UNIVERSITY OF EDUCATION, WINNEBA

INTEGRATING MODERN PEDAGOGICAL SKILLS IN THE TEACHING OF SCIENCE AT THE INCHABAN CIRCUIT JUNIOR HIGH SCHOOLS IN THE SHAMA DISTRICT

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A Dissertation in the Department of Science Education submitted to the School of Graduate Studies, University of Education, Winneba in partial fulfillment of the requirements for award of Master of Education (Science Education) Degree.

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DECLARATION

STUDENT'S DECLARATION

I, FRANK OSEI – MANU hereby declare that except references to other people's work which have been duly cited, this project work is the result of my own work and that it has neither in a whole nor in part been presented elsewhere.

Frank Osei – Manu ....

CANDIDATE'S NAME SIGNATURE DATE

SUPERVISOR'S DECLARATION

I, Dr. K.D. TAALE hereby declare that the preparation and presentation of this project work was supervised in accordance with the guidelines on supervision of action research laid down by the University of Education, Winneba.

Dr. K.D. Taale ....

SUPERVISOR SIGNATURE DATE

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DEDICATION

To God Almighty and my wife Elizabeth Osei – Manu, and my children, I dedicate this project. I am also most grateful especially to the Lord God and also my family.

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ABSTRACT

This study employed a descriptive survey to determine the effect of using integration technology, group work and practical demonstration on the pedagogical skills of basic school teachers as they participated in some carefully designed instructional activities that try to elicit their misconceptions in some selected science topics. A sample size of forty - five (45) teachers was used for the study: 33 (73%) Science teachers and 12 (27%) ICT teachers from the eight Junior High Schools drawn from the Shama District Education Directorate. Both probability and non probability methods (purposive, simple random and convenience sampling techniques) were used to select respondents for the study. Questionnaires, interviews and observations were used to collect data on the teachers' misconceptions toward those topics. The data were obtained from 45 teachers drawn from the Shama District Education.

The results obtained indicated that many teachers had misconceptions in most of the topics selected. In conclusion integration technology and group work were seen as alternative learning methods that can be used to overcome misconceptions in science at the Junior High School. As a result, the determination of in-service and pre - service training on teachers' misconceptions was recommended on educating them to form a better conception about science using ICT.

CHAPTER ONE

INTRODUCTION

1.1 Overview

This chapter gives insight into the background information which provides the challenges in the use of modern and practical skills in the teaching and learning of science in basic schools especially at the Inchaban Circuit Junior High Schools (J.H.S) in the Shama District of the Western Region of Ghana. The chapter also describes the nature of the problem as to what aspects of Science learning constitute the problem and how the researcher identified the problem. The main objectives of the research are outlined in this chapter and seek to identify the obstacles that prevent the J.H.S student from forming basic scientific concepts, identifying appropriate learning strategies that need to be employed and effective teaching techniques that can be employed by the teacher at the J.H.S to overcome their learning difficulties.

The significance of the research which indicates about how the findings of this research are going to be of benefit to the educational system in the country is also highlighted in this chapter.

Finally, the chapter throws light on the delimitations of the study, which focuses on the areas from where the samples were drawn and the origin of the questions used in the study.

1.2 Background of the Study

Many attempts have been made by stakeholders in promoting Science Education in Ghanaian communities. For example, Science, Technology and Mathematics Education (STME) clinics and workshops for Junior High School students, especially girls, as well as Trends in International Mathematics and Science Studies (TIMSS)

Training of Trainers and workshops for Junior High School Science teachers for the past decade (Anamuah-Mensah, 2002). Moreover, the rationale of the 2002 Ghana Educational Reforms centered on inculcating in students the skills that would make them useful information searchers as well as improve students' problem-solving skills so that they will be able to transfer what they have acquired in a situation rather than feeding them with information. Unfortunately, most teacher training institutions do not prepare their student teachers adequately for this task (Ellis, 2002). A teacher trainee who is a student in a College of Education and aspiring to be a teacher, needs to be guided on how to conceptualize knowledge in order not to transmit his misconceptions to his would-be students.

In order to achieve meaning, permanent learning misconceptions are supposed to be corrected by modifying their previous knowledge to make it relate to the new information in an approach called Conceptual Change (Amir & Tamir, 1994). Conceptual Change is a hopeful approach that achieves evolution from unempirical information or misconceptions that students have. Thus conceptual change is a change process of erroneous previous knowledge to valid and reliable information through applications of analogies and explanatory models, conceptual change text concept maps, hands – on activities, information processing skills, and students' written answers. In Ghana, the comments made by the Chief Examiner for Science at the West African Examinations Council, Ghana (WAEC) that "If candidates had had practical experience, they would have realized that as soon as the clip is removed higher, pressure of water will cause movement of water molecules …" and "Obviously, it is only through practical experience that a candidate would be able to understand and cope very well with all the explanations given above" (WAEC, 2008, p. 50).

Junior High Schools in Ghana comprise JHS 1, JHS 2 and JHS 3. Students at this level have ages between 12 and 16 years which is the formal stage of Piaget's Developmental stages. Since the J.H.S is the level and foundation stage for the students to prepare for Senior High School and above, it is imperative for the students to have a firm knowledge of the subject matter. The teachers handling students at this level must teach the subject, Integrated Science, in a more practical and learner – centered approach at the J.H.S.

Science at the Junior High School is a fusion of concepts from many branches of science and covers topics like;

- Matter
- Energy
- Force and Work
- Atoms, Molecules, Elements and Compounds
- Acids and Bases
- Photosynthesis
- Electricity
- Magnetism
- Light
- Solar System
- Basic Electronics

Also, its study at J.H.S level is to equip pupils with the necessary process skills and attitudes that will provide a strong foundation for further study in science at the Senior High School level and beyond and also provide the student with the interest and inclination towards the pursuit of scientific professions. To this end, all the prospective scientists are expected to pass Integrated Science at BECE in order to be eligible to enroll at any Senior High School in Ghana. These students must acquire the basic scientific knowledge and skills that will help them to study science at the Senior High school and beyond. The knowledge and skills that students acquire in order to study science at the various levels of education will enable them use scientific concepts to manipulate materials and procedures for solving practical problems.

1.3 Statement of the problem

The Anamuah-Mensah Educational Review Committee of 2002 was of the view that the philosophy of education in Ghana should be creating well-balanced (intellectually, spiritually, emotionally, and physically) individuals with the requisite knowledge, skills, values, and attitudes for self-actualization and for the socio-economic and political transformation of the nation (Anamuah-Mensah, 2002). According to the Chief Examiner for Integrated Science (WAEC, April 2008, page 49), "Many candidates lack practical experience and, therefore, could not answer questions based on practical work……."

Majority of J.H.S candidates were unable to answer science questions properly during the BECE in Integrated Science. The majority of the candidates were unable to answer practical scientific questions, solve problems involving calculations, and questions relating to their everyday life experiences (WAEC, 2008). They also found it extremely difficult to explain scientific concepts. In order to facilitate an understanding of the problem, it is imperative to take cognizance of the fact that the J.H.S students in Ghana gain admission into senior high schools based on the fact that they have passed Integrated Science at the BECE. It is, therefore, a source of concern that quite a number of the students do not pass Integrated Science or, even if they do, they pass with weak grades. The question to be asked here is, "*why is it that so many J.H.S students perform poorly in Integrated Science, although these students have* *studied Integrated Science from JHS 1 to 3 at the J.H.S using the same topics in the syllabus used by other students who performed better?"*

Again, the ability of the students to form science concepts depends on their own background in science and the conditions under which they are being taught. The implication is that the learning of Integrated Science at the J.H.S will be successful if the students are provided with the enabling environment to develop positive learning principles, such as having awareness that whatever they learn they learn is for themselves and, with such a mentality, they would be highly motivated to learn and have much retention. However, the 2008 BECE Results in Integrated Science depicted a different picture which raises much concern. The question to be asked is how can the J.H.S student be helped to develop positive learning principles in Integrated Science?

It should also be noted that the effectiveness of the practical experience is directly related to the amount of students' individual participation and involvement in the teaching and learning of science. This also means that when students are given the opportunity to perform experiments, interact with teaching and learning materials, make observations, and draw conclusions during science learning, they will be able to achieve a maximum level of learning science. However, some factors may hinder the achievement of a maximum level of learning science. Some of these factors may include students' poor background in science, student being fixated, students' poor vocabulary and command over the English Language, and their negative attitude towards the learning of Integrated Science, (GLP, 2009). The investigation was, therefore, focused on the possible causes of misconceptions of basic scientific concepts by J.H.S students.

1.4 The Rationale for the Study

Since 1980s, agitation for a shift from the traditional system of feeding learners with information to promoting intellectual development has been a subject for public discussion. The reasons for advocating were to develop the thinking skills of learners. The implication of this is that schools should have the teaching of the concept formation at the core of their proceedings since, in this modern technological sophisticated world, good thinking is the key to successful learning. The development of the intellectual and psychomotor skills of learners is the responsibility of teachers. In order to improve students' understanding, practical and computer aided instruction and demonstrative experiments must be included in the teaching and learning strategies (Amir & Tamir, 1994). Teachers must be aware of students' previous knowledge and misconceptions that are likely to destabilize their understanding of the subject matter, therefore, they have to employ appropriate instructional methods that can either eradicate or curb misconceptions in the preparation and during the delivery of lessons. This is because learning occurs when students engage themselves in activities which involve demonstrations and discussions, since this exposes students' misconceptions and suggests appropriate ways to conceptualize knowledge in a simpler form (Amir & Tamir, 1994).

Therefore, there is the need to equip teachers with effective instructional approaches to overcome instructional misconceptions that result in meaningful learning. In this study, the use of demonstrative experiments, practical activities, and computer aided instruction on the conceptual change approach are applied and evaluated with respect to its effectiveness on teachers' pedagogical skills and academic performance of learners.

1.5 The Purpose of the Study

The main purpose of study was to design innovative teaching and learning strategies to ensure adequate practical and learner – centred methods of teaching basic concepts in Integrated Science at the J.H.S level. Also, the study would aid teachers in Integrated Science to investigate the extent of weakness of the students in applying the concept so as to come out with practical ways which should aid students to overcome their difficulties.

1.6 Objectives of the Study

The aim of this research was to investigate how J.H.S teachers guide students to form scientific concepts and to gain an insight into scientific knowledge with the use of pedagogical skills in their lesson delivery.

The specific objectives of the research were to find out:

a. the causes of misconceptions of J.H.S students in the formation of correct concepts in Integrated Science,

b. why J.H.S students find it difficult to grasp science concepts clearly during their study; and

c. the appropriate teaching strategies that could be adopted by science teachers in the J.H.S that deal with these misconceptions.

1.7 Significance of the Study

This investigation into the integration of modern pedagogical skills in the teaching of science at the Inchaban Circuit Junior High Schools by teachers in the Shama District of the Western Region of Ghana will be beneficial in the following ways:

a. The findings can be used to develop J.H.S syllabus in Ghana that will help science teachers at the Junior High Schools to have insight into the learning experiences of the J.H.S students so that effective science teaching takes place at the Junior High Schools.

b. The findings will be of enormous help to J.H.S students in the sense that they will be well equipped with the basic scientific concepts that will help them to increase their knowledge, prepare them for the task in the study of Science in the Senior High Schools, and also help them for further studies.

c. The findings will bring about improvements in science education at the J.H.S in Ghana and consequently improvement in science learning in the Senior High Schools.

d. The findings will guide Ghana Education Service (GES), Curriculum Research and Development Division (CRDD) and science education professionals in science training institutions to develop student-friendly curriculum in science in an integrated manner whose content and scope must be skills and issues centered on how a given problem can be solved with ease.

1.8 Research Questions

The following questions were therefore asked;

1. How are the students' understanding in science influenced by the J.H.S science teachers' concept formations and teaching techniques?
2. What makes it difficult for students to understand basic scientific concepts?
3. How do teachers formulate science and what approach do J.H.S teachers use during lesson delivery?

1.9 Delimitation of the study

The study was limited to only the J.H.S 2 students in the Inchaban Circuit J.H.S. Again, this study was limited to only the Inchaban and Aboadze communities in the Shama District of the Western Region of Ghana.

1.10 Organisation of the study

The study was organised in five (5) chapters. Chapter one discusses the background of the study, statement of the problem and the rationale of the study. The purpose of the study, the formulation of research questions, the significance of the study and the definition of terms are also presented. Chapter two focuses on the review of literature that relate to the study. The third chapter describes the methods used for data collection, including research design, population and sampling, instrumentation, scoring of instruments, reliability and validity of the instruments, and data analysis procedure. Chapters four and five focus on the results and discussion of the results of the study; and also the summary, conclusions, and recommendations of the study for further studies, respectively.

1.11 Definition of terms

Basic School Teacher: - Teacher who teaches at the Primary and Junior High Schools.

BECE: - Basic Education Certificate Examination.

G.E.S: - Ghana Education Service.

Human Constructivism: - The meaningful constructive integration of thinking, feeling, and acting that occurs in human learning and in new knowledge construction.

Inquiry-based learning: - The question-driven activities of students in which they develop knowledge and understanding of scientific ideas, as well as an understanding of how scientists study the natural world through activities.

I.C.T:- Information, Communication and Technology.

J.H.S: - Junior High School.

Knowledge construction: - Individual development of conceptual knowledge through interaction with the physical environment and other persons in the environment.

Meaningful learning: - Non-arbitrary, substantive relating of new ideas or verbal propositions to existing knowledge.

MoE: - Ministry of Education.

MEST: - Ministry of Environment, Science and Technology.

S.H.S: - Senior High School.

WAEC: - West African Examinations Council.

CHAPTER TWO

LITERATURE REVIEW

2.1 Overview

This chapter describes the history of education in Ghana, various theories of learning and their interrelatedness, knowledge construction, knowledge dependency, model that views knowledge construction as a bridge of new and prior knowledge, conceptual change, cooperative learning, the role of ICT in education for the 21st century information literacy, and research methodology.

2.2 Introduction

The review of the literature centres on the various learning theories and the use of ICT in Education in the 21st century with the focus being on a call for paradigm shift from teaching methods that encourage memorization (Lecture method) to a more refined method where learners are involved in concept formation through computer aided demonstrations, discussions and group work.

2.3 Education in Ghana

Education in Ghana had undergone different transformations over the years, from spreading the gospel to creating an elite group to run the colony (MoE, 1975). The main goal of education in the colonial era was to merge civilization with evangelization, and educating mulatto children the colonial merchants had with their indigenous wives. Besides reading, writing and arithmetic, workshops were organized for students to acquire skills in carpentry, masonry, blacksmithing, shoemaking and sewing, as well as, practical agriculture. After gaining independence in 1957, the education system of the country was modelled on the British system, and this has undergone a series of reforms. For example, the educational reform in the I980's was to move the system of education away from being purely academic to a system that was to address the nation's manpower needs. The present structure of education, which starts at the age of 4, consists of 2 years of Kindergarten. 6 years of primary education. 3 years of Junior High School, 3 years of Senior High School and 4 years at the university level or any other related tertiary institution.

By 1933, emphasis was placed on the training of teachers by the government with the assistance of several developmental partners, such as the World Bank, Overseas Development Agency (ODA) and other international donor agencies. The education system was reviewed and proposals were implemented in 1987 with the following objectives:

a. access to basic education.

b. shorten the pre-university education structure from 17 years to 12 years.

c. make education cost-effective.

d. improve quality of education by making it more effective to socio-economic conditions.

Although the reforms brought about some changes, standards were still low at the primary school level, hence, the introduction of the Free Compulsory Universal Basic Education (fCUBE) programme, which was aimed at providing every school-going age child good basic education. In view of the short comings of the previous reforms, the basic education was later designed to expose children to a variety of ideas, skills and inculcate attitudes that will help them to be creative in their environment, and also stimulate them to be an asset to their country. The Tertiary Education also underwent reforms with the aim of providing well-improved quality education that was to be efficient, accessible, equitable and relevant, and sustainable.

From the plethora of educational reforms that have taken place, Ghana developed an action plan known as Vision 2020. The basic objectives of the Vision 2020 document are to: reduce poverty, increase employment opportunities and average incomes, and to reduce inequities in order to improve the general welfare and the material well-being of all Ghanaians and this was in line with the eight Millennium Development Goals (MDGs) – in which providing universal primary education is to be achieved by the target date of 2015. To achieve the objectives of vision 2020, science, technology and innovative education had become an issue of great concern to stakeholders of education in Ghana ("*Ghana-Vision 2020"*, Republic of Ghana, 1995*)*.

2.4 Theories of Learning and Their Interrelatedness

This assessment examines the various theories of learning and what the theorists postulated about the effect of learners' environment on learners' ability to conceptualize knowledge as well as the factors that determine how effective learning occurs.

2.4.1 Behaviourist Theory

Behaviourism is a learning theory based on observable changes in behaviour which focuses on new behavioural patterns being repeated until they become routine. They can be traced back to Aristotle, whose essay "Memory" focused on associations being made between events. The theory of behaviourism encompasses the study of overt behaviours that are measurable and observable (Good & Brophy, 1990). The theory does not reorganize the possibility of thought processes occurring in the mind but rather concerns with how one responds to stimulus.

2.4.2 Pavlov (1849-1936) Conditioning / Learning

Ivan Pavlov, the Russian physiologist is best known for his work in classical conditioning or stimulus substitution which involved food, a dog and a bell. He likened learning to how he conditioned a dog to salivate by association between the food and a bell, and concluded that learning takes place when the learner is conditioned to elicit response repeatedly.

2.4.3 Thorndike (1874 - 1949) Theory of Learning

Edward Thorndike did similar research in animal behaviour before becoming interested in human psychology. He positioned himself to apply "the methods of exact science" to educational challenges by emphasizing "accurate quantitative treatment of information", "Anything that exist, exists in a certain quantity and can be measured" (Johcich, as cited in Rizo, 1991).

His theory, Connectionism, state that learning is the formation of a connection between stimulus and response. He supported his claims with the "laws of Effect, Exercise and Readiness". He alleged that a neural bond is established between the stimulus and response when the response is positive. Learning takes place when the bonds are formed into pattern of behaviour (Saettler, 1990).

2.4.4 Skinner (1904 -1990) Theory of Learning

Like Pavlov and Thorndike, Skinner was a student of stimulus-response pattern of conditional behaviour whose theory deals with change in observable behaviour, ignoring the possibility of any process occurring in the mind. He authored a book in 1948 about Utopian society based on operant conditioning entitled "Walden Two" and another one in 1953 with the title "Science and Human Behaviour", in which he discussed the role of operant conditioning in social institutions like religion, government, economics, law and education among others (Dembo, 1994).

The behaviourists' theories also known as the stimulus- response theory, like the lecture method of teaching, encourages learners to engulf whatever is presented to them without being given the opportunity to analyze the concept behind whatever is being learnt. He/she (the learner) only has to memorize. In such learning situation, the learner always faces problems in learning when the learning environment changes. For example, where the learner is asked to explain how a certain phenomenon occurs, it becomes difficult for him or her, unlike a situation where he or she is asked to define.

Behaviourists were unable to explain certain social behaviours. For example, children do not imitate all behaviours that have been reinforced. Furthermore, they may model new behaviour within days or weeks after their first initial observation without having been reinforced for the behaviour. According to Dembo (1994), Bandura and Walters departed from the traditional operant conditioning explanation - which the child must perform and receive reinforcement before being able to learn. They indicated that an individual could model behaviour by observing the behaviour of another person. This theory leads to Bandura's Social Cognitive Theory.

2.4.5 Cognitivist Theory

Cognitive theories recognize learning through associations between contiguity and repetition as well as the importance of reinforcement. They stress the role of reinforcement in providing feedback about the correctness of responses over its role as a motivator. However, even while accepting such behaviourists' concepts, cognitive theorists view learning as involving the acquisition or reorganization of the cognitive structures through which the human processes and stores information (Good & Brophy, 1990). Similar to behaviourism, cognitive psychology had its root from the ancient Greeks, Plato and Aristotle and became evident in American psychologists during the 1950's (Saettler, 1990).

Jean Piaget was one of the key players in the development of Cognitivist theory who developed the most important aspects of his theory around the I920 but did not impact North America until Miller and Bruner founded the Harvard Center for Cognitive studies in the 1960's.

2.4.5.1 Some Key Concepts of Cognitive Theory

Schema - An internal knowledge structure in learning. New information is compared to existing cognitive structure:-, called "schema". Schema may be combined, extended or altered to accommodate new information.

Meaningful Effects - Meaningful information is easier to learn and remember (Good & Brophy, 1990). If a learner links relatively meaningless information with prior schema it will be easier to retain (Good & Brophy, 1990).

Serial Position Effects - it is easier to remember items from the beginning or end of a list rather than those in the middle of the list, unless that item is distinctly different.

Practice Effects - Practicing or rehearsing improves retention, especially when it is distributed practice. By distributing practices, the learner associates the material with many different contexts rather than the one context afforded by mass practice.

State Dependent Effects - If learning takes place within a certain context, it will be easier to remember within that context rather than in a new context.

Mnemonic Effects - Mnemonics are strategies used by learners to organize relatively meaningless input into more meaningful images or semantic contexts. For example, the notes of a musical scale can be remembered by the rhyme. Every Good Boy Deserves Fruit.

Schema Effects - If information does not fit a person's schema, it may be more difficult for them to remember and what they remember or how they conceive of it may also be affected by their prior schemas.

Although Cognitive theory encourages the learner to practise what is being taught, it does not promote learning due to the fact that the theory anticipates that one can easily forget what is been taught if not practiced frequently. This is in opposition to definition of learning which characterizes learning as relative permanent change in behaviour. Moreover, Mnemonic effect, which is one of the concepts of cognitive theory, promotes learning through memorization other learning by doing. Hence, the learner tries to associate learning to meaningful images or semantic context without taking part in the formation of concept. He or she is seen as passive learner who takes everything from the teacher and stores them hoping to reproduce them to the teacher in nearly the exact way as they were given to him.

In this 21st century, learners are seen as active learners who have the brain and brawn to construct knowledge if they are guided by the teacher. Teachers who were considered as "wisdom pots" that impart knowledge to learners are now considered as facilitators that prepare the grounds for learners to construct a body of meaningful knowledge through what they perceive and experience.

2.4.7 Constructivist Theory

Bartlett, (1932) initiated what became the constructive approach (Good & Brophy, 1990). Constructivists believe that learners construct their own reality or at least interpret it, based upon their perceptions of experiences, and so an individual's knowledge is as a result of one's prior experience, mental structures, and beliefs that are used to read between the lines of objects and events. "What someone knows is grounded in perception of the physical and social experience which is comprehended by the mind."(Jonassen, 1991). A journey through many philosophical and psychological theories of the past reveals the writings of people like Bruner, Ulrick, Nesier, Goodman, Kant, Kuhn, Dewey and Habermas as the brains behind constructivism. Constructivists contest for understanding how learners construct knowledge, the environment that supports the learners, the social nature of learning, and the role of the teacher in the learning process.

2.5 Knowledge Construction

During the Scientific revolution, the scientific method evolved as the perceived method of uncovering 'the truth.' The German philosopher, Immanuel Kant, rejected the possibility of arriving at a precise grasp of absolute knowledge and introduces the human mind as an active originator of experience rather than a passive recipient of perception. According to Kant, knowledge is a co - evolution of understanding and sensibility, of both our faculty and our senses (cited in Dewey, 1997).

John Dewey emphasized the importance of viewing the student as engaged with the environment in a process of continuous "trying" or "undergoing" through the process of reconstructing knowledge. For Dewey education depended on action. Engaging the learner in problem - solving situations stimulates thinking rather than having content simply addressed (Bredo, 1997). He stated, "The reconstruction or reorganization of experience, which adds to the meaning of experience, increases the ability to direct the course of subsequent experience" (Dewey, 1997). His philosophy suggested a greater emphasis on the scientific method and the inclusion of more pragmatic topics in the curriculum (Dana, Campell & Lunetta, 1997).

Jean Piaget made a contribution to constructivism on his view of the psychological development of children and rooted his theory in the role of the learner as being one where the child is actively engaged in the learning process. Piaget viewed the learner as possessing existing mental structures (Schemas) that are acted upon when learning takes place, "a way of explaining how people come to know the world" (Brooks & Brooks, 1993). He described the process as follows: “when a learner comes across a new unfamiliar idea, it causes a state of disequilibrium or questioning in the mind of the learner”. Given preferred state of equilibrium as the motivating factor, the learner attempts to "make sense" of this new knowledge in relation to prior experiences. If learners are able to come to terms with new knowledge within the confines of existing knowledge, then they can accommodate and assimilate the new knowledge within their current knowledge structure.

Piagetian constructivism, generally, regards the purpose of education as educating the individual child in a manner that supports the child's interest and needs. Critics consider the approach decontextualized in terms of learning and teaching. It is their contention that this approach eliminates the "influence of the classroom culture and the broader culture context" (Vadeboncoeur, 1997).

Vygotsky's theory emphasizes education for social transformation, and reflects a theory of human development that situates the individual within a socio-cultural context (Richardson, 1997). Vygotsky's learning theory suggests the notion that children learn concepts through negotiations. According to Vygotsky (1978), learning is emphasized by social interaction which allows linkage between existing knowledge and new knowledge. To accomplish the goal of social transformation and reconstruction, the context of education must be deconstructed. The cultural assumptions, power relationships, and historical influences that support it must be exposed, critiqued, and when necessary, altered (Abdal-Haqq, 1998). Cognitive apprenticeships support learning in a domain that enable students to acquire, develop and use cognitive tools in authentic domain activity. "Students' learning ability can be advanced from both outside and inside the school, "through collaborative social interaction and the social construction of knowledge" (Brown, Collins & Duguid, 1989). Situated knowledge, according to Brown, Collins and Duguid (1989), depends on circumstance formed within subjects, intricacies and culture, and thus it can never exist independently. Lave (1993) proposes that learning, as it normally occurs, is a function of the activity, context, and culture in which it occurs. This contrasts with most classroom learning activities, which involve knowledge that is abstract and shorn of context.

A critical element in fostering learning is to have children carry out tasks and solve problems in an environment that anticipates and mirrors how the knowledge will be used in the future. Learning context in multiple contexts provides the opportunity to learn in a dual form - knowing the content as it is, and how it can be applied. Lave (1993) suggests learning as a legitimate peripheral participation in communities of practice, meaning that:

a. Learning as apprenticeship is a social role which should be played by the learner.

b. The learner's role as participant maximizes his contribution to concept formation.

c. The learner becomes a contributing member of the community instead of a person who is working at related tasks (Bredo, 1997).

Lave and Wegener (1991) cited five different studies demonstrating a gradual acquisition of knowledge, and skills as novices learned from experts in the context of everyday life. Lave suggested that knowledge should be presented in authentic context, since disassociating cognition from its context limits cognitive growth. The principal theme in situated cognition is the assertion that thinking and learning are fundamentally dependent for their proper functioning on the immediate situation of action (Brown & Palinscar, 1989).

Resnick (1989) postulated that traditional instructional theory assumes that knowledge and skill can be analyzed into component parts that function the same way, no matter where they are used. This assumption is the foundation for the building – from the bottom approach that characterizes most current school and technical instruction. This bottom - up approach reduces the learners' ability to function, according to Resnick (1989), due to these limitations:

a. Students who learn isolated facts are less likely to retain facts.

b. Skills need to be practiced in the environment in which they will be used.

According to the Benchmarks, as cited in American Association for the Advancement of Science (AAAS) (1993), the purpose of science education is to develop a scientifically literate populace; that is persons that have the knowledge and understanding of scientific concepts and principles required for understanding natural phenomena and making wise scientific decisions in a civic, economic, and cultural perspective.

2.6 Knowledge Dependency

Resnick (1989) describes knowledge - dependent learning as the process of using current knowledge to construct new knowledge. A main tenet of the constructive model is that new knowledge must be constructed based upon prior knowledge. Constructivism is based upon the premise that students learn by doing rather than by observing. In the learning process, students analyze and re-analyze their understanding of a concept; thus, building a cognitive framework for new knowledge that is dependent on prior knowledge. This practice of students become actively engaged in the learning process by making cognitive connections between prior and new knowledge is evident in the works of Piaget which was outlined in his Cognitive Development.

2.7 Model that views Knowledge Construction as a Bridge of New and Prior Knowledge

Piaget's description of the cognitive process claims that when a new idea is presented, the learner begins the process of trying to associate the new knowledge to something in which they are familiar. If the information is new to the learner, it causes a state of disequilibrium (challenges) or raises questions in the mind of the learner until a state of equilibrium (motivating factor) is met. If the learner is able to come to terms with this new knowledge within the confines of existing knowledge, she or he then accommodates and assimilates the knowledge in her or his current knowledge structure. However, a major goal of science education is to help students build meaningful relationships. Appleton and Asoko (1996) suggest that if students' disequilibrium are not addressed and teacher's intervention employed, the new knowledge will have no meaning.

Vygotsky (1978), states that what children can do with the assistance of others are "even more indicative of their mental development than what they can do alone." The adult assists the student by providing support at the level that is needed. The scaffolding process allows teachers to coach students to achieve their own level of understanding. The social interaction between the student, teacher, and other students' reinforces the student's knowledge acquisition.

Kroll and Black (1993) define constructivism as the acquisition of knowledge through active involvement with content, not imitation or memorization of material. The nature of learning is recursive; that is, repeated considerate" of important concepts in differing contexts promotes understanding. Educators have begun to accept the idea that learning is a constructive process so children must be taught to enable them construct for themselves a basic knowledge of science. A key element to the construction process is to help prospective teachers change their theories of teaching to include reflections on the learning process (Black & Ammon, 1992; Fosnot, 1989; Kroll & Black, 1993). Teachers who are placed in learning situations that allow them to participate in a knowledge building process are more likely to become more reflective about their own personal theories of how the world works.

Learning occurs when the learner is actively engaged in the process. The building of a unique conceptual framework is an active process that requires consciously connecting new knowledge to existing knowledge, and testing it against one's perception of real world objects and events and the knowledge constructed by others (Mintzes & Wandersee, 1998).

Purposeful inquiry supports the Human Constructivist model of becoming actively engaged in learning through hands - on activities. Through active engagement in activities, the learner develops understanding, which promotes higher level thinking, an important part of making connections between existing and new knowledge. Reflective exercises solidify the process by allowing learners to "think and feel" about the actions they have taken, thus seeking meaning and conscious making connections. A significant implication of constructivism is that teacher must shift their attention away from themselves as effective presenters of scientific information towards a focus on students' cognitive needs to learn science with understanding (Dana, Campbell & Lunetta, 1997).

In order for teachers to produce this type of environment for students, they need to provide students with more than the traditional "canned" activities. The implication for Basic School teachers is that this type of teaching environment requires them to have more discipline - specific skills and knowledge to teach successfully.

2.8 Conceptual Change

Vygotsky perceived the conceptual growth process as an interwoven system by which students make sense of everyday concepts in terms of school concepts, and school concepts in terms of everyday understanding. The primary conditions for learning therefore occur when students are confronted with concepts that are different from those they have currently conceptualized. This normally creates conceptual conflict between his/her prior knowledge and the new knowledge; the role of the teacher is to intervene and assist the student to accommodate the new concepts and promote equilibration (Whitebread, 2000).

According to Posner, Strike, Hewson, and Gertzog (1982), conceptual change is defined when the interaction between the teacher and the learner yields an outcome emerging from what the learner already knows. "In conceptual change, new ideas are not merely added to old ones; they interact with them, sometimes requiring the alteration of both ideas" (Strike & Posner, 1985). Children are often reluctant to admit errors and will find ways to adjust their old ideas before assimilating new ones.

Mintzes, Wandersee and Novak (2000) suggest that conceptual change approaches, as varied as they may be, should focus on helping students learn how to learn. Although children come to school with preconceived ideas, if they are taught how to reason about these ideas for themselves, they may be less resistant to relinquish alternative conceptions or misconceptions after these have been challenged directly.

2.9 Cooperative Learning (Group Work)

Cooperative learning is an instructional strategy that engages students in the learning process through group activities and discussions (Johnson & Johnson, 1994). The classroom that emphasizes active science learning, with a teacher that is willing to change his/her practice of "presenting information" or "covering science content" to one where students are engaged in problem solving, discussion, and interactive activities is more likely to create an environment of active learning. John Dewey advocated that children need an environment where they are free to communicate ideas within a social context (Dewey. 1997). Cooperative learning can do this. According to Brown and Palinscar (1989), the cooperative learning model is a means to promote positive social and communication skills, while providing students with the atmosphere to engage in various cognitive processes. Research conducted by Sharan (cited in Brown & Palinscar, 1989) shows that rote learning hinders the practice of higher level thinking as opposed to group activity which encourages learners to reason.

2.10 The Role of ICT in Education for the 21st Century

Judging from the various educational reforms and all the ways of activating learning processes listed above, access to Information and Communication Technology (ICT), which is essential, can be prescribed to any institution that aims at providing students with educational services of the highest quality. The pursuit and achievement of the 2007 educational reform requires that the privilege of using IT resources be made available to all educational institutions. Information and Communication Technologies (ICTs) have become common place entities in all aspects of life. During the past twenty years, the use of ICT has fundamentally changed the practices and procedures of nearly all forms of endeavour within business and governance (cited in Abdul-Wahed & Al-Awa, 2006).

Within education, ICT has begun to have a presence, but the impact has not been as extensive as in other fields. Education is a very socially oriented activity and quality education has traditionally been associated with teachers having high degrees of personal contact with learners. The use of ICT in education lends itself to more student - centered learning settings and often this creates some tensions for some teachers and students. However, with the world moving rapidly into digital media and information, the role of ICT in education is becoming more and more important, and its importance will continue to grow and develop in the 21st century. If one was to compare such fields as medicine, tourism, travel business, law, banking, engineering and architecture, the impact of ICT across the past two or three decades has been enormous. The way these fields operate today is vastly different from the way they operated in the past. But when one looks at education in Ghana there seems to have been an uncanny lack of influence and far less change than other fields have experienced. According to Abdul-Wahed and Al-Awa (2006), ICT policy in Higher Education in Syria reveals that the use of ICT in teaching and learning environment can:

a. provide high quality study plan, auricular and academic activities,

b. enhance institutional and individual capacities,

c. provide enabling structure for course and research, and

d. provide scientific research environment.

2.11 Information Literacy

Another way in which emerging ICTs arc impacting on the content of education curricula stems from the ways in which ICTs are dominating so much of contemporary life and work. Already there has emerged a need for educational institutions to ensure that graduates are able to display appropriate levels of information literacy, "the capacity to identify an issue, locate and evaluate relevant information, in order to solve a problem arising from it" (McCausland, Wache & Berk, 1999). The drive to promote such developments stems from general moves among institutions to ensure their graduates demonstrate not only skills and knowledge in their subject domains but also general attributes and generic skills. Traditionally, generic skills have involved such capabilities as ability to reason formally, to solve problems, to communicate effectively, to be able to negotiate outcomes, to manage time, project management, and collaboration and teamwork skills. The growing use of 1CTs as tools of everyday life have seen the pool of generic skills expanded in recent years to include information literacy and it is highly probable that future developments and technology applications will see this set of skills growing even more (cited in McCausland, Wache & Berk, 1999).

2.11.1 The Impact of ICT on how Students Learn

Just as technology is influencing and supporting what is being learned in schools and universities, so is it supporting changes to the way students are learning. Moves from content - centered curricula to competency - based curricula are associated with moves away from teacher - centered forms of delivery to student - centered forms. Through technology - facilitated approaches, contemporary learning settings now encourage students to take responsibility for their own learning (Jonassen, 1991). The growing use of ICT as an instructional medium is changing and will likely continue to change many of the strategies employed by both teachers and students in the learning process. For example, an increased use of the Web as information source allows internet users to choose the experts from who they will learn.

The use of 1CT in educational settings, by itself acts as a catalyst for change in this domain. ICTs by their very nature are tools that encourage and support independent learning. Students using ICTs for learning purposes become immersed in the process of learning and as more and more students use computers as information sources and cognitive tools (Jonassen, 1991), the influence of the technology on supporting how students learn will continue to increase.

2.11.2. Sustained Staff Development

To help teachers properly complete the "learning cycle" of computer-related professional development, training must he ongoing and systematic (Kinnaman, 1990). In a study examining what hinders or promotes successful integration of technology into the Junior High School curriculum, Persky (1990) noted that using technology is not easy and that learning how to effectively use technology in the context of the classroom does not happen overnight. The need to allot time for continual learning is echoed in studies outside of education, which suggests that providing workers with high technology on the job, ultimately, fails if employees don't receive adequate training and continuing on-the-job support (Moursund. 1992).

Further, this need for continuing support means teacher training must be ongoing and not limited to "one-shot" sessions (Hawkins & MacMillan, 1993; Kinnaman, 1990; Shelton & Jones, 1996). Harvey and Purnell (1995) have stated that teachers want sustained staff development rather than short-term training and development programs in technology.

2.11.3 Link Technology and Educational Objectives

The technological training must have an instructional focus that guides teachers to think first about their curriculum and then helps them address how to integrate technology into the curriculum (Guhlin, 1996; Persky. 1990). Teacher training often isolates technology as a separate discipline and focuses on training for specific computer applications, such as word processing (Persky, 1990: Shelton & Jones, 1996). Focusing on this skill development, however, is problematic since it offers teachers little opportunity to transfer their learning into their classrooms (Shelton & Jones, 1996).

Modern stuff development must do more than simply help teachers embrace technology; it must also anticipate the classroom change that will accompany its widespread use (Guhlin, 1996; Kinnaman, 1990; Persky, 1990; Stager, 1995). This notion of technology as a separate and an isolated entity needs to be significantly altered so that teachers understand how technology can support educational objectives (Boe, 1989).

If educators are going to be convinced to change their practice by integrating technology into their teaching, they must see the relevance of technology to what they do in the classroom (Shelton & Jones, 1996).

2.11.4 Intellectual and Professional Stimulation

The model of staff development for technology must put the teacher - learner at the centre of the learning experience and provide a meaningful context for teaching and learning (Stager, 1995). Teachers need instruction that engages them and forces them to reflect on the benefits and limitations of teaching with technology (Persky, 1990; Shelton & Jones, 1996). When teachers engage with others in ongoing reflection about what they have learned about the instructional use of technology, they are more likely to critically evaluate their own pedagogical practice and redesign their instruction (Persky, 1990).

If technology is to be used by students, then teachers must possess the confidence, and skills to effectively incorporate technology by providing adequate training and development for teachers on how to use integration technology, they can construct knowledge in a more meaningful way with the involvement of their students' discussion, group work and learning by doing without harbouring misconceptions but rather exposing misconceptions and finding remedy to them. The computer aided instruction therefore takes into account all the good aspects of the various learning theories, especially, constructivism.

According to Mereku and Akomolefe (1999), computers can serve as a resource in the three major areas which students in teacher - education programmes should know about. The areas are administration, teaching with computers and computer education. They went on to state that the student - teacher should be exposed to the various forms of tasks the computer could be used to perform.

Computer technology should be a means to an end, not an end in itself. The computer should empower the user to solve problems effectively and efficiently (Forcier, 1999). He gave the reasons why computer studies must be introduced into schools to help teachers and students to become proficient in computer applications about solving everyday problems, and encourage both students and teachers to integrate technology into their professional, academic and personal lives in useful meaningful ways

2.12 Research Methodology

Many questions have been raised concerning the issues of ascendancy of qualitative research as opposed to quantitative research methods (Guba & Lincoln, 1994; Patton, 1990; Tashakkori & Teddlie, 1998). According to Patton (1990), qualitative method of research emanated from constructivist point of view and uses an approach that is inductive and holistic to study human experience within specific environments. Whereas quantitative method is derived from a positivist research paradigm and uses experimental approach to test hypothetical - deductive generalizations, in a quantitative research design, the researcher does not manipulate the research environment since the purpose is to understand how phenomena occur in their natural world and records his findings without applying any treatment. Experimental research of the quantitative approach on the other hand, tries to control the subjects being studied through manipulating, changing, or introducing some factor, in order to measure the behavioural pattern of a set of variables (Patton, 1990). The use of both qualitative and quantitative approaches to research provides inductive and deductive outlook. A researcher is at liberty to use any approach depending on its appropriateness to the research question(s) without necessarily being a student of that school of thought or paradigm. The method that is employed can be separated from the paradigm of which it originated (Patton, 1990).

Due to the fact that the use of both qualitative and quantitative approach to research provides both theoretical and practical insight about what is being studied, both are needed to furnish holistic information on a research study.

CHAPTER THREE

METHODOLOGY

3.1 Overview

This Chapter describes the study site, Research Design, Sampling and Sampling Procedure, Study participants, Study instrument, Field notes, Participant artifacts, Pretest (pilot), Data Collection, Data Analysis Procedure and Protection of Human Subjects.

3.2 Study Site

The study took place at the Inchaban Circuit Junior High Schools in the Shama District with a population of forty - five teachers selected from eight Junior High Schools within the Inchaban Circuit of the Shama District. Inchaban Circuit Junior High Schools are located at the Shama District and in the Inchaban and Aboadze communities. The Schools are located in the industrial and commercial localities within the district with a full complement of teachers on their staff and a few desktop computers which actually facilitated the effectiveness of the intervention strategies.

3.3 Research Design

The research design considered appropriate for this study was descriptive survey. Descriptive survey is non-experimental, in that it concerns itself with relationships between non-manipulated variables in natural, rather than artificial settings. This is also because the phenomenon or condition(s) already occur(s) or exist(s) and for that matter relevant variables are merely selected and observed for analyses of their status. It may, however, involve hypothesis formulation and testing, as well as logical methods of inductive and deductive reasoning in order to arrive at a generalization.

Again, in order to permit future replication, variables and procedures employed in descriptive surveys are described as comprehensively and accurately as possible. It also follows that, in order to estimate and minimize errors, randomization is applied in sampling procedures. This, according to Best & Khan (1989), affords the opportunity to select a sample from the population being studied and then generalized from the sample of the study.

In addition, descriptive survey seeks to find answers to questions through the analysis of relationships between and/or among variables (Fraenkel & Wallen, 2000).This type of research design therefore, seeks to inquire into the status-quo of phenomena without any serious manipulation and control of variables. Much effort is directed towards attempting to measure what exists, without necessarily questioning why that is.

More so, descriptive survey is highly regarded by policy makers where large populations are dealt with mainly using questionnaires. Data gathered by way of descriptive survey in educational research represent field conditions.

This study, therefore, employed a descriptive survey to determine the effect of using integration technology, group work and practical demonstration on the pedagogical skills of basic school science teachers as they participated in some carefully designed instructional activities that try to:

Elicit their misconception about:

a. the solar system concept,

b. the structure of atom, formation of ions and writing of simple chemical equations,

c. engages them in discussions and activities on how to plan and design their own lessons in teaching propagation of light and simple electronics,

d. assist them on how they can effectively employ Information and Communication Technology in teaching and learning of science, and

e. engage them in a discussion on how some misconceptions in science can be corrected.

3.4 Sample and Sampling Procedure

A sample size of forty - five (45) teachers was used for the study. This was made up of the following composition: thirty - three (33) 73% Science teachers and twelve (12) 27% ICT teachers from the eight Junior High Schools. The actual sample was made up of:

a. thirty - two Science teachers, four from each J.H.S., an office staff and,

b. twelve ICT teachers, two from each J.H.S.

Purposive sampling was used to select the respondents at this level. In purposive sampling, the researcher determines the type of respondents who will be appropriate for the study and then select them. Gray (1981) argues that this method allows the researcher to select respondents who he/she believes will be appropriate for the study. Basic School teachers were the target group used for the study, especially J.H.S. science and ICT teachers.

Simple random sampling was used to group the participants in the course of the exercise. The participants were given numbers, which corresponded to the numbers written on pieces of paper. These papers were folded and put into a bowl for participants to pick so that those with common numbers were assigned to a group with the respective number.

The sample for this study was a sample of convenience; the participants were enrolled in course sessions designed by the researcher, who served as instructor for the course. This relationship enhanced the administration and the data collection for the study.

3.5 Study Participants

Some of the teachers who were nominated as group leaders by their respective groups were engaged to lead the class in lesson delivery and other whole class discussion exercises. Science and ICT teachers from the Shama Senior High School were engaged to provide assistance. In addition, a resource person from the Shama District Education Office, in the person of the Science and Mathematics Coordinator, assisted the researcher.

3.6 Study Instrument

The nature of the topic for the study and the level of the target group involved required the use of instruments such as questionnaires, interviews and observations. Greater emphasis was placed on questionnaires, which were closed and open-ended tagged 'strategies in teaching and learning of science in Basic Schools, especially J.H.S. in the Shama District. It consisted of two sections: A and B. Section A sought the demographic data such as: age, sex, class or form that the participant, while Section B contained items developed to elicit information to measure the objectives

3.6.1. Field Notes

During the activities, the researcher observed the participating teachers' performances, and recorded them in a field notebook. Descriptions of situations, events, and dialogues occurring during the exercise were documented.

Patton (1990) describes field notes as the most important task of an observer to preserve the details of an event. Photographs of scenes that took place during the introduction of the interventions were used to amplify the field notes for this study.

3.6.2. Participant Artifacts

The participant artifacts for the study included a training manual from National INSET Centre (NIC) Teacher Training Education Division (TTED) of the Ghana Education Service (G.E.S), activity sheets, reflections and Web quest. Participant artifacts were collected during the course of the study and maintained; and the teachers were given take home exercises to perform.

3.7 Pilot Testing

Copies of the questionnaire were pilot - tested in three Junior High schools in the same circuit to establish the validity and reliability of questions in order to remove ambiguity. Again, the interventional strategies were applied on some teachers in the district to ensure the validity and the reliability of the results. This brought out faults in the structure of the questions asked as well as that of the interventional technique and the necessary modifications were made.

3.8 Data Collection

After carefully selecting the respondents using the appropriate sampling techniques, the respondents were briefed on the questionnaire after which copies were given out to them. The answered questionnaire was collected after five working days (one week).

Patton (1990) argues that when investigating human behaviours and attitudes, it is most fruitful to use a variety of data collection methods. Through the mixed - model design, various sources and methods of data collection are possible, and the evaluation of data can be improved, based upon strengths and weaknesses of each method. In view of this, interviews as well as observations were carried out frequently in the course of the exercise as a means of cross - checking the accuracy of the information collected from the answered questionnaires.

Participating teachers were grouped and asked to prepare and present lessons on some topics like basic electronics, the solar systems, concepts of matter and how to correct some misconceptions in relation to respiration. Some other participating groups acted as students while the other research participants assessed presentations from the groups.

The criteria for the assessment were provided on a pre-typed sheet given to the study participants who filled some portions based upon their observations, and their responses were analysed. The interventional measures on how teachers use practical demonstration, discussions and integration literacy to improve their teaching content skills after discussing the findings by the study participants, comments by the participating teachers and reflection by presenters on the various topics were implemented using a master training manual designed by NIC and TTED.

Participating teachers were asked to do another presentation on similar topics for another assessment.

3.9 Protection of Human Subjects

In research involving humans, it is important that ethics are considered. Since this study involved human beings, ethical considerations such as: proper identification, welfare of respondents, right to privacy, right to anonymity, right to confidentiality, free and informed consent were observed, Fraenkel & Wallen (2000) have stated that the "most important ethical consideration is the fundamental responsibility of every researcher to do all in his/her power to ensure that participants in a research study are protected from physical or psychological harm, discomfort, or danger that may arise due to research procedures" (p.39).

3.10 Data Analysis Procedure

Responses to the questionnaire were analyzed using Excel and Statistical T-test and reported using graphical representations. The pre-interventional questionnaire, which contained 30 items well constructed to reflect the contents of the research questions and to befit the area of study. To overcome the amount of data it presented, some of the items were purposively grouped into cluster of items. A cluster of items then constituted a composite variable which was given an appropriate name. The name represented the common factor of the items making up the variable. This approach lifts discussion up from the items to a more general level (Schreiner and Sjøberg, 2004). However, to identify some interesting stereotypical differences between group profiles, single item analysis were done for some sections of the questionnaire. In this purposive grouping of items, one 'handpicked' the items to be included in the cluster on the basis of content (subject matter areas) and context. This implies that the clusters of items would not emerge from factor analyses. However, the clusters were subjected to reliability analysis with logical reasons to measure the internal consistency within a group of items. Internal consistency is the degree to which the items that make up a scale are all measuring the same underlying attribute (that is, the extent to which the items 'hang together'). Since the items forming one composite variable may not be the best possible selection of indicators or items from the universe of indicators relevant to the name of the variable, the composite variable would not to be considered as a construct, but rather an index representing the clustered items (Anderson. 2006).

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Overview

In this chapter, the analysis of data is presented. Teachers' or participants' responses to the items are then discussed.

4.2 Analysis of Findings Related to Research Questions

4.2.1 Demographic information of participants

Demographic information of participants included the age and sex of respondents; that of the respondents years of teaching; and their areas of specialisation.

Table 4.1: Age and sex of respondents

Sex	Age				Total
	20-25years	26-30years	30-35years	Above 35years	
Male	13 (28.9)	10 (22.2)	5(11.1)	8(17.8)	**36(80.0)**
Female	2(4.4)	4(8.9)	1(2.2)	2(4.4)	**9(20.0)**
Total	**15(33.3)**	**14(31.1)**	**6(13.3)**	**10(22.2)**	**45(100.0)**

Table 4.1 shows that out of the 45 respondents, those within the age bracket of 20-25 years; 13 (28.9%) were males, whilst 2(4.4%) were females. Those within the age bracket of 26-30years, 10 (22.2%) were males, whilst 4(8.9%) were females. 5(11.1%) within the age bracket of 30-35years, were males whilst only 1(2.2%) was a female. For ages above 35yrs 8(17.8%) were males whilst 2(4.4%) were females. The

sample population was made up of 36 males representing 80% and 9 females representing 20%. The population shows a gender imbalance favouring males.

Table 4.2: Respondent's level of teaching

Level	Frequency	Percentage	Cumulative Percent
JHS One	20	44.4	**44.4**
JHS Two	15	33.3	**77.8**
JHS Three	10	22.2	**100.0**
Total	**45**	**100.0**	

Table 4. 3: Respondent's category of training

Institution of training	Years of experience				Total
	0–5Yrs	6–9 Yrs	10–15 Yrs	Above 15 Yrs	
Untrained from Senior High School	2(4.4)	0(0.0)	2(4.4)	1(2.2)	**5(11.1)**
College of Education	5(11.1)	8(17.8)	2(4.4)	3(6.7)	**18(40.0)**
Untrained from University	4(8.9)	1(2.2)	4(8.9)	2(4.4)	**11(24.4)**
Trained from University	8(17.8)	1(2.2)	2(4.4)	0(0.0)	**11(24.4)**
Total	**19(42.2)**	**10(22.2)**	**10(22.2)**	**6(13.3)**	**45(100.0)**

Tables 4.2 and 4.3 show that all the teachers were from the Junior High Schools as and this comprised 15 (33.3%) Integrated Science teachers, 15 (33.3%) I.C.T teachers and 15 (33.3%) Mathematics teachers. Twenty teachers or respondents, that is 44.4% of the total sample population were teaching in JHS one (1), 15 (33.3%) in JHS two and 10 (22.2%) were teaching in JHS three. This means a greater percentage of the total sample population that is 44.4% were teaching in JHS one.

Out of the total sample population, 18 teachers who studied education at the College of Education level (professional teachers) constituted 40%. 11 (24.4%) of the teachers went through University education but never studied education (they were non-professional teachers). The teachers who went to University who studied education (graduate professional teachers) were also 11 constituting 24.4% whilst the remaining 5 (11.1%) were Senior High School graduates who have been employed to teach. This indicated that 29 teachers constituting 64.4% of the total sample population were professional teachers and 16 (35.5%) were unprofessional teachers.

Table 4.4: Respondent's area of specialization

Area of specialization		
	Respondents	**Percentage**
Science	12	26.7
Mathematics	10	22.2
Technical Skills	9	20.0
Social Studies	8	17.8
Others	6	13.3
Total	**45**	**100.0**

Table 4.4 was used to identify the study participants' areas of subject specialisation in their education career, and this has been expressed in percentage.

The illustration in Table 4.4 indicated respondents' areas of subject specialization. Twelve teachers, that is, twenty six point seven percent (26.7%) of the teachers studied Science as their major course of study while 10 (22.2%) majored in Mathematics. Teachers who studied Technical Skills and Social Studies were 9 (20.0%) and 8 (17.8%) respectively. Teachers who majored in subject areas like Agriculture, Home Economics, Basic Education and Special Education were altogether 6 (13.3%). This indicated that out of the total sample population only 12 (26.7%) had a science background.

4.3 Basic School Science Teachers Conceptualize Knowledge in Science

Achieving this result led to inclusion of items in the pre-interventional questionnaire that solicited for information on the calibre of teachers included in the study and how those teachers perceived science teaching. The questionnaire items were used to elicit the views of respondents on the difficulty of teaching science. This was presented in two thematic areas of difficulty associated with the nature of science teaching as identified from the participants. These were views of participants on difficulty in science teaching; and respondent's difficult topics. Areas that were predominant in the respondent's difficult topics were tackled and spoken into and these were the teaching of basic electronics and chemical equations. These are presented in the Table 4.5.

Table 4.5: Views of Participants on Difficulty in Science Teaching

Science teaching rating		
	Respondents	**Percentage**
Very Challenging	12	26.7
Challenging	16	35.6
Interesting	8	17.8
Difficult	9	20.0
Total	**45**	**100.0**

In all, twelve (26.7%) of the participants confirmed that science teaching was very challenging whilst 16 (35.6%) said science teaching was challenging. Eight (17.8%) of the sampled population said science teaching is interesting and 9 (20.0%) difficult respectively. This shows that only 8 (17.8%) saw science teaching as interesting and the rest saw science as challenging or difficult.

Table 4.6: Respondent's difficult topics

	Teachers difficult topics	
	Respondents	**Percentage**
Basic Electronics	16	35.6
Chemical Equations	10	22.2
Solar System	2	4.4
Matter	2	4.4
Atomic Concept	5	11.1
Photosynthesis	2	4.4
Acids and Bases	4	8.9
Others	4	8.9
Total	**45**	**100.0**

Science topics in the syllabus that were considered to be difficult by the teachers or participants have been illustrated in Table 4.6. As shown below, sixteen, representing 35.6% noted basic electronics as a difficult topic whilst 10 (22.2%) indicated chemical equations as the topic they considered to be difficult. Two (2) (4.4%) identified solar system, matter and photosynthesis as difficult topics, 5 (11.1%) said Atomic concept was difficult, 4 (8.9%) said acids and bases was difficult as well as other topics like life processes and force. This shows that majority of the total sample population, that is, 16 (35.6%) saw the teaching of basic electronics as difficult.

Table 4.7: Teaching of basic electronics

Is basic electronics taught		
	Respondents	**Percentage**
Yes	15	33.3
No	16	35.6
Lack of TLMs	6	13.3
Lack of Content Knowledge	8	17.8
Total	**45**	**100.0**

As shown in table 4.7, sixteen constituting 35.6% of the teachers pointed out that they had not been teaching basic electronics whiles 15 (33.3%) stated that they had been teaching the topic. Six (13.3%) said they lack of TLMs as the reason why they were not teaching basic electronics. Finally 8 (17.8%) percent pointed that they lacked the content knowledge. This indicate majority 30 (66.7%) were not teaching basic electronics at all.

Table 4.8: Assessment of teaching of chemical equation

Teachers' assessment of the teaching of chemical equation		
	Respondents	**Percentage**
Very challenging	6	13.3
Challenging	8	17.8
Interesting	10	22.2
Difficult	21	46.7
Total	**45**	**100.0**

The challenges the respondents have been facing in teaching of chemical equations have been captured under Table 4.8. Roughly, 6 (13.3%) indicated that the teaching of chemical equations is very challenging, 8 (17.8%) said it was a challenging topic, 10 (22.2%) of the remaining respondents indicated it was an interesting topic whereas 21 (46.7%) said they had been teaching with difficulties. This implies majority of teachers 35 (77.8%) found difficulty in the teaching of chemical equations.

4.3.1 Discussion for tables 4.5, 4.6, 4.7 and 4.8

The scope of educational background of participants ranged between professional teacher to non-professionals with different levels of academic and professional qualifications. The presence of non-professional teachers in the Shama District Education Service is not an uncommon occurrence in Ghanaian schools. It is mostly marked in the rural areas in Ghana. For example, the sample in this study recorded 29 (64.4%) non-professional teachers as opposed to 16 (35.5%) professional teachers.

The presence of non-professional teachers in schools has also been noted by Ashton and Crocker (1987). A study conducted by Ashton and Crocker showed a stronger, and more consistently positive, influence of education and pedagogical coursework on teacher effectiveness. Studies conducted by Monk (1994) compared the effect on students' achievements in mathematics and found positive relation between teachers' education and pedagogical coursework and students' achievement in mathematics. If there is such evidence that the kind of training given to teachers at Pre-service institution can influence their pedagogical content knowledge and students' academic achievement, then, the number of teachers who had not been to teacher training institutions (Non-professional teachers) is quite significant 29 (64.4%).

Again, the result revealed that some teachers who teach science majored in areas other than science. This is in line with the study conducted in the United States in which 42% to 49% of public Grades 7 to 12 teachers of science and mathematics lacked a major and or full certification in the field they were teaching (Ingersoll 2003). A recent survey conducted by Maagan (2007) (cited in Ingersoll, 2003), even though others have argued that, teachers' area of study and advance academic qualifications had only marginal and statistically non-significant positive relationship with student achievement, I bet to differ from such argument on the basis that some teachers indicated they were not teaching some topics, because they had no knowledge about these topics which could mean that they never had lessons on them at their time of schooling.

4.4 Nature of Classroom Interactions

In an attempt to find out the nature of classroom interactions created by participated teachers and the impact of such interactions on learners' understanding, items requesting for teaching techniques and TLMs used during participants' lessons delivery were included in the questionnaire which include the items on the following themes: approach used by basic school science teachers in lesson delivery; and participants' sources of teaching and learning materials.

4.4.1 Approach used by Basic School Science Teachers in Lesson Delivery

These items seek information about how the teachers interact in classroom due to their beliefs about teaching and learning of science. The information obtained is presented in Table 4.9.

Table 4.9 Approach used by basic school science teachers in lesson delivery

Items	**Responses from Questionnaire**		
	A (%)	**D (%)**	**Total (%)**
1. Engagement of students in discussions to arrive at conclusions is good (ESDG)	31 (68.9)	14 (31.1)	**45 (100)**
2. Teacher lectures students in class (TLSC)	29 (64.4)	16 (35.6)	**45 (100)**
3. Students read major points after explanation(SRMPE)	29 (64.4)	16 (35.6)	**45 (100)**
4. Notes are given in the teaching of subject matter (NGTSM)	28 (62.2)	17 (37.8)	**45 (100)**
5. No discussion with students because they have no facts (NDSNF)	15 (33.3)	30 (66.7)	**45 (100)**

Key: **A** – Agree; **D** - Disagree

Table 4.9 describes the skills teachers used and how they found the teaching of science lessons in the classrooms, as to whether class discussion is good (**ESDG)** way of presenting science lessons. Thirty – one (68.9%) of the respondents agree, but the remaining population remained indifferent. Twenty – nine (64.4%) of the teachers agreed that teachers should be the pivotal point of teaching (**TLSC)** and they should also give information to the students to copy, whiles 16 (35.6%) disagreed. Twenty - nine (64.4%) of the respondents agreed that learners must read for their facts after the teacher has explained some points to them **(SRMPE)** and 17 (35.6%) did not give any response or disagreed. Twenty - eight (62.2%) of the teachers agreed that teachers should be the pivotal point of teaching (**TGTSM)** and they should also give information or notes for the students to copy, whiles 17 (37.8%) disagreed. On the issue about the difficult nature of science teaching and that notes giving is used, 28 (62.2%) agree to the statement but 17 (37.8%) said the nature of science teaching was easier. Finally, 15 (33.3%) of the respondents agreed whiles 30 (66.7%) of them disagreed to the statement that, "students have no facts for class discussions **(NDSNF)"**.

4.4.2 Participants' sources of teaching and learning materials (TLMs)

This item also sought to identify whether teachers' or participants' used teaching and learning materials (TLMs) and the sources they obtained these TLMs in teaching science. This is presented in Table 4.10.

Table 4.10: Participants' sources of teaching and learning materials (TLMs)

Item	Respondents	Percentage
School lab or Science kit	5	11.1
Market	5	11.1
Improvisation	11	24.4
Do not use any	17	37.8
Others	7	15.6
Total	**45**	**100.0**

According Table 4.10, teachers had diverse means of obtaining teaching and learning materials when it came to the teaching of science. Seventeen (37.8%) of the participants indicated they never used TLMs in teaching whilst 28 (62.2%) indicated they had been using the TLMs but indicated different sources through which they got them. Out of the 28 (62.2%), 11 (24.4%) indicated they provide their own TLMs through improvisation and 5 (11.1%) also indicated they obtained them from the school laboratory or science kit and the open market. The other seven constituting (15.6%) indicated that they obtained them from their students and surroundings. This indicates that more than a third of the teachers did not teach with TLMs.

4.4.3 Discussion

The different strategies that the teacher adopts to communicate his/her learning materials are called teaching techniques. For effective science teaching, the teacher should have the ability to create a productive and supportive learning atmosphere for students to conceptualize information, master skills and develop their mind to optimum level (Erinosho, 2008). Learning atmosphere can be created from three teaching styles: discipline - centred, teacher - centered and student - centred (Woods, 2005). Both discipline and teacher-centred approaches make learners passive and regurgitate content without making any effort to apply or transfer content to real life situations. The focus of these two teaching style is transmission of information and to help students in the mastering of facts through illustrations, lecturing and explanations for examination purpose. Learning of concepts tends to memorization since student-teacher interaction is minimal (Erinosho, 2008; Woods, 2005).

Student - centred approach on the other hand, plays emphasize on how learners conceptualize and assimilate information by making use of learner's cognitive abilities and interest (Erinosho, 2008). The teacher serves as a facilitator, whose active role is to ensure that learners take active role in their learning by motivating the learner to conduct his/her own investigations, develop ideas and be ready to discuss ideas with other students for criticisms.

Although 31 (68.9%) (**ESDG**) of the teachers agreed that students had facts for class discussion which could have served as basis for student-centered style of teaching. Twenty-eight (28) (62.2%) of the teachers were in favour of teacher-centred approach (**TLSC** and **NGTSM**). This contradicts their own judgment and is even a reflection of the kind of classroom environment being created by majority of the participants at the basic schools, where learners should learn science by doing. Moreover, in science resources serve as teaching and learning aids. Those that support teaching are classified as teacher-centred aids, whereas those that support learning are under the category of student-centred aids. Any of them (teacher-centred or student-centred aids) is selected by the teacher based on their availability, efficiency and appropriateness for the learning context (Erinosho, 2008). According to Erinosho

(2008), the non-human teaching and learning materials that are not available must either be purchased or improvised from the locally available materials. This means that for effective teaching and learning, a teacher must be innovative and have the ability to use the hands and brain to teach in a meager resourced classroom environment. It was therefore not surprising when 28 (62.2%) of the teachers indicated they had been using teaching and learning materials (TLMs) in their lesson delivery as indicated in Table 4.10. This indicates that the importance of using TLMs to facilitate teaching and learning was not new to the participants, but their availability and suitability was a subject for contemplation as shown in Table 4.10. This also connected to the idea of integrating ICT in teaching and learning of science as shown on tables 4.11 and 4.12. This will reduce teachers' burden of struggling for suitable TLMs. On this note it can be surmised that if teachers combine a teaching method that is teacher-centred with learner-centred aids, learners will be profitably engaged in searching for and conceptualizing knowledge in a more meaningful way that will reduce misconceptions.

4.5 Effect of Integrated Technology and Group Work through Conceptual Change Approach on Basic School Teachers' Content Knowledge and Pedagogical Skills

In evaluating the participants' knowledge on Integrated Technology using ICT as a base and group work in teaching science, some questions were included in both pre-interventional and post-interventional questionnaires.

4.5.1 Participants' Knowledge on Integration Technology

This section assesses the percentage of participants having ICT knowledge before the introduction of the intervention. Views elicited from respondents on integration technology are displayed in the Tables 4.11 and 4.12.

Table 4.11: Teacher's access to computer

Item		Respondents	Percentage
Access to	Yes	18	40.0
computer	No	27	60.0
Total		**45**	**100.0**

In a pre-interventional analysis on teachers' knowledge about information and communication technology (ICT) (Tables 4.11), 18 (40%) indicated their knowledge about the technology, whereas 27(60%) said they did not have any knowledge about the technology before the introduction of the intervention strategies.

Table 4.12: Teacher's usage of Computer

Item	Respondents	Percentage
Uses computer to access mails	6	13.6
Uses computer in watching movies and playing songs	5	11.1
Sometimes uses internet when preparing notes	7	15.6
Uses computer to type letters	9	20.0
Uses computer to do all the above	7	15.6
Do not know how to use computer	11	24.4
Total	**45**	**100.0**

Items on usage of computer of the post-interventional questionnaire tried to find out about the knowledge gained by participants after going through the training of using integration technology as a technique for conceptual change. The information gathered from participants is presented in Table 4.12.

Those who said they used computer to access their mails, play music and watch movies, prepare notes and type letters were 6 (13.6%), 5 (11.1%), 7 (15.6%) and 9 (20.0%), respectively. A number of teachers representing 11 (24.4%) of the total sample said they did not know how to use computers (Table 4.12).

Table 4.13: ICT knowledge gained by Participants after the intervention

Items	Frequency	Percentage
Acquired computer knowledge	21	46.7
Had little time and interest in computer use	12	26.6
Upgraded knowledge in the use of computer	5	11.1
Ability to use computer to teach science	7	15.6
Total	**45**	**100.0**

Table 4.13 presents the knowledge that was gained by the teachers after the interventional strategies on the use of integration technology was introduced. Those who indicated that they had acquired knowledge on introduction to computer studies were 21 (46.7%) and 12 (26.6%) said they had little time and interest in the use of computers. Again, 5 (11.1%) said they had upgraded their knowledge on the use of computers while 7 (15.6%) confirmed their ability to use computer to teach science and also instruct their students on what to do. This indicated that a greater percentage of participants 33 (73.3%) gained if not new, an additional knowledge in use of computers.

Table 4.14: Teachers' level of satisfaction on the integration technology

Items	Frequency	Percentage
Highly satisfied	18	40.0
Satisfied	18	40.0
Unsatisfied	9	20.0
Total	**45**	**100.0**

On the integration technology after the post-intervention, questionnaire sought for the satisfaction level of the participants after going through the training on conceptual change approach. Three levels of satisfaction were captured and have been presented in Table 4.14.

Teachers' level of satisfaction on the implementation of the interventional strategies was assessed and as shown in Table 4.14, 80% indicated they were highly satisfied or satisfied. However, 9 (20%) indicated they were not satisfied with the implementation of the interventional strategies. This shows that teachers appreciated the improvement in their teaching approach.

4.6 Students' Understanding in Science as a result of Teachers' Concept Formations and Teaching Techniques

The influence on students' understanding in science by the basic school science teachers' concept formations and teaching techniques assessed here. In a way of finding answers to this question, some questions that try to fish for misconceptions from the participants were included in the questionnaire to investigate how the participants understand scientific concepts. This section was assessed under the following themes: students' concept formation in science; and some misconceptions on geocentric, matter and atom were also looked at in this section.

4.6.1 Students' Concept Formation in Science

The rising and setting of the sun; definition of matter; the smallest indivisible particle; and atoms are divisible were some of the conceived misconception topics in science that were looked at.

Table 4.15: The rising and setting of the sun

Items	Respondents	Percentage
The sun moves to East during morning and West during evening	5	11.1
The sun moves to the eastern and western corridors all the time	6	13.3
The sun moves round the earth	5	11.1
The earth rotates round the sun	24	53.3
None of the above	5	11.1
Total	**45**	**100.0**

Table 4.16: Definition of matter

Definition	Respondents	Percentage
Anything that has weight and volume	9	20.0
Anything that has volume and occupies space	4	8.9
Anything that has mass and occupies space	28	62.2
None of the above	4	8.9
Total	**45**	**100.0**

Table 4.17: The smallest indivisible particle

	Frequency	Percentage
Molecule	5	11.1
Ion	5	11.1
Atom	20	44.4
None	15	33.3
Total	**45**	**100.0**

Table 4.18: Responses to the question; Are atoms are divisible?

Response	No. of Respondents	Percentage
True	30	66.7
False	10	22.2
Not sure	5	11.1
Total	**45**	**100.0**

4.7 Some Misconceptions about geocentric, matter and atom

As reflected in Table 4.15, there were some misconceptions that were conceived by the respondents. The table shows that 21 (46.7%) of the respondents expressed the view that "the Sun really moves from one position to another" while 24 (53.3%) said the "Sun does not move at all". In Table 4.16, 28 (62.2%) defined it as "Matter is anything that has mass and occupy space" where as 9 (20%) said "matter has weight and volume". 4 (8.9%) expressed that, "matter has volume and can occupy space". The remaining 4 (8.9%) were not sure of the given definition. As to whether the atom is divisible or not, 5 (11.1%) were not sure. While 10 (22.2%) indicated that the atom is indivisible and the remaining 30(66.7%) said it is divisible (Table 4.18).

Table 4.19: Respiration is exchange gases in organisms

Items	Frequency	Percentage
True	31	68.9
False	14	31.1
Total	**45**	**100.0**

This item sought information from teachers on whether respiration is really about gaseous exchange. The respondents were to comment by indicating whether the statement “respiration is gaseous exchange” is true or false. Their views are presented on the Table 4.19.

Participants’ views about respiration in Table 4.19 show 31 (68.9%) indicated that respiration is gaseous exchange whilst the remaining 14 (31.1%) opposed the idea.

Table 4.20: Easy acquisition of acids and bases in your area

	Respondents	Percentage
Yes	15	33.3
No	25	55.6
Not sure	5	11.1
Total	**45**	**100.0**

This item tried to find out the perception of teachers on scarcity of acids and bases; why they consider acids and bases as scarce commodity. The opinions of the participating teachers are presented in Table 4.20

A fraction of the participants representing 5 (11.1%) was undecided on where to get acids and bases from, whereas 25 (55.6%) knew that acids and bases were available but could not identify their sources. Again, 15 (33.3%) proved that acids and bases could easily be obtained from the laboratory. Among those who said acids cannot easily be obtained, 5 (11.1%) said acids and bases are not common in our environment, 7 (15.6%) affirmed that acids and bases are dangerous substances with the remaining 5 (11.1%) saying acids and bases are very difficult to obtain. Finally, 8

(17.8%) said acids and bases can be found from fruits and other natural sources and alcohol from fermented plants and fruits.

Table 4.21: Explanation of Basic electronics

Items	Respondents	Percentage
It deals with the drawing of electron configuration of atoms	10	22.2
It deals with the design and application of electronic circuits devices	25	55.6
It deals with the study of transistors	5	11.1
It is about the study of battery powered gadgets	5	11.1
Total	**45**	**100.0**

This item presents participants' ideas about a simple definition for basic electronics. The various views were categorized under four sections:

As shown in Table 4.21, 25 (55.6%) of the teachers defined basic electronics as the design and application of electronic circuits and 10 (22.2%) classified it as arrangement of electrons on their shells (electronic configuration). A portion of them, that is, 5 (11.1%) in each case defined basic electronics as the study of transistors and the study of battery powered gadgets, respectively.

4.7.1 Discussion

Even though Teachers have a very significant role in realization of the correct educational concepts, the modern educational approaches put much emphasize on the student. These modern approaches require students to be more active in the classroom and participate at all levels (Demirel, 2005).

After analyzing the results of this study, it was observed that there were quite a number of misconceptions that existed among teachers who took part in the programme. For instance, 5 (11.1%) of the participants were of the view that the sun moves gradually from East during the mornings and sets at West in the evenings. The issue of Heliocentricity (the sun is the centre of the universe) and Geocentric (having earth at the centre of the universe) became a subject of debate in the early 16th century where the cosmology that was eventually replaced by Copernican theory postulated a geocentric universe in which the earth was stationary and motionless at the centre of several concentric, rotating spheres (Robert, 2003; Yip, 1998; Sanders, 1993). These spheres bore (in order from the earth outward) the following celestial bodies: the moon, Mercury, Venus, the sun, Mars, Jupiter, and Saturn. Others also buttressed their geocentric views with the story in the bible, where Joshua prayed for the sun to stand still (Robert 2003). Perhaps, those who are saying that the earth really moves from the East to West have been influenced by these stories (Yip, 1998; Sanders, 1993).

Although, 24 (53.3%) of the teachers indicated that the sun does not move, they could not demonstrate with appropriate teaching and learning materials. Those who tried to demonstrate it used a flash light and a globe but the globe never went round the flash light. Others, although tried their best by using models, there was no movement of any of the model planets.

The improper way of presenting lessons on solar systems couple with the story in the book of Joshua might be the prime factors that generated the misconception that the earth does not move but rather the sun.

A power point presentation was used to correct the above misconception. Thus, during one of the skills in integrated technology, participants were taught about the use of the computer in presenting the revolution of the earth, and its movement around the sun. After follow-ups to some of the schools, where the participants teach, it was evident that majority of the learners had adopted the idea that the earth moves around the sun.

A significant number of misconceptions were recorded on the definition for matter, while some said matter is anything that has weight and volume, others believed that matter has volume and can occupy space. This may be due to the fact that some of the teachers had little knowledge about the concept of volume, mass and weight. This is obvious since some indicated that matter has volume and can occupy space forgetting that the amount of space occupied by a substance is its volume.

The misconception was very significant when the data on whether the atom is divisible were analysed. Fifteen (33.3%) of the teachers indicated that atom is indivisible. This misconception might have been due to some of the definitions people have about atom that “it is the smallest indivisible part of an element”. Those who define the atom this way may be compelled to say that the atom is indivisible. These teachers definitely had problems with formation of ions and ionic compounds.

No wonder, 21 (46.7%) of the teachers indicated that they had problems with the teaching of chemical equations and formation of chemical compounds.

According to Ozmen and Demircioglu (2003), in the mist of misconceptions, it is important to find approaches to eliminate them, so teachers were engaged in group activities where each group was asked to describe an atom using a well labelled diagram. Participants were also engaged in lessons on formation of ions where a CD-ROM labelled essential study partner was used to demonstrate how atoms lose or accept electrons to become ions. The misconception was remedied by their own diagrams after labelling the various parts of the atom. Participants were more relaxed and convinced when they saw electrons moving from one atom to the other. The question that arose was “Is it possible for something that is not divisible to give out a portion (electron) of it? Or “how is it possible for something that is not divisible has parts?” As said earlier, the diagrams and the presentation from the internet were able to convince the teachers that atom is divisible.

The results also exposed some misconceptions teachers had about acids. Some of the participants considered an acid as something that cannot be obtained easily, since, it is dangerous and also difficult to obtain. These participants harboured this misconception mainly because they had perception about the corrosive nature of acid. Many people associate acid to something that is highly corrosive and may not want to even go near it when they hear the name. This misconception has influenced the perceptions people have about acids (Ozmen & Demircioglu, 2003).

The difficulty nature about the teaching of basic electronics, which is a new topic in the science syllabus also exposed misconceptions about the idea of what the basic electronics is all about. Teachers who thought basic electronics deals with the study of transistors might have linked the two, since the study of transistors is a sub-topic under basic electronics. Others who linked it to the study of electron configuration might have coined the meaning of the basic electronics from the word electron, which qualifies the word configuration as in electron configuration. They based their facts on what they had already heard.

In an attempt to agree with Orphan (2004) (cited in Forcier, 1999), contemporary learning process experimentation, application, and observations of circuit boards were used to encourage teachers to conceptualize knowledge about basic electronics. Teachers were taken through a course on the functions of the electronic components using the internet, since some of the participants argued that teaching materials on the subject matter were not available. Participants were also engaged in group activity, where they were asked to go to Ministry of Education website and download the science syllabus for their studies since some were of the view that basic electronics were not part of the syllabus.

4.8 Participants' Opinions on Working in Groups

Table 4.22A: Views on group work

Responses	Percentages of the respondents
Interesting	12 (26.7%)
Eye opening	9 (20%)
Encouraging	18 (40%)
Not effective	6 (13.3%)

Table 4.22B: Views on individual work

Responses	Percentages of the respondents
No interruption	8 (17.8%)
Yield low performance	15 (33.3%)
Very challenging	12 (26.7%)
Less time consuming	10 (22.2%)

Table 4.22A shows the views of participants on the effectiveness of group work. Eighteen (18) (40%) of the participants indicated that group work is encouraging, 12 (26.7%), group work is interesting. Nine (9) (20%) indicated that group work is eye opening, whereas 6 (13.3%) not effective.

In Table 4.22B, 10 (22.2%) indicated that working as individuals is less time - consuming, whilst 12 (26.7%) was of the view that working as an individual is very challenging. Fifteen (15) (33.3%) of the remaining population indicated that individual work yield low performance as compared to group work whilst 8 (17.9%) expressed that there is no interruption in individual work.

4.8.1 Discussion

Integration technology, group work and demonstrative experiments based on the conceptual change approach is very effective in eliminating the teachers' misconceptions of the topics discussed above because these strategies applied in the conceptual change approach explain misconceptions between scientific information and existing information. The results of this study are in line with previous studies by Kose, Ayas and Usak (2006), and Baser and Geban, (2007).

In support of Mereku and Akomolefe (1999) statement that computers can serve as a major area of resources for students in teacher education programme, the use of integration technology was found useful in the study, since teachers could obtain their TLMs from the internet (Table 4.11) without thinking of improvisation or buying them from the market. Again, since the 2007 educational reform emphasized integration technology in all the subjects, teachers who had little or no knowledge in ICT were motivated to take up the mantle and improve their skills in ICT. The teachers or participants knowledge in ICT was not encouraging (Table 4.13) but after the introduction of the integration technology, it raised the moral of the participants because the gained enough knowledge and their level of satisfaction were boosted as captured under Table 4.14.

In this study, it was found that the strategies applied in conceptual change approach using integration technology, group work and demonstrative experiments were much more effective ways of dealing with misconceptions. Therefore, the application of the conceptual change approach will make an important contribution to the elimination of misconceptions of in-service teachers in other related science topics.

The use of integration technology was found useful in the study since teachers could obtain their TLMs from the internet without thinking of improvisation or buying them from the market. Again, since the 2007 educational reform emphasized integration technology in all the subjects, teachers who had little or no knowledge in ICT were motivated to take up the mantle and improve their skills in ICT. Moreover, the study have unveiled that the study of science requires the active involvement of the learner as opposed to cases where teachers believe that "spoon feeding" the learner is the best way, such as indicated in the study where many teacher-centred approaches were dominant.

Again, participants confirmed that working in groups is more effective and enhances learning than working as individuals even though working as individuals has it merits as shown in Table 4.22 A&B. This may positively influence the teaching techniques of participants as they teach science at the Junior High School level.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATION

5.1 Overview

This chapter summarises and concludes the study as well as recommends possible ways of improving the study. It talks about the misconceptions that came out from the participants, the possible ways that might lead to conceptualization of these misconceptions, results obtained from participants on the issues about integration technology and group work.

5.2 Summary

This research revealed that basic school science teachers hold some misconceptions which can influence their students' understanding. It also appears that some teachers who indicated that they lacked content knowledge in some topics and others who did not identify the existence of some topics in the syllabus may have difficulties teaching science and this is an indicator to the emergence of misconceptions in science classrooms. This argument is based on that fact that a teacher must be knowledgeable and well-versed in his teachable subject area so that he/she can carefully select activities that will engage learners to acquire new knowledge and skills in the learning experiences.

Moreover, the types of misconceptions elicited from the teachers were in relation to topics they had been teaching; this suggests that there had been impartation of misconceptions from these teachers to the students they taught over the years. One of the effects may be students' low performance in science.

Although, some teachers indicated that they either knew how to use the computer or heard about integrated technology, only 14 (31.2%) indicated that they used internet to prepare their notes. However, at the end of the training program, participated teachers could not hold their enthusiasm. They started jubilating and showing appreciation for getting the opportunity to abreast themselves with the technological age. This revelation holds the basis of encouraging science teachers on the use of Integrated Technology in Ghanaian classrooms due to that fact that it encourages learners to work on their own pace, communicate with both teachers and colleague students on a subject matter, work independently, get reliable and appropriate TLMs and challenges students to compete globally.

5.3 Conclusion

This study shows that the integration technology and group work through conceptual change approach can serve as a legitimate alternative to other teaching techniques, such as lecture and notes taking which are frequently used in science courses. This study also provides evidence that the tools used for the study – integration technology, group work and demonstrative experiment can help in clearing misconceptions from our science classrooms, but for the implementation of integration technology for effective teaching and for that matter science teachers should be taken through the basic computer training programmes like introduction to computer and information technology and also stakeholders of education in Ghana must furnish schools with computers.

5.4 Recommendation

For effective science teaching, the teacher should have the ability to create a productive and supportive learning atmosphere for students to conceptualize information, master skills and develop their mind to optimum level, should be taken through the basic computer training programs like introduction to computer and information technology and modern comprehensive approach of teaching science.

Integration technology, group work and demonstrative experiments based on the conceptual change approach would be very effective in eliminating the teachers' misconceptions of the topics highlighted in the research, these strategies applied in the conceptual change approach explain misconceptions between scientific information and existing information, hence should be inculcated in the training of science teachers in the colleges of education and universities.

Science teachers should use of integrated technology in Ghanaian classrooms due to that fact that it encourages learners to work on their own pace, communicate with both teachers and colleague students on a subject matter, work independently, get reliable and appropriate TLMs and challenges students to compete globally.

Since this study was carried out with small sample size, it is recommended that large sample size should be used to verify result obtained.

An instruction method is supposed to eliminate the misconceptions and increase the achievement of students. A comparative study should be made for other teachers in different schools in different districts in different regions.

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APPENDIX 1

Questionnaire

THIS QUESTIONNAIRE SEEKS INFORMATION ON HOW TEACHERS IN BASIC SCHOOLS CAN CONTRIBUTE TO THE CONCEPTUAL CHANGE APPROACH OF TEACHING AND LEARNING OF SCIENCE. ANY INFORMATION GIVEN WILL BE TREATED AS CONFIDENTIAL WITHOUT DISCLOSING YOUR IDENTITY TO ANY PERSON OR INSTITUTION.

STRATEEGIES IN TEACHING AND LEARNING OF SCIENCE AT BASIC SCHOOLS IN SHAMA DISTRICT OF WESTERN REGION OF GHANA.

[Pre-Intervention Questionnaire]

SECTION A

CODE

You are kindly requested to respond by ticking the box that is in front of the word, phrase or sentence which corresponds to your reaction.

1. Sex: Male [ ] Female [ ]
2. Age: Below 20yrs. [ ] 20 – 25 yrs [ ] 26 – 30 yrs [ ] Above 30 yrs [ ]
3. Class teaching: Lower primary [ ] Upper primary [ ] JHS [ ]

Section B

1. Category of teaching:

   Trained from college of education [ ] Graduate trained [ ]

   Untrained from secondary level [ ] Tertiary untrained [ ]

2. How many years have you been teaching?

   0 – 5 yrs [ ], 6 – 10 yrs [ ] 10 – 15 yrs [ ] Above 15 yrs [ ]

3. Which area did you major in your course of study?

   Science [ ] Mathematics [ ] Home Economics [ ]

   Other specify …………………………………………………………………………

4. How do you rate your way of science teaching?

   Very challenging [ ] Challenging [ ] Interesting [ ] Slightly difficult [ ]

5. Where do you mostly get comprehensive materials to teach science topics?

   ………………………………………………………………………………

6. Do you always get information from the source in Q. 5 above?

   Yes [ ] No [ ]

   If yes skip to Q.7, if no what do you do to such topics?

   ……………………………………………………………………………………………

7. Where do you get teaching and learning materials (TLMs) to teach science topics?

   I get them from school resource centre [ ]

I buy them from market [ ]

I construct them personally [ ]

I do not use them because our school has no laboratory [ ]

Specify if any other..………………………………………………………………..

8. How do you rate students' understanding in a situation where TLMs are used and where they are not used in teaching?

……………………………………………………………………………………

……………………………………………………………………………………

……………………………………………………………………………………

Teacher's pedagogical content knowledge

9. Which topics in science do you find difficult to teach?

……………………………………………………………………………………

10. Have you been teaching basic electronics since its introduction?

Yes [ ] No [ ]

If yes, are you able to present the content successfully? ………………………………

If no, why? …………………………………………………………………………

11. How do you assess yourself if you have been teaching how to write chemical equations under matter?

……………………………………………………………………………………

……………………………………………………………………………………

12. The sun rises from the east and sets in the west means:

The sun moves to east in the morning and to west in the evening [ ]

The sun moves towards the eastern and western corridors at all time [ ]

The sun rest at west and start moving from the east during the next day [ ]

The earth rotates around the sun [ ]

13. One of these best describes matter:

Anything that has weight and volume [ ]

Anything that has volume and can occupy space [ ]

Anything that has mass and can occupy space [ ]

None of the answers can describe matter [ ]

14. Which of the following is the smallest indivisible particle?

Molecule [ ] Ion [ ] Atom [ ] None [ ]

15. Respiration is the process whereby living organisms exchange gases.

True [ ] False [ ]

16. Plants exhale carbon dioxide during the day and oxygen during the night.

True [ ] False [ ]

17. Apart from buying acids and bases from shops, is it easy to get them?

Yes [ ] No [ ]

If yes where, and if no

…………………………………………………………………

18. Atoms can never be divided into simpler forms.

True because ………………………………………………………………………….

No because..……………………………………………………………………….

I am not sure of the answer [ ]

19. Photosynthesis occurs in green plants only.

Agree [ ] Disagree [ ] I am not sure [ ]

20. How will you explain basic electronics to your student?

It deals with the drawing of electron configurations of atoms

It deals with the design and application of electronic circuits devices

It deals with the study of transistors

It is about the study of battery powered toys

Teachers' knowledge in information technology

21. I use computer to assess my mails

I use computer for watching movies and playing of songs

I sometimes use the internet when preparing my notes

I use the computer for typing letters

I use computer to do all the above

I do not know how to use computer

22. Do you have access to computer?

Yes [ ] No [ ]

23. Which of these resources have you heard about?

Skool [ ] Encarta [ ] Internet [ ] Study partners [ ]

All of them [ ] None of them [ ]

24. If you have heard about any, in what way can it be beneficial to a science teacher?

……………………………………………………………………………………………

……………………………………………………………………………………………

……………………………………………………………………………………………

……………………………………………………………………………………………

Pedagogical teaching skills

25. I mostly engage my students in class discussions to arrive on what they should achieve. Agree [ ] Disagree [ ]

I mostly give notes to my students as I teach them the subject matter.

Agree [ ] Disagree [ ]

I ask students to read after explaining the major points

Agree [ ] Disagree [ ]

26. Although practical demonstrations enhance student understanding:

I do not engage my students in activities that involve practical work

Agree [ ] Disagree [ ]

Students learn better when they are given notes than engaging them in practical activity

Agree [ ] Disagree [ ]

I do not discuss lessons with students because they do not have facts in science.

Agree [ ] Disagree [ ]

It depends upon the students you dealing with [ ]

APPENDIX 2

FIELD NOTE

DATE\TIME OF PRESENTATION:

APPENDIX 3

Post-interventional Questionnaire

GROUP MEMBERS' COMMENT

PLEASE READ AND RESPOND TO THESE QUESTIONS

CODE:

1. How do you assess group work as compared to individual's work?

   …………………………………………………………………………………………

   …………………………………………………………………………………………

2. What would you have done if you had worked as an individual?

   …………………………………………………………………………………………

   …………………………………………………………………………………………

3. Would that thing had been better that what your group did?

   …………………………………………………………………………………………

   …………………………………………………………………………………………

4. Did you observe or find out that most of the group members were contributing to your group work?

   …………………………………………………………………………………………

   …………………………………………………………………………………………

5. What role did you play as a group member?

………………………………………………………………………………………………

………………………………………………………………………………………………

6. List any two contributions from your group members that impressed you or unimpressed you.

………………………………………………………………………………………

………………………………………………………………………………………

7. Did you learn any new thing from your group? Yes\No. If yes, how will that thing benefit you as a teacher?

………………………………………………………………………………………

………………………………………………………………………………………

8. Do you think your students can enhance their understanding in science by engaging them in group work?

………………………………………………………………………………………

………………………………………………………………………………………

9. Group work is time consuming and does not produce better result. How do you react to this statement?

………………………………………………………………………………………

………………………………………………………………………………………

APPENDIX 4

Post-interventional Questionnaire

USING INTEGRATION TECHNOLOGY BASED ON CONCEPTUAL CHANGE APPROACH TO TEACH SCIENCE IN BASIC SCHOOL LEVELS IN SHAMA DISTRICT OF WESTERN REGION.

You are pleased entreated to provide frank and dispassionate answers to the question items to make the project work a success. Information provided will be treated confidentially. Thank you.

PLEASE TICK OR WRITE WHERE APPROPRIATE

SECTION A

Background information

1. Sex: Male [ ] Female [ ]
2. Age Range: 21-30 [ ]
   31-40 [ ]
   41-50 [ ]
   51-60 [ ]
3. Academic and Professional Qualification
   Diploma [ ]
   1st Degree [ ]
   Higher Degree [ ]

4. Did you have any knowledge in ICT before you joined this programme?

Yes [ ] No [ ]

5. Do you think ICT is relevant to our current education system?

Yes [ ] No [ ]

6. Are you aware that every teacher needs skills about the use of ICT?

Yes [ ] No [ ]

7. Do you think the duration for the programme was enough?

Yes [ ] No [ ]

8. What knowledge have you gained from the programme?

……………………………………………………………………………………………

……………………………………………………………………………………………

9. What are some of the problems you identified from the programme?

……………………………………………………………………………………………

10. How will you assess the trainer in terms of his organizational and teaching ability?

Not good [ ] Good [ ]

Better [ ] Best [ ]

11. How will you rate your satisfaction of the programme?

Not Satisfied [ ] Satisfied [ ] Highly Satisfied [ ]

12. Do you have any recommendation on the programme?

Yes [ ] No [ ]

If yes, state them

……………………………………………………………………………………………

……………………………………………………………………………………………