack of general scientific knowledge placed a damper on an inquiry approach. Pupil autonomy and self-responsibility were also highlighted as impediments since the learners need constant guidance with experimental procedures, the reading and interpretation of questions as well as continual reminders to clean their work space. These factors according to teachers make teaching via inquiry exhausting and time-consuming and as such it is therefore difficult for him to remain focused and enthusiastic.

Inadequate institutional Support

All teachers (100%) indicated that they were not supported and developed enough by the Ministry of Education as often promised. This inadequacy of support is another factor found to influence the attitude of teachers towards teaching practical work and process skills. The respondents indicated that, workshops organized by the Ministry of Education were not enough and more training is needed to increase their competencies with regard to the teaching of biology and other science subjects.

There were 8 (80%) of the teachers who emphasized the lack of effective professional development in Learning Outcome (i.e. Scientific Investigations) as one for of inadequate institutional support. When prompted about what is needed to teach science as a process more effectively, the teachers unanimously indicated that learning materials and resources from responsible bodies such as the Ministry of Education are needed so as to encourage and guide teachers to introduce future activities that will reinforce the use and development of science process skills.

The sentiment regarding the lack of support and the availability of learning material and resources as highlighted by the teachers in this study indicate that these kinds of services need to be accelerated and improved. Darling-Hammond (1998) in an extensive overview of educational reform efforts concluded that reform efforts must focus on building the capacity of educators in terms of the content to be taught and how it could be taught best to deal with the changes successfully. Authors such as Fullan (2007) argue that the process of professional development has to be enhanced with high quality teaching and training material.

Teachers' educational background and experiences related to biology

Again, the attitude of teachers was also found to be influenced by the individual educational background of teachers. The ten (10) biology teachers interviewed for this study indicated that they had themselves learned science dogmatically, using rote memorization of facts, principles and laws. When they were at school and in pre-service training their own science teachers had relied heavily on the traditional teaching paradigm since it was considered as one of the most effective approaches. They stated that their science teachers were always well prepared and had the ability to hold the learners' attention for quite a long period of time.

The biology teachers also stated that their science teachers were always in control of the learning content. One biology teacher recalled that, although in his student days his science teacher did most of the talking and supplied them with information, they were also requested to answer stimulating questions. Some teachers also indicated during the interviews that they had been taught by means of demonstrations and neat wall charts.

"At our time, the wall charts were displayed against the wall after the lesson to beautify the classroom" one teacher explained. Thus, the current practices of biology teachers reflect their training and how they were taught during their time as students.

Improving teacher attitude towards the teaching of practical work and process skills

The biology teachers suggested a number of measures that could be adopted to improve their attitudes towards the teaching practical work and process skills. In the first place, during the ten biology teachers indicated the need for the design and development of learning materials consistent with methods of inquiry that will motivate and guide teachers to introduce learning activities that will reinforce the use and development of science process skills in their science teaching practices. It is recommended that these visits of district officials should not only be limited to the evaluation of curriculum documents but should also focus on intensive classroom visits so that teachers are supported and guided in a realistic and practical manner.

Secondly, teachers indicated the need to have continuous professional development programs. This refers to the knowledge and skills educators acquire to improve their classroom practices and enhance their effectiveness as educators (Dreckmeyer, 1994).Verbal reactions from the teachers revealed that they were not supported by the MoE to act any differently in their classrooms or to change their practices so as to align their practice with inquiry-based learning. For this reason data generated from this study suggests the need for science teachers to be exposed to developmental programmes whereby inquiry teaching strategies are instilled and developed. In order for teachers to grow professionally and to transform their practices, Wessels (1998) is of the opinion that educators should be afforded the opportunity to participate in hands-on workshops in which they physically work with the learning material, workbooks, posters, apparatus and other stimulus material. According to Wessels (1998), educators gain content knowledge, a deeper understanding of concepts and are immersed in a constructivist philosophy, both explicitly and through workshop practice.

Again, respondents suggested that there is the need to establish learning communities to improve the general attitude of teachers towards science process skills and practical work. Getting educators to change is a difficult phenomenon, according to Webb and Glover (2004) since most of them particularly resist complex, conceptual, longitudinal changes as opposed to change in management routines or temporary changes. Communities of practice provide opportunities for teachers to support one another morally and emotionally and to engage in dialogue to discuss the meaning of educational changes and how to deal with them successfully. When teachers feel that their peers experience the same concerns and fears that they are experiencing, they become less hesitant about changing their practices and are more willing to accept change. Fullan (2007) states that communities of practice may serve as a source in which educators discuss and share effective practices, identify barriers, focus collectively on student learning and share norms and values. These communities support learning conditions for motivating the disengaged educator, they build and manage knowledge and they create shared language and standards for practice and student outcome (Fullan, 2007).

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Overview

This study assessed the attitude of biology teachers towards the teaching of practical work and science process skills. This is the final chapter of the study. In this chapter, the researcher summarizes all major findings. Conclusions are drawn based on these findings and recommendations are made for consideration.

5.2 Summary of findings

A mixed method approach was adopted for the study. It entailed interviews with 10 biology teachers, classroom observation and use of attitude scale. The following are the most notable findings of the study.

1. It was found out that majority of biology teachers in the Pru and Atebubu Amantin Districts were well aware of the science process skills and applied them during lessons. The elements relating to observing and comparing, predictions, conducting investigations and collecting data and recording results were always present during their teaching. However, questioning, evaluation and communicating results were not observed.

2. Again, some of the biology teachers in the Pru and Atebubu Amantin Districts held predominantly traditional beliefs about their classroom practices. Teachers believed that the conventional approach to teaching science is still appropriate although they acknowledged the need for practical work and process skills.

3. With regard to the attitude of biology teachers towards the teaching of process skills and practical work, all biology teachers in the Pru and Atebubu- Amantin Districts agreed that practical work gives students the idea of what biologists do in the real world. This notwithstanding, biology teachers were skeptical about the how to balance practical work with the conventional approach to teaching in the Pru and Atebubu-Amantin districts.

4. Again, biology teachers in Pru and Atebubu Amantin Districts recognised several challenges of teaching practical work and process skills and these were related to the school environment.

5. In relation to the factors responsible for the attitude of biology teachers in the Pru and Atebubu-Amantin districts, it was found out that biology teachers' understanding of science processes skills was key.

6. Other factors responsible for biology teachers in the Pru and Atebubu-Amantin districts attitudes were the challenges arising from infrastructure, inadequate support, student attitude and general structure of biology lessons.

5.3 Conclusions

The results of the study show that many biology teachers in Pru and Atebubu Amantin Districts are knowledgeable about the science process skills and practical work although they do not use process skills in its entirety. Biology Teachers' attitude to teaching science process skills and practical work is in the Pru and Atebubu-Amantin Districts in the Brong Ahafo Region of Ghana is apathetic. Thus, the biology teachers know the value of practical work and process skills but are unable to teach these skills adequately because of a number of factors.

Moreover, the understanding of the concept science process skills affected teachers' level of confidence and attitude towards the teaching of science process. The school science environment, lacking infrastructure and inadequate institutional support are also other factors affecting the attitude of biology teachers towards the teaching of practical work and science process skills. This study confirms the findings of researchers such as Webb and Glover (2004), Wenham (2005) and Wessels (1998) that the educators' understanding of any area of science influences their classroom practices.

5.4 Recommendations

Based on the outcome of the study and the conclusions drawn, the following recommendations are made for consideration.

1. There is the need to provide appropriate teaching and learning materials and realistic support for biology teachers in Pru and Atebubu Amantin Districts of the Brong Ahafo Region.
2. Again, biology teachers in Pru and Atebubu Amantin Districts should be given the opportunity of continuous professional development to improve the understanding and teaching of science process skills and practical work.
3. Also, teachers should be inspired to use the enquiry based approach to teaching in its entirety and not to teach some elements and disregard others.

5.5 Suggestions for Future Research

1. Further research may consider the effects of teachers' attitudes towards practical work and process skills on the academic achievement of students.
2. Also, future researchers may probe the attitude of students towards the learning of science processes and practical work.

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APPENDIX A

Identification and interaction between data collection sources

Interview

1) What is your understanding of the concept of science process skills?

2) To what extent do you employ these basic skills in your science classroom?

3) What problems do you experience teaching the science process skills?

4) How could science educators be supported to implement science process skills more effectively?

5) Could you describe your educational background and experiences concerning the teaching and learning of biology?

APPENDIX B

Observation Scale for Science Process Skills

<u>Science Process Skills: Observation Scale</u>

	1	2	3	4
Did the teacher encourage the learners to use their senses (sight, touch, smell, taste, and listen) to collect data in a practical situation?				
Did the teacher encourage the learners to describe an event in general or to identify its similarities or differences?				
Did the teacher promote student independence in contributing an investigable question to develop their thinking?				
Did the teacher encourage the learners to ask an investigable question?				
Did the teacher encourage the learners to make any predictions to respond to "what if" questions?				
Did the teacher promote student independence to carry out instructions, follow procedures and collecting data?				
Did the teacher encourage the students to record the results that they obtained from the investigation?				
Did the teacher employ strategies to motivate the learners to reflect, or construct meaning to their ideas? To evaluate and communicate their findings?				

To what extent did the teacher promote the use and development of science process skills? Place “x” in the box indicating how often you observed each of the following:

Score Criterion

1 Not seen 2 Performed satisfactorily

3 Performed well 4 Performed in outstanding and advanced manner

APPENDIX C

Attitude scale

Statements	Agree	Neither Agree nor Disagree	Disagree
1. I enjoy teaching practical work and process skills in biology lessons			
2. My students are able to learn from practical work and process skills in biology lessons			
3. I prefer teaching practical work to non-practical work in biology lessons			
4. Teaching practical work and process skills is my favourite part of biology lessons			
5. Practical work and process skills help students understand biology			
6. I find practical work in biology easy to do			
7. What is taught in biology practical work will be useful when students leave school			
8. What I teach in biology practical work is always useful for when I leave			
9. School			
10. I find practical work a way of seeing how biologists work in the real world			
11. I think we should teach more practical work and process skills in biology lessons			
12. For me to teach biology lessons, I need to do teach practical work and process skills			
13. I prefer the freedom I have during practical work in biology lessons			
14. My school science environment makes teaching practical work and process skills easy in my Biology lessons			
15. I do find practical work and process skills help my students learning in biology			

APPENDIX D

Raw Scores and Standard Deviation of Attitude scale

Statement	Agree	Neither	Disagree	Standard Deviation
1. I enjoy teaching practical work and process skills in biology lessons	7	3	0	3.5
2. My students are able to learn from practical work and process skills in biology lessons	6	2	2	2.3
3. I prefer teaching practical work to non-practical work in biology lessons	3	5	2	1.5
4. Teaching practical work and process skills is my favorite part of biology lessons	3	4	3	0.6
5. Practical work and process skills help students understand biology	8	2	0	4.2
6. I find practical work in biology easy to do	2	3	5	1.5
7. What is taught in biology practical work will be useful when students leave school	4	6	0	3.1
8. What I teach in biology practical work is always useful for when I leave School	3	7	0	3.5
9. I find practical work a way of showing students how biologists work in the real world	10	0	0	5.8
10. I think we should teach more practical work and process skills in biology lessons	8	2	0	4.2
11. For me to teach biology lessons, I need to do teach practical work and process skills	5	1	4	2.1
12. My students have freedom during practical work in biology lessons	4	2	4	1.2
13. My school science environment makes teaching practical work and process skills easy in my Biology lessons	2	1	7	3.2
14. I do find practical work and process skills help my students learning in biology	4	2	4	1.2