UNIVERSITY OF EDUCATION, WINNEBA

EXAMINING J.H.S MATHEMATICS TEACHERS' PERCEPTION AND USE OF THE PRINCIPLES OF CONSTRUCTIVISM IN THE EFFUTU MUNICIPALITY

DAVID KWAME DOTSE

2017

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DEPARTMENT OF BASIC EDUCATION

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DAVID KWAME DOTSE

(8150030002)

A THESIS IN THE DEPARTMENT OF BASIC EDUCATION, FACULTY OF EDUCATIONAL STUDIES, SUBMITTED TO THE SCHOOL OF GRADUATE STUDIES, UNIVERSITY OF EDUCATION, WINNEBA, IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF THE MASTERS OF PHILOSOPHY IN BASIC EDUCATION

OCTOBER, 2017

DECLARATION

STUDENT'S DECLARATION

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

SIGNATURE:……..

DATE:……..

SUPERVISOR'S DECLARATION

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

NAME OF SUPERVISOR: DR. JOSEPH NYALA

SIGNATURE:……

DATE:……

ACKNOWLEDGEMENT

My first and most important acknowledgement is to God almighty for giving me the strength and wisdom to successfully complete my study in the University of Education, Winneba. I would like to show gratitude to my father, Mr. Theophilus Dotse, and my mother, Mrs. Leticia Dotse, for the marvelous support they provided me throughout my study in the university.

I appreciate the guidance and support of my supervisor, Dr. Joseph Nyala. I say thank you for your patience and direction which has resulted to the success of this work. A big thank you to all the teachers in the Effutu Municipality for availing themselves to be used for this research, this work would not have been possible without you.

I would also like to show gratitude to my lecturer and mentor, Mr. Nixon Saba Adzifome, for his wise counsel and support that has seen me this far. To my lovely sister, Theodora Fafa Dotse and friend, Godfred Asiedu Mireku, I say thank you for the love and support you have shown and continue to show me. Finally, to colleagues with whom I have journeyed this far, thank you for making my study in the University of Education, Winneba, exciting and worthwhile.

DEDICATION

This work is dedicated to God almighty and the entire Dotse family.

ABSTRACT

This study examined Junior High School mathematics teachers' perception and use of the principles of constructivism in the Effutu Municipality of the Central Region, Ghana. This study used the descriptive survey research design and adopted a mixed method approach to data analysis and presentation. The purposive sampling technique was used to sample one hundred and thirty-eight (138) JHS mathematics teachers for the study. Instruments such as documents, a structured questionnaire and an interview guide served as tools for data collection. Data collected through these instruments were further analysed as follows: documents were analysed using content analysis; responses from the structured questionnaire were analysed using descriptive statistics such as mean, standard deviation and simple percentages; while responses from the interview were transcribed and analysed thematically. Also, the hypothesis for the study was tested using the Pearson product-moment correlation analysis. The study revealed that, contrary to the view that teachers in the basic school employ teacher centred methods of instruction, JHS mathematics teachers in the Effutu Municipality of the Central Region always employed the constructivist principles of learning in their classroom instructions which is a child centred approach and has been proven to maximize learning outcome. It again revealed JHS mathematics teachers' in the Effutu municipality had a positive perception about constructivism and that their perception of constructivism influenced their classroom instruction. The study also revealed that majority of the teachers had not attended any form of in-service training while others had not received any form of education on constructivism. It was thus recommended that the Ministry of Education (MoE) in collaboration with the Ghana Education Service (GES) establish clear policies to ensure and guide the professional development of teachers of mathematics so as to keep them abreast with modern theories of education, such as the constructivist theory of learning as well as effective methods of lesson delivery.

TABLE OF CONTENTS

CHAPTER FIVE: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

LIST OF TABLES

ABBREVIATIONS

CRDD: CURRICULUM RESEARCH AND DEVELOPMENT DIVISION

GES: GHANA EDUCATION SERVICE

J.H.S: JUNIOR HIGH SCHOOL

MoE: MINISTRY OF EDUCATION

NCM: NATIONAL COUNCIL FOR MATHEMATICS

RPK: RELEVANT PREVIOUS KNOWLEDGE

TIMSS: TRENDS IN INTERNATIONAL MATHEMATICS AND SCIENCE STUDIES

TLMs: TEACHING AND LEARNING MATERIALS

CHAPTER ONE

INTRODUCTION

1.0 Overview

This chapter presents the background to the study, statement of the problem, purpose of the study, the objectives of the study, research questions, the significance of the study, delimitation, limitations, definition of terms, and organisation of the study.

1.1 Background to the Study

Education is the development of the inherent abilities in a person which will enable him or her to control his or her environment as well as fulfill his/her possibilities to a large extent (Ampofo & Osei-Owusu, 2015). In the 21st century, a nation that contributes and places much emphasis on education of its citizens reaps the benefits of sustained economic development. Connected to this is the fact that quality education and a positive beginning on academic and social experiences pupils receive in their early years of learning puts them on a path to academic excellence by stimulating their curiosity and the desire to learn (Yakubu, 2015). Thus, quality education is needed if one is to be able to contribute immensely toward personal achievement and national development. Due to this, stakeholders of education have over the years constantly sought for ways to improve the quality of education provided to children to help keep up with the changing trends of the society.

This can be said for all subjects taught in schools, especially mathematics education. This is because mathematics is viewed as the bedrock of other subjects such as the sciences (Dotse, 2014). There are different views among mathematicians regarding the exact

meaning and scope of mathematics. According to Asafo-Adjei (2001), mathematics is the study of quantity, structure and change. It is a subject which deals with finding solutions to problems, making use of knowledge on shapes and measurement in everyday life, counting and calculating as well as identifying patterns and relationships (Asafo-Adjei, 2001). Asafo-Adjei further states that, in dealing with mathematics, one goes through processes such as abstracting, generalizing, classifying, grouping, sorting, just to mention a few. Therefore mathematics learning is a means of developing logical and qualitative abilities and skills. Mathematics serves as the mother or back bone of all the subjects studied in our schools and according to the Ministry of Education and Employment (2012), mathematics is a logical, reliable and growing body of concepts which makes use of a specific language and skill to model, analyse and interpret the world. Recognising the important role mathematics plays in the overall development of a nation, many countries have made it a core subject of study from the basic level to the university, of which Ghana is included.

Mathematics finds its applications in almost all the disciplines, especially in science and other science-related subjects, such as the social sciences. It provides a medium of communication that is precise, concise and powerful. As a human activity, mathematics involves creativity in the discovery of patterns of shapes and numbers, the recognition of relationships, the modelling of situations, the interpretation of data and communication of emerging ideas as well as concepts. There is therefore the need to address issues such as type of environment and conditions that are conducive for teaching and learning of mathematics, nature of assistance teachers should give or offer to learners, kind of experience teachers should have to help learners and ways teachers should present or interact with learners to facilitate effective teaching and learning of mathematics.

All of these factors are, one way or the other, influenced by the perception a teacher holds with regards to the teaching and learning process. As Pickens (2005) puts it, perception is closely linked to ones' attitudes. Though there might be a laid down procedure or structure for the implementation of the curriculum, the teacher's view or perception of the teaching and learning process comes to play due to the fact that they are the final implementers of the curriculum. Jonassen (1991) cited by Applefield, Huber and Moallem (2001), purports that, a person's knowledge is usually founded on his unique perception of his physical and social experiences; while using their varied mental capabilities to explain, predict, or make inferences about a phenomena in the real world. In addition, teachers' views of teaching and learning guide them as they make decisions about desirable means of implementing and assessing their instruction (Applefield et al., 2001). This therefore implies that the perception of mathematics teachers towards the teaching of mathematics, with regards to theories and procedures governing its planning, activities and assessment, plays an important role in ensuring a positive academic achievement of the child.

Trends in education have seen significant shifts to the adoption and use of teaching practices based on certain perceptions and philosophical ideas coined into learning theories. Davis (2013) sees learning theories as theories that explain, predict, and influence the part of behavior which is related to the acquisition of knowledge. Ertmer and Newby (2013), add that "learning theories provide instructional designers with verified instructional strategies and techniques for facilitating learning as well as a foundation for intelligent strategy selection" (p.43). The quest to improve the quality of education in the 21st century, has led to a shift from the use of traditional teaching methods such as teacher centred instructions to child centred instructions. The goal of education in this new age is to prepare students to use their skills to solve real-world

problems; yet, education has been criticized for failing the task (Dotse, 2014). The common reason cited is that the learning experience provided in school is so different from the experience in the real world that students cannot transfer the skills between the two environments (Chen, 2003). This has been the bane of mathematics education in Ghana (Yakubu, 2015). Child-centred instruction is an approach to education that lays much emphasis on the use of practical activities, explicit skill instruction, reflective practice, collaborative learning, and child-controlled learning process (Weimer, 2002) rather than focusing on teachers. "This approach emphasizes a variety of methods that shift the role of teachers from givers of information to facilitators of pupils' learning" (Blumberg, 2008, cited by Yakubu, 2015, p.3).

Semple (2000) purports, child centred learning is a teaching method whose principles are founded on constructivism. The theory of constructivism has gained much prominence in the world Education. It places much emphasis on the learners with the view that they are able to and needed to be guided to construct their own knowledge. Findings from several research such as that of Nayak (2007), Karaduman and Gültekin (2007), Barman and Bhattacharyya (2015) and Yakubu (2015); have pointed to the fact that when children are allowed to play active part in the teaching and learning process, it improves their academic achievement. As Dhindsa and Emran (2006) cited in Hussain (2012) puts it, in the world of children "knowledge is constructed through observation, reflection and interaction with the surrounding environment such as their peers, teachers or technology" (p.180). The constructivist approach thus provides the needed solution to modern learning needs of children by engaging learners in experimentation.

Learning mathematics is a mental activity and as such educators should endeavour to comprehend the thinking processes that learners undergo in order to assist them develop love and interest for the subject right from the lower levels of education. Thus, teachers at all levels of education should find first, how learners think about mathematics, how their understanding of mathematics concepts develop, how mathematics skills could be learnt with ease and how the skills are applied in solving mathematical problems (Dotse, 2014). Constructivism, in line with this, provides a framework for understanding the cognitive processes of learning in children and provides principles that guide the teaching and learning. It incorporates different forms of activities such as cooperative learning, experiential learning, problem-based learning and inquiry learning (Hussain & Reza, 2010), and provides learners with the necessary critical thinking, problem-solving and analytical skills seen as essential constructs of higher education (Hussain, 2012).

1.2 Statement of the Problem

The general performance of students in mathematics education is on a constant decline. Sogbey (2011) posits that data collected from the West African Examination Council (WAEC) have shown that the pass-rate of pupils who take the Basic Educating Certificate Examination (BECE) is nothing to write home about. The abysmal performance of students in mathematics is evident in the analysis provided by the Trends in International Mathematics and Science Studies (TIMSS) for 2003 and 2007 as well as in the 2008, 2009, 2010 and 2011 Basic Education Certificate Examination (BECE) results which indicates a poor performed of students (Sarfo, Eshun, Elen, & Adentwi, 2014). Findings from the National Education Assessment for 2016 revealed also that pupils' performance was "noticeably lower for mathematics than for English, with only 22% of P4 pupils and 25% of P6 pupils achieving proficiency in mathematics compared

to 37% of P4 pupils and 36% of P6 pupils achieving proficiency in English" (MoE, 2016, p.8-9). Similarly, the Chief Examiner's report for 2016 shows that the performance of candidates in mathematics did not meet expectations since about 65% of the candidates scored marks below 50% (Baffour, 2017).

Recent studies have revealed that the decline in students' mathematics performance is due to the process by which mathematics is taught in schools (Anthony & Walshaw, 2009). Mathematics classrooms are often characterized by teacher-directed instruction with an emphasis on rules and technical procedures, testing for the right answer and a reliance on texts as well as decontextualised forms of learning (Brinkworth, 1994). According to Fredua-Kwarteng (2005), mathematics teaching in Ghana, especially at the basic level, is characterized by transmission and command models. Thus, "pupils are not encouraged to pose questions or engage in hands-on activities and problem-solving activities in order to attain both conceptual and procedural understanding of what they are taught" (Sarfo et al., 2014, p.768). Due to this, most basic school pupils in Ghana lack the necessary conceptual understanding underlining mathematics and its concepts (Baffoe & Mereku, 2010).

Society is dynamic and so is education. The methods used a century or two ago which proved to be very effective might not be effective today. This explains the emergence of different theories of learning, from time to time, to guide the perceptions, philosophies and practices of teaching and learning; the current one being the theory of constructivism. Per the rationale of mathematics education in Ghana, there is the need to address issues such as the type of environment and conditions that are conducive for teaching and learning of mathematics, the nature of assistance teachers should give or offer to learners,

the kind of experience teachers should have to help learners and the ways teachers should present or interact with learners to facilitate effective teaching and learning of Mathematics (CRDD, 2012). Research has proven that constructivist approach to learning provides a framework which caters for all of these in the sense that it incorporates most principles and practices of other theories of learning (Amineh & Asl, 2015) while at the same time providing learners with the necessary critical thinking, problem-solving and analytical skills seen as essential constructs of higher education (Hussain, 2012).

Clearly adopting a constructivist approach to teaching and learning is beneficial for the improvement of students' mathematical achievement but it lies in the hands of teachers, being the final implementers of the curriculum with varied beliefs and perceptions, to ensure its implementation in the classroom. According to Huitt and Hummel (2003), constructivism forms the basis for child centeredness and allows children to learn in their own pace while allowing them to be in charge of their own learning which leads to better understanding. Despite its benefit and world-wide accreditation, little research has been conducted on its awareness amongst Ghanaian teachers, their perceptions about it and how it influences their teaching, as in the case of teachers in the Effutu Municipality. Hence the need to examine JHS mathematics teachers' perception and use of the principles of constructivism in the Effutu Municipality.

1.3 Purpose of the Study

The purpose of the study was to examine Junior High School mathematics teachers' perception and use of the principles of constructivism in the Effutu Municipality. This research also determined whether the mathematics curriculum (syllabus) conformed to constructivist principles of teaching and learning.

1.4 Objective of the Study

The specific objectives of the study are as follows:

1. To determine whether the basic school mathematics curriculum (syllabus) conforms to constructivist principles of teaching and learning.
2. To identify the teaching and learning theory that predominantly informs JHS mathematics teachers' instruction in the Effutu Municipality.
3. To investigate JHS mathematics teachers' perception on constructivism as a modern theory for lesson delivery in the Effutu Municipality.
4. To determine to what extent JHS mathematics teachers in the Effutu Municipality employ constructivist principles in teaching and learning.

1.5 Research Questions

The following research questions were formulated to guide this study:

1. To what extent does the basic school mathematics curriculum (syllabus) conform to the constructivist principles of teaching and learning?
2. What is the teaching and learning theory that predominantly informs JHS mathematics teachers' instructional practices in the Effutu Municipality?
3. How do JHS mathematics teachers in the Effutu Municipality perceive constructivism as a guide to lesson delivery?
4. To what extent do JHS mathematics teachers in the Effutu Municipality employ the principles of constructivism in teaching and learning?

1.6 Research Hypothesis

The following hypothesis was formulated and tested in the study:

$H_{0:}$ There is no statistically significant difference between JHS mathematics teachers' perception of constructivism and its influence on their classroom practice in the Effutu Municipality

$H_{01:}$ There is a statistically significant difference between JHS mathematics teachers' perception of constructivism and its influence on their classroom practice in the Effutu Municipality

1.7 Significance of the Study

The outcome of this study would provide information to teachers, educational authorities, Curriculum Research and Development Division (CRDD) and the general public on the state of mathematics teaching and learning.

It would then inform educational authorities and Curriculum developers in planning a good and effective curriculum for the educational system in the country as well as prepare syllabuses and textbooks to cater for the changes that occur in the teaching and learning of mathematics.

The outcome of this study again would inform educational authorities and head teachers to structure in-service training that would keep their teachers abreast with modern trends of teaching and learning mathematics thereby improving teachers teaching skills which would lead to high level of performance on the part of pupils.

It will enlighten teachers about the need for continuous professional development as a means of keeping up with changing trends in education and demystify their perception towards the adoption and implementation of modern methods of lesson delivery.

The recommendations of this study would add to the existing body of knowledge about the best approach to instruction at the basic school level. Other researchers can use the findings as reference for conducting further research into the constructivist approach to teaching and learning.

1.8 Delimitation

This study was carried out in the Effutu Municipality of the Central Region therefore teachers in other districts may not directly benefit from this research. Also, this research will target only Junior High School Mathematics teacher due to subject specialization and not all basic school teachers.

1.9 Limitations of the Study

Schools within the Effutu municipality were widely interspersed and as such administration and collection of data was difficult adding to the financial constraints of the researcher.

Also, little studies have been conducted in Ghana with regards to constructivism and its practices in the Ghanaian classroom hence getting access to such data was quite difficult. This also led to limited Ghanaian content on constructivism in the literature review.

1.10 Definition of Terms

1. **Constructivism**: Teaching philosophy based on the concept that learning (cognition) is the result of 'mental construction' - students construct their own understanding by reflecting on their personal experiences, and by relating the new knowledge with what they already know (Thompson, 2000).
2. **Perception:** The process by which people translate sensory impressions into a coherent and unified view of the world around them. Though necessarily based on incomplete and unverified (or unreliable) information, perception is equated with reality for most practical purposes and guides human behavior in general (Akurugu, 2010).
3. **Learning theories:** Learning theories refers to theoretical frameworks which try to explain how people and animals learn, thereby helping us understand the inherently complex process of learning (Davis, 2013).

1.11 Organisation of the Study

For effective and successful research work, the study would be organised into five chapters. Chapter One discusses the introduction which involve the overview, background to the study, statement of the problem, the research questions, objectives of the study, delimitation, definition of terms and the organisation of the study. Chapter Two deals with literature review, that is, the review of relevant literature related to the study.

Chapter Three details with the methodology employed in the study. This covers the research design, population, sampling, instruments, data collection procedure, method of data analysis and ethical considerations. Chapter Four focuses on data presentation and

analysis where data collected were be analysed based on responses provided for each research questions as well as discussion of the findings. Chapter Five provides a summary of findings, conclusion and recommendations based on the findings of the study.

CHAPTER TWO

LITERATURE REVIEW

2.0 Overview

This chapter discusses literature related to the subject understudy. Literature reviewed in this chapter is summarised into the following main headings:

- Theoretical Framework of the Study
- Theories of Learning that Informs Teachers Instructions
- Perception and its influence on the Teaching and Learning of Mathematics
- The Mathematics Curriculum and Basic School Mathematics Education
- Empirical Review on Constructivism

2.1 Theoretical Framework of the Study

This study is hinged on the theory of cognitive development ascribed to Jean Piaget in relation to the constructivist theory of learning. Piaget's theory of cognitive development purports that every child, as they grow, builds mental maps and a network of concepts which helps them to understand and respond to physical experiences within their environment. This theory was adopted for the study because it forms the basis for constructivism (Huitt & Hummel, 2003).

2.1.1 The Theory of Cognitive Development

According to Madole and Oakes (1999), as cited by the Carlifonia Department of Education (2017), the last twenty years of child research has witnessed dramatic changes to the way developmental psychologists perceive the initial stages of cognitive development. The child, who was once regarded as a simple sensorimotor driven

organism, is now seen a possessor of refined cognitive skills as well as sophisticated concepts that guide their acquisition of knowledge (Carlifonia Department of Education, 2017).

Cognitive development refers to the development of the capacity or the skill of thinking and reasoning (Stanford Children's Health, 2017). The Encyclopedia of Children's Health (2017) also define cognitive development as the formation of thought processes, which encompasses remembering, problem solving, and decision-making, from childhood to adulthood. They further purport that cognitive development refers to the means by which an individual perceives, reason, and gains knowledge of their world by the communication of genetic and learned factors. Cognitive development covers areas such as information processing, intelligence, reasoning, language development, and memory (Encyclopedia of Children's Health, 2017). According to the Carlifonia Department of Education (2017), the term cognitive development refers to the process involving the growth and change in an individual's intellectual or mental skills such as thinking, reasoning and understanding which includes the attainment and consolidation of knowledge. "The cognitive developmental theories explain the change in reasoning level of a child acquiring new ways of understanding their world" (Lefa, 2014, p.1).

Many researches have been conducted with regards to the cognitive development of children. The oldest of them being intelligence tests, of which includes the Stanford Binet Intelligence Quotient (IQ) test which was first adopted for use in the United States by psychologist Lewis Terman in 1916 from a French model pioneered in 1905 (Encyclopedia of Children's Health, 2017). As purported by Grohol (2016), intelligence quotient (IQ) is a theoretical concept used by psychologists in a standardized tests as a

means of describing a persons' level of intelligence. Scoring made on intelligence quotient is based on the concept of "mental age"; the scores of a child of average intelligence matches his or her age, a gifted child's performance can be compared to the intelligence of an older child, while a slow learner's performance can be compared to a younger child (Encyclopedia of Children's Health, 2017).

This means of measuring the cognitive development of children have come under criticisms: first, for limiting the scope of defining ones' intelligence and secondly, for being race and gender biased. Due to these inaccuracies, researchers such as Jean Piaget (1896-1980) and Lev Vygotsky (1896-1934) probed into a more comprehensive study on the process of children's cognitive development. According to Huitt and Hummel (2003), Jean Piaget can be said to be one of the most prominent researchers in the field of developmental psychology during the 20th century. They further add that, his main interest was in "how we come to know" and believed the main difference between human beings and other animals is our ability to reason abstractly. Lev Vygotsky, on the other hand, studied more into social interaction as the principal source of cognition and behavior; in all the writings of Piaget and Vygotsky, supported by the work of John Dewey, Jerome Bruner and Ulrick Neisser, form the basis of the constructivist theory of learning and instruction (Huitt & Hummel, 2003).

2.1.2 Piaget's Theory of Cognitive Development

Jean William Fritz Piaget, popularly known as Jean Piaget, was born in Neuchâtel, Switzerland, on the 9th of August, 1896. He was a clinical psychologist as well as a philosopher. Piaget was one of the leading researchers in developmental psychology in the 20th century and was best known for his pioneering work on the development of

intelligence amongst children. He was very passionate about child education and most of his studies have had a major impact on the fields of psychology and education (Zhou & Brown, 2014). Piaget was interested in the development of thinking and how it relates to development in a child's life. According to Boundless Psychology (2016), Piagets' theory of cognitive development, presented in the mid-20th century, remains one of the most influential and widely accepted theories in cognitive development amongst children to this day. They further add that Piagets' theory of cognitive-development was founded on the idea that a child actively constructs his/her own knowledge as they investigate and manipulate the world around them.

2.1.3 Piaget's Stages of Cognitive Development

According to the Barnardos' Training and Resource Service (2002), Jean Piaget's concepts on the stages of cognitive development is, by far, the most prominent and influential theory in developmental psychology. Flavell (1963), as cited by Simatwa (2010), is also of the view that Piaget's theory of intellectual development can be considered the leading theory on cognitive development. Through a series of clinical interviews based on open ended questions and conversations with children, he studied the processes involved in children's thinking (Barnardos' Training and Resource Service, 2002). "Piaget's theory asserts that intellectual development is a direct continuation of inborn biological development. That is, the child is born biologically equipped to make a variety of motor responses, which provide them with the framework for the thought processes that follow" (Simatwa, 2010, p.366). According to Awwad (2013), Piaget maintained the view that when a child is born into the world, their mind is not blank, but rather they possess certain beliefs and inherited potential which helps them to start

growth. Piaget also believed that there are two types of genotypes transmitted to the child through the genetic media. These types include:

1. *Physical structures*: These include structures such as the eye, hands, nervous system and the senses. These physical structures help the individual to familiarise himself with the surrounding environment.
2. *Involuntary behavioral reactions*: Like reflections that occur automatically when a particular incident occur in the surroundings of the child such as sucking and baby's screaming when they are hungry. These activities do not need any special training, but is considered inevitable for direct contact with the environment and these responses play a great role in the early years of a child's life because it is these reflections which are subsequently modified by the child and converted into mental and psychological constructs that serve as the basis of mental activity later (Jaber, 1984, cited by Awwad, 2013).

In Piaget's perspective, intelligence is seen by how one interacts with his environment through mental adaptation (Lutz & Huitt, 2004). This adaptation, according to Lutz and Huitt (2004), is manipulated by mental structures that an individual uses as a representation of the world and is motivated by a natural impulse to obtain balance (homeostasis or equilibrium) between those mental organisations and the environment. Piaget is of the view that intelligence is entrenched in two biological traits which is found in every living creature: *organisation and adaptation*. "Organization is the tendency of every living organism to integrate processes into coherent systems. It occurs, for instance, when an infant, originally capable of either looking at objects or grasping them, integrates these two separate processes into a higher order structures which enable them

to grasp something at the same time he looks at it. Adaptation is the innate tendency of a child to interact with his environment. This interaction fosters the development of a progressively complex mental organization" (Simatwa, 2010, p.366). According to Lefa (2014), the process of adaptation is an innate tendency to adjust to conditions imposed by the environment. Thus, in a way making an organism more attuned to its environment. According to Simatwa (2010), "adaptation comprises two complementary processes of assimilation and accommodation. The child assimilates experiences and fits them into the expanding structure of the intellect when he encounters new experiences which he cannot fit into the existing structure accommodation, or modified way of reacting takes place" (pp. 366-367).

In the view of Huitt and Hummel (1998) as cited by Lutz and Huitt (2004), Piagetian theory can be discussed in two parts: 1) his theory of adaptation and the process of using cognitive schemes and 2) his theory of cognitive developmental stages. The first aspect of Piaget's theory holds the view that children are born with natural reflexes, also referred to as physical structures (Awwad, 2013), which allows them to communicate effectively with the environment. "These reflexes are quickly replaced by constructed mental schemes or structures that allow them to interact with, and adapt to, the environment" (Lutz & Huitt, 2004, p.2). Piaget (1952), cited by McLeod (2015), defines *schema* as "a cohesive, repeatable action sequence possessing component actions that are tightly interconnected and governed by a core meaning" (p.2). Schema (schemata-plural), according to Fournier (2016), is a means of processing information by categorizing objects into mental structures representing various aspects of the world. For instance, a child may have a primary schema for a "fish" as including all animals that live in water

thus upon seeing a frog, the child might calls it a fish. With time, due to experience and other factors, the child gets to know the differences between animal found in water and associates each of them by their appropriate names. Wadsworth (2003) posits that schema can be assumed as 'index cards' kept within the brain, each one signaling to an individual how to react to incoming stimuli or information.

This adaptation, as purported by Lutz and Huitt (2004), occurs in two different ways, thus: *assimilation and accommodation*, and is crucial in building mental structures as well as a critical element of modern constructivism. "Adaptation is predicated on the belief that the building of knowledge is a continuous activity of self-construction; as a person interacts with the environment, knowledge is invented and manipulated into cognitive structures" (Lutz & Huitt, 2004, p.2). As disagreements occur between the environment and mental structures, the child either changes his perception of the environment in order for the new knowledge to be aligned with existing schemes through assimilation, or he changes mental structures as a result of the interaction through accommodation (Lutz & Huitt, 2004). Should any of these two fail, it child leaves the child in a cognitive conflict also referred to as *disequilibrium*. When a child recieves information from their environment which is unfamiliar with their mental structure to be accommodated yet makes sense that denying it becomes difficult, they are said to be in a state of *disequilibrium* (Wankat & Oreovicz, 2015). According to Lefa (2014), "these cognitive conflicts occur when the learner is confronted with the information which he/she cannot deal with in terms of the current cognitive structures" (p.2). In this state, the child therefore strikes a balance (or *harmonizes*) by creating new schemes or modifying the old schemes (Wordsworth 1990, cited by Awwad, 2013). This is referred

to as *equilibrium*. In the state of equilibrium, assimilation and accommodation continuously interact; accommodation opens up to the possibility of assimilation and vice versa in an ever expanding cycle making the child capable of solving more complex situations (Lefa, 2014).

The second stage studies how the mental structures (schemes) of children are formed. "From his observation of children, Piaget understood that children were creating ideas. They were not limited to receiving knowledge from parents or teachers; they actively constructed their own knowledge. Piaget's work provides the foundation on which constructionist theories are based" (Zhou & Brown, 2014, p.13). Piaget, as purported by the Centre for Learning Innovation (2006), believed that childrens' thinking process passed through four separate stages and changes substantially in each of these stages. He further emphasized the importance of maturation and the provision of a stimulating environment for children to explore. Piaget maintain that a child matures mentally, they chronologically pass through four major stages of cognitive development, each stage having several sub stages (Hertherington & Park, 1975, cited by Simatwa, 2010).

The four major stages of cognitive development as proposed by Paiget (1954) include:

1. Sensory motor stage: 0 - 2 years

2. Preoperational or intuitive stage: 2 - 7 years

3. Concrete operations stage: 7 - 11 years

4. Formal operations stage: 11 - 15 years

At every stage of Piaget's levels of cognitive development there is peculiar level of analysis, internal organisation and knowledge as well as in the level of understanding the environment, and events (Lefa, 2014). Piaget`s theory again clearly shows that the child`s understanding is very much dependent on the stage that he/she has reached and as such, teachers must take this into consideration when teaching learners at different levels of intellectual development (Lefa, 2014).

2.1.3.1 Sensory Motor Stage (Ages 0-2 years)

The sensory motor stage is the first stage in Piaget's level of cognitive development. "In general, this stage lasts from birth to about two years of age. At this point intelligence is based on physical and motor activity, but excludes the use of symbols" (Lutz & Huitt, 2004, p.2). At this stage, the child mainly acquires information through his senses, thus touch, sight, feeling, taste and smell; he therefore builds knowledge by interacting with the environment and through experiences. "Mobility, crawling, and walking facilitate knowledge acquisition, and progress is shown through the modification of reflexes in response to the environment" (Lutz & Huitt, 2004, p.3). The child's cognitive structure (schema) or knowledge is limited at this stage hence cannot predict reaction, and therefore must continuously experiment and learn through trial and error (Zhou & Brown, 2014). An important milestone at this stage, beginning at about 7 months, is that the child starts to understand the fact that objects continue to exist even though they cannot be seen. The end of stage, the child develops an immature use of symbols and language development that signals the progression to the second stage (Lutz & Huitt, 2004).

2.1.3.2 Preoperational or Intuitive Stage (Ages 2-7 years)

This stage follows immediately after the sensory motor stage and at this stage intuitive mode of thought prevails characterized by free association, fantasy and unique illogical meaning (Simatwa, 2010). According to Zhou and Brown (2014) "during this stage children begin to use language; memory and imagination also develop. In the preoperational stage, children engage in make believe and can understand and express relationships between the past and the future" (p. 14). The child can symbolize experience mentally and this is facilitated by the development of language skills (Meyer & Dusek, 1979, cited by Simatwa, 2010). According to Lutz and Huitt (2004), children at this stage are able to mentally represent objects and events, as well as possess a well-developed memory and imagination. "An important signifier of this stage is the ability of a child to do monological, nonreversible thinking; children in this stage can deal with or determine only one aspect of a problem at a time, and they cannot think or process information in a multidimensional fashion" (Lutz & Huitt, 2004, p.3). They further add that children's' thinking at this stage is also highly self-centred (egocentric) and they fail to understand or accept any perspective which differs from theirs. This stage ends with the child being able to discriminate between the quantities of objects irrespective of their dimensions.

2.1.3.3 Concrete Operations Stage (Ages 7 - 11 years)

This is the third stage in Piaget's theory of cognitive development and begins from ages 7 to 11 years. According to Lazarus (2010), problem solving and reasoning becomes a powerful tool for the child in this stage, thus, the child is able to reason logically on issues based on concrete evidence. Reedal (2010), reports that a child, at this stage, thinks logically and begins classification based on several features and characteristics rather

than only visual representation. At this point in development, the child's exposure to, and integration of, knowledge has matured such that all three types of knowledge (physical, logical-mathematical, and social) can be used by the child to interact with the environment to a relatively high degree (Lutz & Huitt, 2004, p.4). The child then becomes less egocentric (Zhou & Brown, 2014) and is able to accept as well as relate to the views of others. They are also able to engage in reversible mental operations such as being able to study or tackle issues from different perspectives (Lutz & Huitt, 2004). "The major milestone yet to be reached by the concrete operational child, however, is the ability to make abstractions and hypothesize [and their] development is still limited to the application of knowledge to concrete objects and stimuli" (Lutz & Huitt, 2004, p.4).

2.1.3.4 Formal Operations Stage (11 - 15 years)

The formal operation stage is the final stage in Piaget's theory of cognitive development and it is from ages 11 to 15 years thus, the period from adolescence through to adulthood. "At this stage, intelligence is shown through the logical use of symbols related to abstract concepts" (Lutz & Huitt, 2004, p.4). Thus, the child begins to think more logically as well as abstractly. During this stage in Piaget's theory of cognitive development, children do not necessarily need the concrete material and experiences for understanding; they form their own hypotheses and can determine possible results of a particular situation based on differing perspectives (Reedal, 2010). Simatwa (2010) adds to this by saying

"*when the student has reached the stage of formal operations, he can construct theories and make logical deductions about their consequences without having had previous direct experience on the subject. He can deal with abstractions and mentally explore*

similarities and differences because he has mastered reversibility and decentration" (p.369).

Siegler (1991) as cited by Lutz and Huitt (2004) suggests one important ability of individuals at this stage is the ability to reason abstractly about issues on truth, morality, justice, and the existence of things as well as provide alternative, competing beliefs with regards to these issues. Thus, cognitive development becomes a foundation for the constructing morality based on abstract principles (Lutz & Huitt, 2004).

According to Driscoll (2001), three types of knowledge must be evident at all the stages of cognitive development, these are: physical, logical-mathematical, and social knowledge. As Lutz and Huitt (2004) posit:

1. Physical knowledge is very concrete in nature and is gained through hands-on or direct interaction with the environment.
2. Logical-mathematical knowledge is an abstract reasoning that is applicable without interacting physically with a concrete stimulus. Thus, while physical knowledge is discovered, logical-mathematical knowledge is gained through repeated exposure and interaction with different objects and in different settings in order for cognitive structures to be modified and created.
3. Social knowledge is a type of knowledge acquired through interaction with others. It is culture specific and its acquisition is based on actions rather than physical perception of objects.

2.1.4 Factors Affecting the Cognitive Construction

Piaget (1954) is of the view that the process of cognitive development occurs gradually from the time of ones' birth till he/she matures. According to Awwad (2013), the following are some factors that affect the cognitive construction of a child:

1. **Inheritance:** Piaget acknowledges the role of inheritance in the cognitive development of every child. He believes that inheritance affect cognitive development in two ways:
    a. Construct nerve: These nerves are found in every individual and is believed to somewhat naturally delay cognitive function or facilitate it.
    b. Functional constants: "Piaget believes that within each person there is an internal self-regulation mechanism that responds to environmental stimulation by constantly fitting new experiences into existing cognitive structures (assimilation) and revising these structures to fit the new data (accommodation). Piaget refers to these cognitive structures as schemas" (Webb, 1989, p.93).
2. **Content, Function and Construction:** Piaget is of the view that intelligence consists of three components:
    a. Content: means behavioral patterns, observation and perceived kinetic abilities that reflect intellectual activity. This intelligence differs from time to time and from one child to another.
    b. Function: means the processes that are resorted to by the individual when he interacts with environment.

c. Constructions: indicates extracted educational characteristics; they are plans (knowledge and information) that explain the emergence of special behavioral techniques as the learner is faced with new challenges.

3. **Activity:** The cognitive growth of the child requires activities that engages them directly with the environment
4. **Maturity:** Piaget believes that maturity is one of the main contributors to a child's cognitive development. Maturation, which is dependent on neurodevelopment, endocrine system, and the maturation of the nervous system, determines the extent of one's potential with the help of the social environment.
5. **Social Interaction:** social interaction is the exchange of ideas amongst people. It may be in several forms such as dealing with comrades, parents and teachers. "Social interaction offers opportunities for the observation of a wide varietv of behaviors, for direct instruction, and for feedback concerning the individual's performance" (Webb, 1989, p.93).

2.1.5 Educational Implications of Piaget's Theory of Cognitive Development

According to Mwamwenda (2009), it is possible to integrate Piaget`s theory of cognitive development in the classroom. Thus, each stage equips the teacher with information upon which they can rely to teaching and learning more fulfilling. Piaget takes a constructivist point of view to learning which states that learners are not passive during the process of knowledge acquisition; his theory posits that learners need a teaching curriculum which supports every level of their cognitive development and makes the learning of concepts more logical and systematic (Lefa, 2014). Driscoll (2001) provides three basic instructional principles:

1. The learning environment should support the activity of the child.
2. Children's interactions with their peers are an important source of cognitive development
3. Instructional strategies that make children aware of conflicts and inconsistencies in their thinking should be adopted.

Zhou and Brown (2014) are of the view that one important implication of Piaget's theory of cognitive development is to adapt instructions to suit the learner's level of cognitive developmental, thus, the content of an instruction needs to be consistent with the developmental level of the learner. They propose the following as some of the implications of Piaget's theory to education:

- Provide concrete props and visual aids, such as models and/or time line.
- Use familiar examples to facilitate learning more complex ideas, such as story problems in mathematics.
- Allow opportunities to classify and group information with increasing complexity; use outlines and hierarchies to facilitate assimilating new information with previous knowledge.
- Present problems that require logical analytic thinking; the use of tools such as "brain teasers" is encouraged.

Lefa (2014) again posits that "Piaget emphasizes that learning take place as a result of active engagement of learners is important, so teachers have to see the learners take an active role by participating in whatever is being taught and learned" (p.7). The role of the teacher here, therefore, is to serve as a facilitator and not an instructor. Piagets theory acknowledges the difference that exist between learners (Lefa, 2014), hence it is the

teacher's duty to arrange activities, teaching methodology and teaching materials, in a way that is appropriate to each learners' cognitive level (Simatwa, 2010). Simatwa (2014) further adds that "since the theory says that there is a mutual interaction between the learner and the environment, teaching materials should come from the learner's environment" (p.370). Also, discovery learning should be encouraged since it provides varied opportunities for learners to explore and experiment, thus encouraging new understandings (Zhou & Brown, 2014). McLeod (2015) provides the following as the role of the teacher within the classroom based Piaget's theory:

- Focus on the process of learning, rather than the end product of it.
- Using active methods that require rediscovering or reconstructing "truths".
- Using collaborative, as well as individual activities (so children can learn from each other).
- Devising situations that present useful problems, and create disequilibrium in the child.
- Evaluate the level of the child's development through suitable tasks.

Huitt and Hummel (1998), as cited by Zhou and Brown (2014), assert that many school graduates from industrialised countries do not fully operate in the formal operational characteristics of Piaget's theory of cognitive development during adulthood. To help prevent this, they therefore propose the:

- Use visual aids and models.
- Provision of opportunities to discuss social, political, and cultural issues.

- Teaching of broad concepts rather than facts, and to situate these in a context meaningful and relevant to the learner.

Curriculum, instructional and assignments developers should make a special effort to understand the child's world and should not assume that they know what is good for the child; this will enable them design educational experiences based on the child's need and readiness and this will help avoid teaching children something before they are ready to learn it (Simatwa, 2014).

2.1.6 Connection between Piaget's Theory of Cognitive Development and Constructivism

According to Zhou and Brown (2014) Piaget's work serves as the foundation upon which principles of constructivism are based. The term constructivism might most certainly be derived from his work as he made reference to his views as "constructivist", supported by Bruner, who described discovery learning as "constuctionist" (Gruber & Voneche, 1977; Bruner, 1966 all cited by Applefield et al., 2001).

Piaget's work on the cognitive development of learners serves as a foundation for child-centred learning. Thus, the major connection between Piaget's theory of cognitive development and the constructivism is the fact that both theories support child-centred learning. According Qvortrup, Wiberg, Christensen and Hansbøl (2016) Piaget was of the view that "traditional teaching created overly passive learners left without the possibility of making the necessary operations, such as analysis, experiment, suggestions, communication" (p.109). Constructivist also believe that learners are not empty slate and are capable of constructing knowledge for themselves through experience and practice given a conducive learning environment. Each stage of Piaget's theory has a major goal

which needs to be achieved and each principle held by constructivists provides a way of dealing with learners' specific needs at every developmental level.

The first stage of Piaget's cognitive development, the sensory motor stage, emphasize that children at this level are beginning to construct knowledge about the world in which they live and they do this mainly through their senses. At this stage the constructivist believes a conducive learning atmosphere needs to be created coupled with the provision of appropriate manipulative materials for learners gain mastery over concrete objects so as to develop appropriate mental structures for future learning. The second stage of Piaget's cognitive development, the operational stage, emphasizes the development and use of language; memory and imagination among children. At this stage also, the child is egocentric and Piaget together with constructivist believes that allowing children lean collaboratively will help solve this problem while at the same time making use of pupils' previous knowledge constructions, beliefs and attitudes (Qvortrup et al., 2016; Koohang, 2009). Constructivists encourage exploration at this stage so as to help learners develop abstract thinking and memory development. The third stage of Piaget's cognitive development, the concrete operations stage, emphasize problem solving and reasoning as a powerful tool for the child (Lazarus, 2010). The child thus, begins to think logically and begins classification based on several features and characteristics rather than only visual representation. Constructivist at this stage say that learners should be provided with the opportunity for apprenticeship learning in which there is an increasing complexity of tasks, skills and knowledge acquisition such as in scaffolding while stressing on collaborative and cooperative learning in order to expose the learner to alternative viewpoints (Koohang, 2009). The final stage of Piaget's cognitive development, the

formal operations stage, emphasizes the ability to "reason in terms of theories and abstractions, as well as concrete realities" (Lefa, 2014, p.5). At this stage learners mastery over their thoughts and the constructivist believe that engaging them in projects and as well, lessons and activities should provide multiple perspectives and representations of concepts and content while learning situations, environments, skills, content and tasks are relevant, realistic, authentic and represent the natural complexities of the real world (Koohang, 2009).

By viewing learning as an active process, taking students prior knowledge into consideration, building on preconceptions, and eliciting cognitive conflict, Piaget's work on the cognitive development helps teachers to design instruction that goes beyond rote learning to meaningful learning that is more likely to lead to deeper, longer lasting understandings (Jones & Brader-Araje, 2002, p.4). Ertmer and Newby (2013) purport the following as some principles from the constructivist position that have direct relevance for designing instruction:

1. An emphasis on identifying the context in which the skills will be learned and subsequently applied (anchoring learning in meaningful contexts).
2. An emphasis on learner control and the capability of the learner to manipulate information (thus, pupils actively using what is learned).
3. Presenting information in a variety of different ways (revisiting content at different times, in rearranged contexts, for different purposes, and from different conceptual perspectives).

4. Supporting the use of problem solving skills that allow learners to go beyond the information given (developing pattern-recognition skills, presenting alternative ways of representing problems).
5. Focusing assessment on transfer of knowledge and skills (presenting new problems and situations that differ from the conditions of the initial instruction).

In all, both Piaget and constructivists agree on the fact that knowledge does not exist independently from the learner but that, the individual is responsible for his own understanding of the world in which they live. "Piaget's position towards the existing teaching in contemporary schools can best be summed up as a critique of an ideology founded on authoritarian beliefs and "heterogeneous' morals, forced upon the individual from without" (Qvortrup et al., 2016, p.110). The individual, thus, have to be encouraged to construct knowledge by exploring and investigating into whatever he is presented with, store them in a form of mental structures and constantly review or update those mental structures for a more accurate description of events and phenomena. They both believe the learner is capable of constructing knowledge for themselves, that lessons should be planned systematically based on the learners' ability and prior experiences (schema), that lessons should be authentic (having a bearing on pupils' everyday life), that learners should be provided with the necessary learning materials as well as a conducive learning atmosphere, that collaborative learner is of great importance and that the teacher should serve as a facilitator in the classroom and not an instructor. In effect, both Piaget and constructivist believe in child-centred learning; after all, Piaget's theory of cognitive development has served as the foundation for constructivist theories (which will be discussed in details under theories of learning) (Bhattacharjee, 2015).

2.2 Theories of Learning

Before venturing into what learning theories are, lets first try to establish the meaning of 'learning' and 'theories'. Learning, as frequent as one may hear this word, has been without a universally acceptable definition. According to Shuell (1986) as cited by Schunk (2012), amongst theorists, researchers, and practitioners there has not been one definition of learning that is universally accepted. This may be because of the several perspectives held by experts in the field of education who try to define it. The most common definition given for learning is that it is any activity that results to a permanent change in behavior. Shunck (2012) thus, defines learning as "an enduring change in behavior, or in the capacity to behave in a given fashion, which results from practice or other forms of experience" (p.3). To him, we can consider an activity as learning if it involves gaining and modifying knowledge, skills, strategies, beliefs, attitudes, and behaviors. De Houwer, Barnes-Holmes and Moors (2013) also defined learning as the changes that occur in the behavior of an organism as a result of consistencies in the environment where the organism is found. This is to say as the individual becomes more and more conversant with his environment through exploration, he learns.

According to Darling-Hammond, Rosso, Austin, Orcutt and Martin (2001), a theory is "an idea that explains a set of relationships that can be tested" (p.19). They add that a theory: is developed from research as well as practical experience and systematic observation, is modified over time on the basis of practitioners' insights as well as the work of researchers, and is interrelated, thus, the come together to help explain a more complex phenomena. Sunday (2015) provides the following as the definition for a theory:

1. Theory is a model or framework for observation and understanding, which shapes both what we see and how we see it. Theory allows the researcher to make links between the abstract and the concrete; the theoretical and the empirical; thought statements and observational statements etc.
2. Theory is a generalized statement that asserts a connection between two or more types of phenomena – any generalized explanatory principle.
3. Theory is a system of interconnected abstractions or ideas that condenses and organizes knowledge about the world.

From the definitions provided so far, we can thus conclude that a theory is a framework for studying and analyzing the truth or falsity of a phenomenon. According to Neuman (1997) as cited by Sunday (2015), a good theory should:

1. Provide basic concepts and directs us in answering important questions.
2. Suggests ways for us to make sense of research data.
3. Enables us to connect a single study to the immense base of knowledge to which other researchers contribute.
4. Helps a researcher see things in a wider view instead of just pointing to a single spot.
5. Increases a researcher's awareness of the interconnections and of the broader significance of data.

Therefore, in studying any issue or event, theories provide a foundation upon which one can develop understanding as well as make projections since they contain in themselves, explanations to the occurrence of event.

We now shift focus to what learning theories are. From the above definitions for both the terms 'learning' and 'theory', we can define learning theories as ideas, frameworks or models propounded for learning with each model explaining the manner through which knowledge is constructed or acquired by an organisms. Davis (2013) see learning theories as theories that explain, predict, and influence the part of behavior which is related to the acquisition of knowledge. According to Ertmer and Newby (2013), "learning theories provide instructional designers with verified instructional strategies and techniques for facilitating learning as well as a foundation for intelligent strategy selection" (p.43). Learning theory focuses on the role of environmental factors in shaping the intelligence of children, especially on a child's ability to learn by having certain behaviors encouraged and others discouraged (Encyclopedia of Children's Health, 2017). The teachers' views of learning guide them as they make decisions about desirable means of implementing and assessing instruction (Applefield, Huber & Moallem, 2001).

Lefrancois (1988) as cited by Davis (2013) provide two models that represent most psychologists' perception about human beings:

1. The Mechanistic Model which envisions humans as, in many ways, resembling machines predictable and highly responsive to environmental influences.
2. The Organismic Model which considers humans to be more like dynamic, active, exploring organisms

These two models serve as the proponent for three main learning theories that have helped shape the nature of teaching and learning in the history of learning. These are the behaviorist theory of learning (from the mechanistic model) and the cognitivist as well as the constructivist theories of learning (from the organismic model). Ertmer and Newby

(2013) are also of the view that learning theories are divided into two main categories: behavioral and cognitive but later approve the addition of a third category, thus the constructive theory, due to the uniqueness of its instructional design. Chen (2003) explains this by saying that constructivism is an improvement of cognitive science. Ertmer and Newby (2013) adds that these theories may seem to overlap but are "distinctive enough to be treated as separate approaches to understanding and describing learning" (p.46). It should be noted, however, that behaviorism, cognitivism and constructivism are not the only learning theories that have helped to shape the course of teaching and learning but rather, they form the main pillars from which other learning theories have evolved.

2.2.1 The Behaviorist Theory of Learning (Behaviorism)

According to Wikibooks (2016) the behaviorist theory of learning can be traced back to the days of Aristotle, who wrote an essay on "memory" focusing on associations that existed between events such as lightning and thunder. Black (1995) as cited by Wikibooks, (2016) posits that "other philosophers that followed Aristotle's thoughts are Hobbes (1650), Hume (1740), Brown (1820), Bain (1855) and Ebbinghause (1885)". "Ivan Pavlov, John B. Watson, Edward Thorndike and B.F. Skinner later developed the theory in more detail [however] Watson is the theorist credited with coining the term behaviorism" (Black, 1995, p.3).

The contributions of Pavlov, Watson, Thorndike and Skinner has, by far, added greatly to the theory of behaviorism. Pavlov (1849-1936) was studying the digestive process of a dog, specifically the interaction of salivation and stomach function, when he stumbled upon the fact that reflexes in the autonomic nervous system closely linked these actions (Zhou & Brown, 2014). To be sure whether external conditions (which he referred to as

'stimuli') had an effect on this process, he rang a bell then after some time gave food to the dog. He observed, upon a repetition of this pattern, that the dog salivated shortly before the food was given. He later realized, after some time, the sound of the bell alone (which he referred to as a 'conditioned stimulus') would cause the dogs to salivate. He referred to this as a 'conditioned response'. "Pavlov also found that the conditioned reflex was repressed if the stimulus proved "wrong" too frequently; [thus] if the bell rang and no food appeared, the dog eventually ceased to salivate at the sound of the bell" (Zhou & Brown, 2014, p.5). Pavlov referred to the cessation of response from an organism when a conditioned stimulus is presented repeatedly without being paired with the unconditioned stimulus as *extinction* and the restoration of the response when the conditioned stimulus is presented after some time has elapsed since extinction as *spontaneous recovery* (Glassman & Hadad, 2009). This suggests that a learnt behavior can be unlearnt and that conditioned responses are not necessarily permanent without repetition.

Watson's view of learning was partly based on Pavlov's studies. Watson (1878-1958) was of the view that the behavior of human beings results from specific stimuli that elicit certain responses. "Watson's basic premise was that conclusions about human development should be based on observation of overt behavior rather than speculation about subconscious motives or latent cognitive processes" (Zhou & Brown, 2014, p.5).

Skinner, just like other proponents of this theory, was of the view that how human beings respond to situations could be manipulated like machines to produce required results (Zhou & Brown, 2014). In his research on animals, he came to a conclusion that both animals and humans would repeat certain behaviors that led to favorable outcomes, and stop behaviors that was accompanied with unfavorable outcomes (Shaffer, 2000). Skinner

referred to the action or behavior of the organism as 'operant behavior', and the response as 'reinforcer'. It should be noted however that the reinforcer may be positive or negative with regards to whether one wants to encourage or suppress a behavior. Negative reinforcers can also be referred to as Punishment. "Skinner believed the habits that each of us develops result from our unique operant learning experiences" (Zhou & Brown, 2014, p.6).

Also, Thorndike in his thesis published in 1898, analyzed the conditions under which animals changed their behaviour by focusing on the connection between response and its consequences. He referred to this connection as the 'law of effect' which purported that, "any response which leads to an outcome that the organism finds satisfying is likely to be repeated, and any response which leads to an unpleasant outcome is not likely to be repeated" (Thorndike, 1898, as cited by Glassman & Hadad, 2009, p.112). This is to say a behavior which is rewarded is likely to be repeated while those which are punished are likely to end. According to Glassman and Hadad (2009), this idea of reward and punishment extends back to the ancient Greeks but Thorndike's version was different in the sense that it was supported by experimental data thereby making it scientific in nature and this paved the way for behaviorism.

2.2.1.1 Principles of Behaviorism

"Behaviorism is primarily concerned with observable and measurable aspects of human behavior [and] in defining behavior, behaviorist learning theories emphasize changes in behavior that result from stimulus-response associations made by the learner" (Zhou & Brown, 2014, p.4). According to Rotfeld (2007), as cited by Weeger and Pacis (2012), behaviorism provides a roadmap for research which allow the control and measurement

of all relevant variables by ignoring human thought or cognition thus, disregarding what might occur in people's minds and strictly focusing on behavioral responses (observable characteristics). According to Glassman and Hadad (2009), Watson's proposition holds these three central principles in behaviorism:

1. The emphasis on observable responses and environmental stimuli;
2. The rejection of mentalistic concepts not grounded in direct observation; and
3. The focus on learning and experience as central to the understanding of human behaviour.

Cunningham, Gannon, Kavanagh, Greene, Reddy and Whitson (2007) also propose the following as principles underlying behaviorism:

1. Knowledge is infinite and is itself an action or at least rules for action. "It is a set of passive, largely mechanical responses to environmental stimuli" (GSI Teaching & Resource Center, 2016, p.3).
2. Learning is said to be overt, observable and measurable using empirical methods such as observing the changes in a learner's behavior.
3. Thought processes fall outside the remit of the controlled environment and are therefore of little or no concern.
4. When specific stimuli are introduced within a controlled environment, it triggers appropriate learning to achieve specific goals.
5. Behavior is largely influenced by external factors, as opposed to internal thought processes.
6. Learning occurs where specific stimuli are introduced to the learner causing certain responses to occur which result in a change in behaviour.

7. Learning usually takes place in incremental steps and can be increased through repetition and reinforcement.

The GSI Teaching & Resource Center (2016) adds that motivation, in the view of behaviorists, is explained in terms of schedules of positive and negative reinforcement. Thus rewarded actions (positive reinforcement) leads to the repetition of desirable results while punished or ignored actions (negative reinforcements) helps to extinguish undesirable behaviors. To Cunningham et al. (2007), "it is the prospect of receiving positive reward that drives learning, such as passing an exam [thus] extrinsic motivation drives students to do things for tangible rewards or pressures" (p.5).

2.2.1.2 Pedagogies based on Behaviorism

Teaching methods or pedagogies based on behaviorism "tend to rely on so-called 'skill and drill' exercises to provide the consistent repetition necessary for effective reinforcement of response patterns" (GSI Teaching & Resource Center, 2016, p.4). From the skill and drill exercises we obtain teaching methods such as question (stimulus) and answer (response), rote learning, guided practice; and regular reviews of learnt materials (mental drills).

One of the most prominent teachings methods adopted by behaviorists is the lecture method. This is method of teaching is based on the premise that learners are empty slates or tabula rasa and thus come to school with virtually nothing in their head; the teacher is also seen as a warehouse of knowledge whose duty is to fill the empty heads of learners with the knowledge needed at their level. Hence in the classroom, the teacher is seen as an instructor rather than a facilitator and is virtually the only person licensed to talk while providing little or no room for contributions from learners. The Academic Practice and

Organizational Development (2010) refers to this method as the traditional method which is largely based on "behavioral learning where the learner is reactive to conditions in the environment rather than taking an active role in discovering the environment" (p. 15). They add that this method is most appropriate for recalling facts, defining and illustrating concepts, applying explanations and automatically performing a specified procedure where the learners' role is mostly passive and is almost totally dependent on the teacher.

2.2.1.3 Teaching and Learning in the Behaviorist Classroom

Behaviorist classrooms are mostly teacher-dominated or what is mostly referred to as teacher centred where learners basically receive knowledge without necessarily questioning or examining it. Below are some characteristics of a behaviorist classrooms:

1. Teacher centred lessons where learners are passive receivers of knowledge.
2. Use of teacher centred methods such as lecture as well as skill and drill methods
3. Non reliance on pupils prior experiences during learning.
4. Desirable behaviors are rewarded to ensure repetition while undesirable ones are punished to cause its termination.
5. Assessment of student performance is done mainly through their actions, thus the ability to recall fact, perform an experiment, etc.
6. Emphasizing the observable end product of learning rather than the mental processes involved in learning.

As purported by Ertmer and Newby (2013), there is no attempt to determine the structure of a student's knowledge nor to assess the mental processes necessary for them to use. They also outline the following as assumptions or principles that have direct relevance to instructional design:

1. An emphasis on producing observable and measurable outcomes in students [behavioral objectives, task analysis, criterion-referenced assessment]
2. Pre-assessment of students to determine where instruction should begin [learner analysis]
3. Emphasis on mastering early steps before progressing to more complex levels of performance [sequencing of instructional presentation, mastery learning]
4. Use of reinforcement to impact performance [tangible rewards, informative feedback]

The GSI Teaching & Resource Center (2016) adds that there is a heavy "use of positive reinforcements such as verbal praise, good grades, and prizes [and that] behaviorists assess the degree of learning using methods that measure observable behavior such as exam performance" (p.4). The job of the teacher, according to Gropper (1987) as cited by Ertmer and Newby (2013), is to (1) determine which cues can elicit the desired responses; (2) arrange practice situations in which prompts are paired with the target stimuli that initially have no eliciting power but which will be expected to elicit the responses in the "natural" (performance) setting; and (3) arrange environmental conditions so that students can make the correct responses in the presence of those target stimuli and receive reinforcement for those responses.

Behaviorist teaching methods prove very successful where there is a need for memorizing a fact or providing a singular appropriate response. Parkay and Hass, (2000) as cited by Zhou and Brown (2014), add that behaviorism ensures that "students work for things that bring them positive feelings, and for approval from people they admire; they change behaviors to satisfy the desires they have learned to value [and] they generally avoid

behaviors they associate with unpleasantness and develop habitual behaviors from those that are repeated often" (p.9).

2.2.2 The Cognitive Theory of Learning (Cognitivism)

Cognitivism dates back to the early twenty century. According to Yilmaz (2011), the move from behaviorism to cognitivism was as a result of the failure behaviorist to explain how individuals process information. "Psychologists and educators began to de-emphasize a concern with overt, observable behavior and stressed instead more complex cognitive processes such as thinking, problem solving, language, concept formation and information processing" (Snelbecker, 1983, as cited by Ertmer & Newby, 2013, p.50). This led to early advocates to "demand an approach to learning theory that paid more attention to what went on inside the learner's head" (GSI Teaching & Resource Center, 2016, p. 5). They were of the view that prior knowledge and mental processes played a bigger role than stimuli in building and adjusting behavior or response but also intervene between a stimulus and response (Deubel, 2003; Winn & Snyder 1996; all cited by Yilmaz, 2011).

Early proponents of this theory simply opposed the view that all human beings can be programed to behave like machines and thus can respond similarly in the same situation; they then developed what is now referred to as the cognitive theory which focuses on the mental processes of an organism rather than just the observable characteristics. "Common to most cognitivist approaches is the idea that knowledge comprises symbolic mental representations, such as propositions and images, together with a mechanism that operates on those representations" (GSI Teaching & Resource Center, 2016, p. 5). According to Yilmaz (2011), "Piaget's theory of individual cognitive development,

Vygotsky's theory of social cognitive growth or zone of proximal development, Festinger's cognitive dissonance theory, Spiro's cognitive flexibility theory, Sweller's cognitive load theory, Bruner's cognitive constructivist learning theory, and Tolman's theory of sign learning" (p.205), have all contributed to the growth of cognitivism.

2.2.2.1 Principles of Cognitivism

As opposed to behaviorism, cognitivists believe that organisms, and human beings for that matter, are not passive when it comes to knowledge construction but rather, they actively construct their own knowledge always makes reference prior experiences as well as to already built cognitive structures. As the GSI Teaching & Resource Center (2016) puts it, they believe that "knowledge comprises active systems of intentional mental representations derived from past learning experiences [and] because knowledge is actively constructed, learning is presented as a process of active discovery." (p.5). The Academic Practice and Organisational Development (2010) proposes the following as the key tenets of cognitivism:

1. Learning improves as the quality of cognitive engagement increases.
2. Cognitive engagement enables the intentional and purposeful processing of lesson content.
3. Engagement requires strategies that promote manipulation of information rather than memorization.
4. Learning takes place most effectively when students are actively engaged and learn in the context in which the knowledge is to be used.

The GSI Teaching & Resource Center (2016) adds that while the behaviorist learning theory focuses on extrinsic factors such as rewards and punishment to motivate or

demotivate behavior, the cognitive learning theory sees motivation as intrinsic. In the view of Perry (1999) as cited by the GSI Teaching & Resource Center (2016), this is because behavior modification involves a significant reorganization of existing mental structures therefore a successful learning requires a personal investment on the part of the learner which is intrinsic. They argue that any form of behavior modification or learning which does not have a firm foundation or reason in the learners mind will sooner or later be questioned by the individual and at that moment, that information may be discarded should the individual find no use or application for that piece of information or knowledge.

Ertmer and Newby (2013) also proposed the following as assumptions or principles that have direct relevance to instructional design

1. Emphasis on the active involvement of the learner in the learning process [learner control, metacognitive training (e.g., self-planning, monitoring, and revising techniques)]
2. Use of hierarchical analyses to identify and illustrate prerequisite relationships [cognitive task analysis procedures]
3. Emphasis on structuring, organizing, and sequencing information to facilitate optimal processing [use of cognitive strategies such as outlining, summaries, synthesizers, advance organizers, etc.]
4. Creation of learning environments that allow and encourage students to make connections with previously learned material [recall of prerequisite skills; use of relevant examples, analogies]

Ertmer and Newby (2013) however identify some commonalities between some cognitivist and behaviorist principles though they perform different functions in the case of each theory. One of these principles is the use of feedback during learning. They purport behaviorists employ the use of feedback to modify the behavior of learners in a preferred direction, while cognitivists make use of feedback to guide and support accurate mental connections (Thompson, Simonson & Hargrave, 1992, cited by Ertmer & Newby, 2013). Ertmer and Newby (2013) add that both the cognitivist and behaviorist engage in learner and task analysis. They purport the cognitivist engage in learner and task analysis to determine their predisposition to learning, thus, how they activate, maintain, and direct their learning (Thompson et al., 1992, cited by Ertmer & Newby, 2013); as well as to determine how to design teaching so that concepts can be easily understood. The behaviorist on the other hand, engage in learner and task analysis to determine where to begin a lesson as well as which reinforcers would be most effective for a lesson (Ertmer & Newby, 2013).

2.2.2.2 Pedagogies based on Cognitivism

According to Ertmer and Newby (2013), since cognitivism places much emphasis on mental structures, it is usually considered more suitable for explaining complex forms of learning such as reasoning, problem-solving and information-processing. The Academic Practice and Organisational Development (2010) add that examples of teaching methods related to cognitivism include: problem-solving, research projects, creative visualization and brainstorming. Yilmaz (2011, p.209) also proposes the following as methods of teaching based on a cognitive perspective on learning:

1. **Cognitive Apprenticeship**: Cognitive apprenticeship is a method of helping students grasp concepts and procedures under the guidance of an expert such as the teacher. This approach characterized by the following phases of instruction:-
    a. *Modeling*: The teacher performs a task or explains a process for students to observe, which helps them understand what it takes to accomplish the learning task. Modeling allows students to generate conditionalised knowledge, thus, when, where, and how to use knowledge to solve different kinds of problems.
    b. *Coaching*: This is where the teacher observes students and provides hints, cues, feedback, and help, if needed.
    c. *Articulation*: At this stage, students are allowed to think out loud about how they performed the task and offer reasons for the strategies that they used.
    d. *Reflection*: Here, students retrospectively think of their performance on completing the task and compare their actions with the teacher's or other students' actions.
    e. *Exploration*: The teacher at this point urges students to identify a problem, formulate a hypothesis, and seek needed information to solve it. Students look at the different aspects of the problem from different perspectives on their own. (Collins, Brown, & Newman 1989; Wilson & Cole 1991; Wilson, Jonassen, & Cole 1993, all cited by Yilmaz, 2011).
2. **Reciprocal Teaching:** This is defined as an instructional activity in the form of a conversation happening between teachers and students about parts of text (Palincsar, 1986, cited by Yilmaz, 2011). The main purpose is to bring meaning to the text in question to facilitate learning and understanding.

3. **Anchored Instruction:** Anchored instruction refers to designing and implementing instruction in a realistic setting around certain anchors such as cases, stories, or situations to encourage some kinds of case-study and problem solving.
4. **Inquiry Learning:** This teaching method grows out of Piaget's cognitive development theory and resembles the scientific inquiry method. The main goal here is to help students develop their higher-order thinking skills by involving them in a process of either investigating an issue or formulating and testing a hypothesis in order to find solutions to a problem (Saskatchewan Education, 1997, cited by Yilmaz, 2011).
5. **Discovery Learning:** This teaching method is also informed by Piaget's theory of cognitive development. Ormrod (1995) as cited by Yilmaz (2011), defines this method as an instructional approach whereby students communicate with their environment by exploring and manipulating objects, grappling with questions or performing experiments. As the name suggests, discovery learning encourages students to discover principles and important relationships by engaging them in activities like asking questions, formulating hypothesis, doing experiments and research, and investigating a phenomenon (Schunk 2004, cited by Yilmaz, 2011).
6. **Problem-based Learning:** Problem-based learning involves presenting students with an well-structured, open-ended, authentic or real-life problem with many possible correct solutions and asking them to find answers to it. As opposed to traditional instruction that teaches facts and skills first and then introduces the problem, this method introduces the problem at the very beginning of instruction

on the basis of what students' prior knowledge as well as teaches facts and skills in a relevant context.

As purported by Ertmer and Newby (2013), cognitivists employ the use of two techniques to achieving effectiveness and efficiency of knowledge transfer: *simplification* and *standardization*. This simply refers to the analysis, decomposition, and simplification of knowledge or information into basic building blocks as well as the removal of irrelevant information (Ertmer & Newby, 2013) which may render the information or knowledge too cumbersome for assimilation.

2.2.2.3 Teaching and Learning in a Cognitivist Classroom

To the cognitivist, learning is equal to discrete changes between states of knowledge rather than with changes in the probability of response and as such, cognitivism focuses on the conceptualization of students' learning processes as well as addressing the issue of how learners receive, organize, store, and retrieve information by the mind (Ertmer & Newby, 2013). "Learning is concerned not so much with what learners *do* but with *what* they know and *how* they come to acquire it" (Jonassen, 1991, cited by Ertmer & Newby, 2013, p.51). Below are some characteristics of a cognitive classroom:

1. Emphasis is placed on the progress of learning than the end result of learning.
2. Lessons are planned based on the cognitive level of pupils.
3. Assesment of learning is made based on the cognitive level of pupils.
4. Assessment of learning is done at every stage of the learning process and not necessarily at the end of the learning process.

5. Students encouraged to memorize the core points of a lesson. For instance, through the use of mnemonics.
6. Much emphasis is placed on the mental processes of learning.
7. Reasoning, problem-solving and information-processing activities are most likely employed during lessons.

Ertmer and Newby (1993) as cited by Yilmaz (2011), also summarizes the following as the basic characteristics of a classroom instruction based on cognitive theories:

1. Emphasis on the active involvement of the learner in the learning process (learner control).
2. Metacognitive training (e.g., self-planning, monitoring, and revising techniques).
3. Use of hierarchical analyses to identify and illustrate prerequisite relationships (cognitive task analysis procedures).
4. Emphasis on structuring, organizing, and sequencing information to facilitate optimal processing (use of cognitive strategies such as outlining, summaries, synthesizers, advanced organizers, etc.).
5. Creation of learning environments that allow and encourage students to make connections with previously learned material (recall of prerequisite skills; use of relevant examples, analogies).

Unlike the behaviorist who views learners as empty vessels and thus incapable of contributing meaningfully to lessons, the "cognitive school views (1) learning as an active process "involving the acquisition or reorganization of the cognitive structures through which humans process and store information" and (2) the learner as an active

participant in the process of knowledge acquisition and integration" (Good & Brophy, 1990; Merriam & Caffarella, 1999; Simon, 2001, all cited in Yilmaz, 2011, p.205). The teacher's role however, is to serve as a guide or facilitator by providing a conducive atmosphere and a well structure as well as simplified content for learners.

2.2.3 The Constructivist Theory of Learning (Constructivism)

Constructivism is a "theory of education that has great influence in every field of education like educational research, evaluation, educational outcomes and enhancing teaching and learning experience" (Muhagir, 2014, p.2). According to Cooper (1993), cited by Applefield, Huber and Moallem (2001):

> "*the field of education has undergone a significant shift in thinking about the nature of human learning and the conditions that best promote the varied dimensions of human learning. As in psychology, there has been a paradigm shift in designed instruction; from behaviorism to cognitivism and now to constructivism*" (p.4).

Constructivism surfaced as interest in behaviorism waned (Mayer, 1996, cited by Liu & Matthews, 2005). Vygotsky, together with many others, condemned the behaviorist approach to learning as too narrow, specialised, isolated and intrapersonal to say the least (Liu & Matthews, 2005). Likewise, Phillips (1995), as cited by Liu and Matthews (2005), added that "the mechanistic underpinning by an orderly, predictable, and controllable view of the universe proved inadequate to capture the active and social characteristics of learners" (p.387). This gave raise to the emergence of cognitivism which was later improved to become constructivism. As Chen (2003) puts it "constructivism is an outgrowth of cognitive science" (p.19).

Taber (2011) sees constructivism as "a major referent in education, although it has been understood in various ways, including as a learning theory; a philosophical stance on human knowledge; and an approach to social enquiry" (p.39). Phillips (2000) also purports that constructivism can be viewed with two different lenses: sociological and psychological.

1. With the sociological lens, we have the *social constructivism*. This theory purport that knowledge cannot be considered to provide an objective representation of the external world because knowledge is as a result of "human constructs", and that these forms of knowledge are influenced by such things as "politics, ideologies, values, the exertion of power and the preservation of status, religious beliefs, and economic self-interest" (Phillips, 2000, p. 6). This perspective basically focuses on the ways in which human structures such as the economy, power, political systems and social factors, affect how the society form understandings which in turn influences the way they interpret the world (Richardson, 2003).
2. With the psychological lens, we have the *psychological constructivism*. "This approach relates to a developmental or learning theory that suggests that individual learners actively construct the meaning around phenomena, and that these constructions are idiosyncratic, depending in part on the learner's background knowledge" (Richardson, 2003, p.1625). this is to say that every individual tend to develop understanding of issues and come to know by relating the new information to the one he already has constructed based on personal experience.

The difference between these two lenses from which the theory of constructivism can be viewed is that, while sociological constructivism focuses on the construction of knowledge influenced by external factors, psychological constructivism focuses on the construction of knowledge based on ones' own understanding based on experience.

According to Phye (1997), as cited by Chen (2003), "constructivism is a movement that combines cognition from a developmental perspective with other important issues, such as motivation, self-directed learning, and a focus on the social context of learning" (p.19). In the view of Resnick (1989), as cited by Richardson (2003), constructivism is a theory of learning or a theory of meaning making whereby individuals create their own knowledge through an interaction between their experience and/or perceptions and the new information they are confronted with. To Thompson (2000), constructivism is not a theory of learning but a model that can be followed to acquire knowledge and may serve as a foundation upon which learning theories are built. Chen (2003) views constructivism as a process of constructing knowledge with concept development and comprehensive understanding as it ultimate goals. "Constructivism learning theory is defined as [the] active construction of new knowledge based on a learner's prior experience" (Koohang, Riley, Smith & Schreurs, 2009, p.92). According to Woolfolk (1993), as cited by Koohang et al. (2009), the main idea when it comes to constructivism is that learners actively build their own knowledge by mediating between inputs from the outside world and one's experiences thus making learning an active mental work and not a passive reception of teaching.

All the explanations provided as the definitions for constructivism presents the idea that developing one's understanding requires the active involvement of the individual in the

process of constructing meaning. In contrast to behaviorism, constructivists are of the view that learners are not empty slates who passively receive knowledge but rather build it up through cognitive structures and experience, thereby shifting the focus from knowledge as a product to knowing as a process (Von Glasersfeld, 1995, as cited by Applefield et al., 2001). Constructivism can thus be defined as a theory of learning which holds the view that learners are not tabula rasa and are capable of constructing their own knowledge through their interaction with the environment and their experiences. Those who believe in the theory of constructivism are referred to as constructivists and they basically hold the view that "learning in school demands students with the ability to relate actively to the academic subject and through dialogue, experiment, reflection etc. thereby creating a personal academic identity" (Qvortrup, Wiberg, Christensen & Hansbøl, 2016, p.101).

2.2.3.1 Principles and Characteristics of Constructivism

Constructivism purports that learners construct their own truths based on their perceptions of prior experiences. "Thus, each person's knowledge is a function of his or her prior experiences, how they are perceived and how they are organized" (Applefield et al., 2001, p.22). Constructivism is based on a philosophical view that reality is independent of our way of knowing and that we as human have no access to an objective reality. Rather, we build understanding of the world from our perceptions and experiences, which are themselves mediated through our previous knowledge (Simon, 1995). Constructivism suggests that learner acquires knowledge via making meaningful investigations by engaging in a process of constructing individual interpretations of their experiences (Applefield et al., 2001). The constructivist believes that "knowledge is

constructed and learning occurs when children create products or artifacts. They assert that learners are more likely to be engaged in learning when these artifacts are personally relevant and meaningful" (Zhou & Brown, 2014, p.13). As purported by Taber (2011) constructivism as a theory of learning, holds the following as the nature of human learning:

1. Human learning is constrained and channeled by the nature of the cognitive apparatus that inevitably has built-in biases; and
2. Human learning is contingent upon the cognitive resources that are available to any particular individual to interpret (make sense of) information.

Taber describes information as the electrical signals that passes through the senses (tough, smell, sight, feel and taste) of an individual into the brain providing them with signals which are representations of the external environment in the form of electrical pulses.

According to von Glasersfeld (1989) "constructivism is a theory of knowledge with roots in philosophy, psychology, and cybernetics" (p.1). Glasersfeld asserts that constructivism has two main principles whose is useful for the study of cognitive development and learning. These principles are that:

1. knowledge is not passively received but actively built up by the cognizing subject; and
2. the function of cognition is adaptive and serves the organization of the experiential world, not the discovery of ontological reality.

Hein (1991) in his presentation at a conference in Israel gave the following as some guiding principles of constructivism:

1. Learning is an active process in which the learner uses sensory input and constructs meaning out of it. This is to say that learning is not the passive acceptance of knowledge which exists somewhere but that learning involves learner's engaging with the world.
2. People learn to learn as they learn, thus, learning consists both of constructing meaning and constructing systems of meaning. Meaning we construct makes us better able to give meaning to other sensations which can fit a similar pattern.
3. The crucial action of constructing meaning is by using the mind. This to say, physical actions and hands-on experience may be necessary for learning, especially for children, but these should be consolidated with activities which engage the mind as well as the hands.
4. Learning involves language, thus, the language we use influences learning.
5. Learning is a social activity. This is to say, our learning is intimately associated with our connection with others such as our teachers, our peers, our family as well as casual acquaintances.
6. Learning is contextual. Thus, we do not learn isolated facts and theories separate from the rest of our lives but rather we learn in relationship to what we know, what we believe, our prejudices and our fears.
7. One needs knowledge to learn. This means that it is not possible to assimilate new knowledge without having some structure developed from previous knowledge to

build on, thus, the experience or prior knowledge of every individual is necessary for knowledge construction.

8. It takes time to learn; learning is not instantaneous and that for learning to be permanent we need to revisit ideas, ponder them try them out, play with them and use them.
9. Motivation is a key component in learning. It does not only helps learning, it is essential for learning. This may be through the provision of a conducive learning environment and accepting the view of learners without discrimination.

These principles serve as the foundation upon which instructional strategies under constructivism are designed. Jonassen (1994), as cited by Yakubu (2015), proposed the following eight characteristics that underline the constructivist learning environments:

1. Constructivist learning environments provide multiple representations of reality.
2. Multiple representations avoid over simplification and represent the complexity of the real world.
3. Constructivist learning environments emphasise knowledge construction instead of knowledge reproduction.
4. Constructivist learning environments emphasise authentic tasks in a meaningful context rather than abstract instruction out of context.
5. Constructivist learning environments provide learning environments such as real-world settings or case-based learning instead of predetermined sequences of instruction.

6. Constructivist learning environments encourage thoughtful reflection on experience.

7. Constructivist learning environments enable context and content dependent knowledge construction.

8. Constructivist learning environments support collaborative construction of knowledge through social negotiation, not competition among learners for recognition.

"In constructivism, constructing an understanding requires that the learners have the opportunities to articulate their ideas, to test those ideas through experimentation and conversation, and to consider connections between the phenomena that they are examining and other applications of the concept" (Chen, 2003, p.19). In a nut shell, a constructivist class is characterized by the fact that learners collaborate with each other and actively participate in lessons; knowledge is constructed based on the learners' prior life experiences, activities are very interactive through the use of manipulatives as well as using examples that are familiar to learners, the whole learning process is child-centred and the teacher serves as a facilitator.

2.2.3.2 Misconceptions about Constructivism

There are numerous misconceptions that have developed from the instructional practices of constructivism usually stemming from misinterpretations of the underlying principles derived from constructivism (Applefield et al., 2001). Popular amongst these misconceptions are that:

1. The teacher loses his authority over learners: This stemming from the misconception that the teachers' only duty is to arrange activities and observe pupils discover knowledge for themselves. The teacher in a constructivist classroom does not only observe learners as they construct knowledge but provides useful cues and clues through questioning so as to guide learners on the path of constructing knowledge.
2. Constructivist instructions are time wasting: Some assume that instructional time may be too limited to indulge in constructivist instructional practices since much has to go into planning, more structured activities and constant supervision which can be easily achieved using traditional methods of instructions like the lecture method. Constructivist rely on the end product of learning, thus learners acquiring knowledge that they can personally apply to solve other issue they may later be confronted. Hence, rather than clumping up a lot of materials for learners, a teacher influenced by the constructivist principles rather makes learning meaning and permanent in the learner by breaking the syllabus into smaller, teachable and enjoyable units which prepares learners for the life ahead.
3. Constructivist instructional practices automatically leads to learning: this also stems from the misconception that a lesson with the right activities will lead to learning but if the lesson is not sequentially planned and the necessary guidance of the teacher is absent, learners may achieve nothing.

Applefield et al. (2001) refer to these misconceptions surrounding constructivist instructional practices as myths and talks about five of such misconceptions:

1. ***There is no focus for learning, no clear goal in constructivist-based instruction***. They affirm it is possible to create a purposeful learning environment under the knowledge construction assumptions of constructivist learning and that learners will actively strive to achieve a cognitive objective. They emphasize that the fact that constructivism does not offer clear guidelines for planning a particular sequence of instruction nor prescribe a particular set of activities the learner must engage in, it does not mean that no learning outcomes can be identified for learners as a group or that instruction cannot be planned in any systematic way. "Rather, it emphasizes the design of learning environments that focus on knowledge construction, instead of reproduction" (Duffy & Jonassen, 1993 cited by Applefield et al., 2001, p.24).
2. ***Constructivist based instruction is not thoughtfully planned; careful preparation is less important than in traditional instruction.*** Contrary to this assumption, constructivist instructions rather demand a lot of careful planning. Identifying an authentic activity as well as identifying the problems learner may face in advance is not an easy task and demands careful planning. Carefully planned activities is the driving force of a constructivist instruction, this means that careful attention needs to be given to whatever content and material the teacher employs to administer his lesson. This is because the quality and suitability of the activity coupled with the right guidance by from the teacher will lead to effective learning and vice-versa.
3. ***There is an absence of structure for learning in a constructivist learning environment.*** Contrary to this assumption, structure does exist in a constructivist classroom and according to Applefield et al. (2001), it emerges in two ways: the first being that, "a curriculum or a lesson has an organizing topic, task or question (design and construct a parallel and a series circuit) that sets the initial direction of the classroom conversation" (Applebee, 1996, cited by Applefield et al., 2001, p.25). The second aspect is that there

is a relationships among the various parts of a learning experience in the sense that when confronted with a problem to be solved, both the teacher and learners collaboratively search for its causes, note similarities and differences with tasks with which the learners are conversant, and classify it hierarchically as part of a larger system. These systems provide a perfect structure for the constructivist classroom though not a clear cut as other traditional methods of teaching.

4. ***As long as learners are involved in discussion and other forms of social interaction, learning will take place.*** In every classroom learners interests vary and necessarily needs guidance. Teachers in a constructivist learning environment must constantly monitor discussions and intervene where necessary to maintain the focus of the discussions as well as ensure learners do not get off track or develop any misunderstanding on the topic being treated. It is thus necessary that the teacher carefully monitors group work and whole-class discussions, to keep students on track, to stimulate consideration of key issues and perspectives, and to guide learners in correcting their misunderstandings. This shows that pupils' interaction alone does not automatically lead to learning and that the absence of the teachers' guidance may lead to disaster in the constructivist classroom.
5. ***Since teachers are not primarily engaged in delivering instruction (lecturing and explaining), their role in the classroom is less important.*** As discussed in the third and fourth point above, the teacher's role in the constructivist classroom is of vital importance owing to the fact that he has to be able to anticipate learners' needs and problem before hand, plan authentic activities and provide guidance while maintaining a friendly learning environment. These duties show relevance of the teacher in the classroom and can be seen as even more critical as

compared to traditional methods of teaching because the teacher has to be more versatile to be able to, not only, plan lessons systematically but also facilitate learning and take on-the-spot decisions to ensure a successful lesson.

2.2.3.3 Pedagogies derived from Constructivism

According to Jones and Brader-Araje (2002), constructivism provides teachers with instructional methodologies which correlate with current research on learning. The different perspectives held by constructivist on learning have paved way to a number of teaching strategies in the classroom (Palmer, 2005). Some of these teaching strategies include: problem-based, inquiry learning and discovery method, enquiry learning, co-operative learning, just to mention a few. Muhagir (2014) also identified and discussed three of these methods namely: scaffolding, discovery learning and cooperative learning. These three are further discussed below:

1. **Scaffolding**: According to Wood and Middleton (1975) as cited by Jonassen (1999), the concept of scaffolding represents any kind of support for cognitive activity that is provided by an adult when the child and adult are performing the task together. Collins et al. (1987) as cited by Muhagir (2014), scaffolding can be seen as a teacher carries out "parts of the overall task that the student cannot yet manage. As such, it involves a kind of cooperative problem-solving effort by teacher and student in which the express intention is for the student to assume as much of the task on his own as possible, as soon as possible" (p.6). Scaffolding, in the view of Muhagir (2014), is the support the teacher or other colleagues of the learner provide to the learner. He adds that it can be seen in various forms of

learning like problem based learning, classroom discussion, cooperative learning, and brainstorming.

2. **Discovery Learning:** Hammer (2009) defined discovery learning as a form of curriculum in which learners are exposed to certain specific questions and experiences in order for them to discover for themselves the intended underlying concept. Discovery learning is based on the assumption that pupils are more likely to retain the knowledge they discover for themselves. "In this teaching / learning approach of learning students are given assignment to do scientific experiment or to investigate a problem in order to discover concepts by themselves" (Muhagir, 2014, p.7). The student's inquiry is usually guided by the teacher and the material. Spencer and Walker (2011) as cited by Muhagir (2014, p.7), purport that discovery learning "exploits the strategies of engagement, exploration, explanation, elaboration, and evaluation of learning experiences" as well as strict supervision of learning activities by the teacher to ensure learners stay on track. To Yakubu (2015), "the role of the teacher in discovery learning is to provide pupils with problems and provide feedback when necessary, without actually directing their efforts" (p.26).
3. **Cooperative learning:** According to Muhagir (2014) in cooperative learning learners are put in groups to work collaboratively towards implementing a learning tasks. He adds that collaborative learning comes in different variations such as problem solving, laboratory work and in projects such as designing a prototype of a product or an object. Assignments given under co-operative learning should be clearly explained so as to ensure a correct division of task and to maximize learning.

In the view of Yakubu (2015) the constructivism has given rise to many different but related instructional approaches; some of which include:

1. **Case-based learning:** Herreid (1997) as cited by Yakubu (2015) explains case-based learning as using real-life illustrations to build a learners knowledge by solving questions about specific cases usually focusing on small groups and the interactions between the participants. She further adds that learners in case-based learning benefit from because they are given an opportunity to take decisions and address different perspectives as part of their learning process. "By engaging themselves in collaborative learning and provocative group discussion, pupils are coached to become accustomed to taking responsibility and respecting different views. They also acquire critical thinking, creativity, self-learning and communication skills" (p.26).
2. **Inquiry-based learning:** as purported by Edelson, Gordin, and Pea (1999) cited by Yakubu (2015), inquiry-based learning places the responsibility for learning and understanding concepts, thus determining the content, the learning process, and the assessment of learning, on pupils by actively involving and leading them to understand concepts usually through questions that serve as guide to instruction rather than predetermined topics. Lee (2004) as cited by Yakubu (2015) posits that "if this method is implemented effectively, pupils would learn to formulate good questions, identify and collect appropriate evidence, present results systematically, analyse and interpret results, formulate conclusions, and evaluate the worth and importance of those conclusions" (p. 27).

3. **Problem based learning:** Problem-based learning teaches pupils to think critically, analyze problems, and use appropriate resources to solve real-life problems (Yakubu, 2015) by presenting them with open-ended and authentic problems as they work in teams to find hints and develop solutions with the teachers acting as facilitators (Tan, 2003). Yakubu (2015) adds that throughout this process, the teacher plays the role of a facilitator, mainly providing guidance and advice, rather than directing and managing pupil's work. "At the end, pupils demonstrate their newly acquired knowledge and are judged by how much they have learned and how well they communicate it" (p.28).
4. **Active learning:** Yakubu (2015) describes the process of active learning as create an environment in which learners solve problems, answer questions, formulate questions of their own, discuss, explain, debate, or brainstorm during lessons. This, she adds, greatly encourages the learner as they are actively involved in the learning process. Active learning involves learners in two ways, thus, doing things while at the same time thinking about the things they are doing (Yakubu, 2015) under the guidance of the teacher.

2.2.3.4 Teaching and Learning in the Constructivist Classroom

From a constructivist perspective, meaning is understood to be the result of humans setting up relationships, reflecting on their actions, and modeling and constructing explanations (Fosnot, 2005). One of the core ideas to constructivism is that learners are not passive receivers of knowledge but play an active role in constructing their own meaning through the process of accommodation or adaptation based on their experiences or ideas (Jenlick & Kinnucan-Welsch 1999, cited by Le-Cornu & Peters, 2005). According to Windschitl (2002, p 135) teaching is now seen as "co-constructing

knowledge with students, acting as conceptual change agent, mentoring apprentices through the zone of proximal development and supporting a community of learners". One of the main functions of a teacher in constructivist classroom is to be a reflective practitioner, thus one who is constantly pondering over lessons before, during and after lessons. The teacher therefore has to engage in reflective processes for themselves as well as engage the students in reflective processes (Le-Cornu & Peters, 2005). Dewey (1933), as cited by Le-Cornu and Peters (2005), identified three attitudes as prerequisites for reflective teaching:

1. Open-mindedness: Having an active desire to listen to more sides of an issue than just one.
2. Responsibility: Having the ability to question as well as find answers to why you are doing what you are doing in the classroom.
3. Wholeheartedness: Having an ability to take risks and act.

Teachers are, as well, challenged to provide teaching techniques that support students' construction of their understanding (Chen, 2003). Chen further proposes the following to help make learning more effective in the constructivist classroom:

1. Concept must be presented in realistic, meaningful contexts, and the interconnections among knowledge components must be made explicit.
2. Providing the experience alone is not sufficient; the teacher should ask questions and listen carefully to students' interpretations of the data.
3. The teacher must push students to think as clearly as they can about their ideas. This can usually be achieved through constructive follow-up questioning and providing cue and clues where necessary.

4. The teacher should perceive errors as the results of the learners' conceptions for the moment, because at that moment that is what makes sense to the student.
5. To modify learners misconceptions, the teacher will need to elicit an explanation as to how the students have arrived at their answers, and ask questions or provide a different perspective which will allow the learner to discover their errors and construct the correct concept (von Glasersfeld, 1995, cited by Chen, 2003).
6. Allow learners to manipulate objects as this will make concepts become visible to them.
7. A playful atmosphere needs to be maintained because as long as learners are having fun, they are motivated and attentive, and it also helps to release the frustration inherent in constructing understanding.
8. The learners, not the teacher, are responsible for defending, proving, justifying, and communicating their ideas to the classroom.

The Australian Council for Educational Research (2015), provides three functions as being the teachers' role to facilitate learning in a constructivist learning environments: modelling, couching and scaffolding.

1. **Modeling** –Modeling is the most commonly used instructional strategy in a constructivist learning environment. According to Jonassen (1999) there are two types of modeling: behavioural modeling of the overt performance and cognitive modeling of the covert cognitive processes. Behavioural modeling deals with demonstrating how to perform the activities identified while cognitive modeling articulates the reasoning that learners should use while engaged in the activities.

2. **Coaching** – One of the functions of the teacher in the constructivist learning environment is coaching. Jonassen (1999) acknowledges that a good coach motivates learners, analyzes their performance, provides feedback and advice on the performance and how to learn about how to perform, and provokes reflection and articulation of what was learned.
3. **Scaffolding** – Scaffolding provides temporary frameworks to support learning and student performance beyond their capacities. Thus students are given tasks beyond their level of understanding then provided with the necessary guidance to help them complete the task. The concept of scaffolding represents any kind of support for cognitive activity that is provided by an adult when the child and adult are performing the task together (Wood & Middleton, 1975, cited by Jonassen, 1999).

2.3 Perception

To appropriately assess the actions of people, one needs to analyze the elements that interact to inform a person's behavior. One of these elements is the individuals' perception which is closely linked to ones' attitudes (Pickens, 2005). Gould (2003) states that perception is a cognitive activity and is individualistic in the sense that it is subject to the perceiver. He adds that sensation takes place before perception and defines sensation as the process by which our "sensory receptors receive, transduce, and code stimulus information into electrochemical impulses in our nervous system [thus] it is the initial, relatively simple process of detecting individual stimuli" (p.1). Fazio and Williams (1984) as cited by Akurugu (2010) defines perception as "those subjective experiences of objects or events that ordinarily result from stimulation of the receptor organs of the body" (p.27). They further add that, this stimulation is converted into neural activity and

is transmitted to the nervous system for further neural processing. According to Bodenhausen and Hugenberg (2009), perception is basically the border between the internal and external worlds of an individual. To them, "the outer environment create signals (visual, auditory, etc.) that can be sensed, and the perceiver receives these signals and converts them into psychologically meaningful representations that define our inner experience of the world" (p.2). Perception is the means through which "organisms interpret and organize sensation to produce a meaningful experience of the world" (Lindsay & Norman, 1977, as cited by Pickens, 2005, p.52). This is to say, if a person is confronted with an unfamiliar situation, the person interprets and provides a meaningful explanation to it based on knowledge constructed through prior experiences. Similarly the manner in which the individual responds to a situation relies largely on the cognitive structures and belief systems obtained through exploration and experience. Greenberg and Baron (1999) as cited by Akurugu (2010) defines perception as "the process through which we select, organise and interpret information gathered by our senses in order to understand the world around us" (p.14).

2.3.1 Elements and Conditions of Perception

The ability of an individual to perceive is dependent on certain elements and conditions. According to Lewis (2001), some fundamental elements of perception is that:

1. There is an experiencing person or perceiver (the one who performs the perceiving activity).
2. Something is being perceived and this can either be an object, person, situation or a relationship.
3. There is the context within which objects, events or persons are perceived.

4. Perception occurs through certain processes (known as the perceptual process) starting with the experiencing of multiple stimuli by the senses and ending with the formation of a mental concept or cognitive structures which can help an individual take decisions.

Lewis (2001) adds that certain conditions must certainly be satisfied for the perception to take place. These conditions include:

1. There must be a sensory system (such as the ear, tongue, skin, eye and nose) in place that functions normally (Jordaan & Jordaan, 1994, cited by Lewis, 2001).
2. The sensory system be subjected to basic sensory stimulation (such as the ability to smell, touch, hearing, sight and taste).
3. The stimulation should be in a constant state of changes, both physiologically and psychologically. Thus, stimulation from the senses should not be fixed so as to create room for modification of knowledge.

2.3.2 Stages of Perception

According to Bodenhausen and Hugenberg (2009), "the very same social stimulus can be experienced in distinctly different ways by individuals who have different motives, attitudes, expectancies, and recent experiences" (p.14). Pickens (2005) purports that the perception process of an individual follows four stages:

1. Stimulation: This is the first stage of the perception process and according to Pickens (2005), the individual at this stage receives sensory stimuli through their sensory organs in the form of touch, smell, taste, sight and sound.

2. Registration: At this stage of the perception process, the data collected from the sensory organs are recorded in the cognitive structures of the individual for organization.
3. Organization: This is the third stage in the perception process as purported by Pickens (2005). At this stage the individual classifies or categorizes sensory data recorded based on cognitive structures.
4. Interpretation: This is the final stage of the perception process and is characterized by the individual making analysis and trying to understand classified data collected again based on based on prior experiences, beliefs, etc.

Pickens (2005) adds that feedback plays an important role in the interpretation of information collected. According to him the feedback could be positive or negative and that positive feedback reinforces interpretation of one's reality while negative feedback cause internal conflict need for re-examination for future reference.

Kashyap (2016) also proposes three stages for the processes involved in ones' perception:

1. **Perceptual Inputs:** We are constantly being confronted with a lot of stimuli from the environment in the form of information, objects, events, people, etc.; these serve as the inputs for further perceptual processes. According to Kashyap (2016), this is basically through the senses such as touch, sight, smell, taste and hearing. He adds that some stimuli do not affect the senses of an individual consciously and this process is referred to as subliminal perception.
2. **Perceptual Mechanism:** This is the second stage of the perceptual process. According to Kashyap (2016), after a person receives information, they try to

process it through the following sub processes of selection, organisation and interpretation.

a. Perceptual Selectivity: An individual is exposed to a lot of activities in the environment at the same time. However, equal attention cannot be given to all the information around, hence the need for perceptual selectivity. Perceptual selectivity refers to the tendency to select certain objects from the environment for attention. Usually, the objects which are selected are those which are relevant and appropriate for an individual or those which are consistent with our existing beliefs, values and needs. Pickens (2005) refers to this as perceptual vigilance. According to Kashyap (2016), the ability to select the right stimuli depends on external factors (such as size, intensity, repetition, status, constrast, movement, familiarity, nature) and internal factors (such as prior knowledge, motivation, personality).

b. Perceptual Organisation: After selecting the essential data from the range of stimuli available in ones' environment at any given time, we then try to organize the perceptual inputs in such a manner that would facilitate us to extract meaning out of what we perceive. In other words, person's perceptual process organizes the incoming information into a meaningful whole. According to Kashyap (2016) some factors underlying this organization are: similarity, proximity, closure and continuity.

3. **Perceptual Outputs:** Perceptual outputs encompass all that results from the organization and interpretation of information received. These would include such factors as one's attitudes, opinions, feelings, values and behaviours resulting from the perceptual inputs. Perceptual errors adversely affect the perceptual outputs;

> the lesser ones' biases in perception, the better our chances of perceiving reality as it exists or at least perceiving situations with the minimum amount of distortions.

Kashyap (2016) adds an important aspect of the perception process, thus perceptual interpretation. Kashyap purports that perception is said to have taken place only after the data have been interpreted and that without interpretation, selection and organisation of information do not make any sense at all; this is because after the information has been received and organized, the perceiver needs to give interpretation or assigns meaning to them. The person, after receiving and interpreting data, tends to *check* whether his interpretations are right or wrong usually through introspection and then *react* to the information by indulging in some action in relation to the perception arrived at in the form of perceptual outputs (Kashyap, 2016). Pickens (2005) however adds that whenever information received is not congruent with the person's current beliefs, attitudes, motivation, a perceptual defence is formed which creates an internal barrier that limits the external stimuli passing through the perception process when it. He refers to this as selective perception. "Selective perception occurs when an individual limits the processing of external stimuli by selectively interpreting what he or she sees based on beliefs, experience, or attitudes" (Sherif & Cantril, 1945, cited by Pickens, 2005, p.54).

Lewicki (2005) suggests the internal and external encoding style of individuals as accounting for differences in thier perception. The external encoding style refers to the traditional, sensory-driven approach to perception whereby reactions to stimuli is governed mainly by environmental factors while internal encoding styles, on the other hand, rely on the readiness or ability of an individual to make theory-driven assumptions

based on cognitive structures or expereince. Thus, though all individuals may be exposed to similar information, one may interpret information received using the external encoding style while another may rely on internal encoding style thereby leading to differences in perception and actions.

2.3.3 Influence of Perception on the Teaching and Learning of Mathematics

Teachers are no exception to the influence of perception on their teaching and learning activities. According to Applefield, Huber and Moallem (2001), teachers' perception of learning theories and teaching in general, have been seen to have a considerable influence on almost all aspects of their instructional decisions. As Jonassen (1991), cited by Applefield et al., (2001), puts it, person's knowledge is usually founded on his unique perception of his physical and social experiences; while using their varied mental capabilities to explain, predict, or make inferences about a phenomena in the real world. In addition, teachers' views of teaching and learning guide them as they make decisions about desirable means of implementing and assessing their instruction (Applefield et al., 2001).

As far back as in 1950's, researchers sought evidence with regards to the influence of teacher practice, expectations, and perceptions on learning outcome (Contreras, 2011). It was later discovered by a sociologist, Howard Becker, in a research that "teachers in schools within lower socioeconomic areas used different teaching techniques and expected less from their students than did teachers in middle-class schools" (Contreras, 2011, p.28). Similarly, in 1974, Chaiken and colleagues conducted a research where they videotaped the teaching and learning process of a class where the teachers were alerted that certain students were gifted; they realized, upon analyzing the videos, that

unconsciously teachers favored those students who they knew were talented and treated the rest normally (Contreras, 2011).

Areepattamannil and Kaur (2013) in a study which sought to determine the effect of Mathematics teachers' perceptions on their students' mathematical competence in Singapore and Australia, revealed that mathematics teachers' perception of their students' competencies where positively liked to students' achievement in mathematics, their attitude towards mathematics and their engagement in mathematics lessons. This is to say, teachers who had positive perception about their student mathematical competencies channeled their efforts to providing materials and classroom situations which fostered in turn led to a positive learning outcome. It can thus be said that, a mathematics teacher with a positive perception and expectation towards their students is not in itself a solution to students learning problems but helps the teacher to understand as well as select well established teaching strategies, which promotes students' motivation, commitment and involvement in school activities which inevitably leads to high performance among students (Jussim, Robustelli & Cain, 2009)

2.4 Basic Education Mathematics Curriculum

Mathematics serves as the mother or back bone of several subjects studied in our schools and according to the Curriculum Research and Development Division [CRDD] (2012), "Mathematics is a logical, reliable and growing body of concept which makes use of specific language and skill to model, analyse and interpret the world. It [therefore] provides a medium of communication that is precise, concise and powerful" (p.iv). Ziegler (2011) accepts that there is no definite definition for Mathematics and adds that it is normally referred to as a science that helps to investigates abstract structures for their

properties and patterns. He defines mathematics as the "science that developed from the investigation of figures and computing with numbers" (p.vii).

As an activity carried out by human, "Mathematics involves creativity in the discovery of patterns of shapes and numbers, the recognition of relationships, the modelling of situations, the interpretation of data and communication of emerging ideas as well as concepts" (CRDD, 2012, p.iv). As purported by Piagets' constructivist theories, "people's acts must be considered the genetic source of mathematical conceptualization" (Godino, 2015, p.3). Thus, Mathematics can be said to originate from daily human activities in the quest to understand the world. As the National Mathematics Advisory Panel (2008), cited by Sarfo, Eshun, Elen and Adentwi (2014), puts it "mathematics is the invisible culture of our age; it manifests in our lives in many ways: practical, civic, professional, recreational, and cultural" (p.766). We can thus say that mathematics is the oldest and well-structured body of knowledge which helps us to understand and appreciated the world through the study of relationships, structures, space and patterns. The Universal Encyclopedia (1996), as cited by Dotse (2014), assert that mathematics is divided into arithmetic, which studies numbers, geometry, which studies space, algebra, which studies structures, analysis, which studies infinite processes and probability and statistics, which study random processes.

The term curriculum has been defined in several ways by several authorities in the field of curriculum development (Tse Nga, 2013). Earlier definitions of curriculum were given by Tyler and Wheeler. To Tyler (1949), the curriculum could be seen as "all of the learning of students which is planned by and directed by the school to attain its educational goals" while Wheeler (1967) sees the curriculum as "the planned experiences

offered to the learner under the guidance of the school" (Tyler, 1949, Wheeler, 1967; cited by Stefan, 2010). Edward, Ebert and Bentley (2013), also define the curriculum as "the means and materials with which students will interact for the purpose of achieving identified educational outcomes" (p.1). In simple terms, the curriculum can be defined as what to teach and how to teach it under the guidance of the school.

We can therefore define the mathematic curriculum as a curriculum as which guides and directs the learning experiences of students in mathematics education under the guidance of a school. As discussed earlier, mathematics serves as a bedrock for other important subjects in our basic schools such natural and integrated science. It is for this reason that mathematics education has undergone several transformation coupled with educational reforms and is treated as one of the core subjects from the Primary school to the Senior High School level. However, deciding what to teach and how to teach is influenced by identifying what "repertoire of knowledge and skills that are important for the young learner to master, what role the child should play in achieving mastery, and what organization of learning experience is most likely to yield maximum cognitive power" (Frede & Ackerman, 2007, p.1).

The Basic Education mathematics curriculum in Ghana is thus "designed based on the recognition that mathematics is not only a collection of concepts and skills to be mastered but also involves processes that will help the individual to develop his ability to explore, conjecture, solve problems and reason logically" (Ministry of Education, 2007, cited by Sarfo et al., 2014, p.766). Due to this, Mathematics has been made on of the core subjects in both the basic and secondary school levels of education in Ghana. According to the Curriculum Research and Development Division (2012), the rational of the Basic

Education Mathematics Curriculum is to equip every citizen with the necessary problem solving and decision making skills thereby making every citizen Math literate and able to discover, adapt, modify and be innovative in facing changes and future challenges. As purported by the CRDD (2012),

> "*the learning of mathematics at all levels involves more than just the basic acquisition of concepts and skills; it involves, more importantly, an understanding of the underlying mathematical thinking, general strategies of problem solving, communicating mathematically and inculcating positive attitudes towards an appreciation of mathematics as an important and powerful tool in everyday life*" (p.iv).

To achieve the above rational proposed by the Curriculum Research and Development Division (2012), the following aims were set to guide the mathematics curriculum:

1. to help children appreciate the value of mathematics and its usefulness to them, to develop confidence in their own mathematical ability, to foster a sense of personal achievement and to encourage a continuing and creative interest in mathematics;
2. develop in children the skills, concepts, understandings and attitudes which will enable them to cope confidently with the mathematics of everyday life;
3. help children develop a variety of problem solving strategies involving mathematics and develop the ability to think and reason logically;
4. help children become mathematically literate in a world which is information technology (IT) oriented; and
5. provide a foundation for those children who may wish to further their studies in mathematics or other subjects where mathematical concepts are essential.

From these aims, the following objectives were made to guide the syllabus at the basic level:

1. work co-operatively with other pupils and develop interest in Mathematics
2. read and write numbers
3. use appropriate strategies to perform number operations
4. recognise and use patterns, relationships and sequences and make generalizations
5. identify and use functions, formulae, equations and inequalities
6. identify and use arbitrary and standard units of measure
7. draw and use graphical representations of equations and inequalities
8. use the appropriate unit to estimate and measure various quantities.
9. identify solids and plane shapes and appreciate them in the environment
10. collect, analyse and interpret data and find probability of events
11. use the calculator to enhance understanding of numerical computation and solve real-life problems
12. manipulate learning materials to enhance understanding of concepts and skills

To meet the above aims and objectives requires a sound mathematics curriculum, competent and knowledgeable teachers who can integrate instruction with assessment, classrooms with ready access to technology, and a commitment to both equity and excellence (CRDD, 2012).

2.4.1 The Junior High School Mathematics Syllabus

According to Kelly (1999), as cited by Tse Nga (2013), the curriculum can be viewed as a syllabus which guides teachers to select appropriate content or the body of knowledge they wish to transmit within a given subject. The National Syllabus for mathematics

(Junior High School 1-3), serves as the curriculum that guides mathematics education in the Junior High School level. It therefore includes what must be taught, how it must be taught and how to measure the effectiveness of the teaching and learning process (Asafo-Adjei, 2001). One of its main aims is to help children to develop a deep understanding of Mathematics concepts by building a strong foundation for them at the basic level of education as well as shaping their personality in a way that will be acceptable by the society.

The curriculum is designed under the strict supervision of Curriculum Research and Development Division under the Ministry of Education, based on the current needs and aspirations of the nation. According to Essuman (2009), the preparation of the curriculum for the various subjects treated in the basic school level goes through a well-structured process to ensure no area, being it culture, religion, gender, just to mention a few; is left out. This process, as purported by Essuman (2009), involves:

1. Evaluating existing curriculum based on feedback or responses after its implementation
2. Selecting Subject Panels; which includes subject teachers, university professors, curriculum expert, CRDD expert, textbook researchers and secondary school teachers.
3. Drafting syllabuses integrating societal needs such as belief systems, culture, human rights, courtesy and etiquettes, gender issues, health and sanitation, personal safety, population & family life, environmental issues, science and technology.
4. Trailing Drafts

5. Analyzing the trialed data
6. Drafting the Syllabuses
7. Proof reading
    a. Check Correct Sequencing of Instructional Objectives
    b. Check Appropriateness and Weighting of Profile Dimensions
    c. Link Themes and Topics Horizontally and Vertically
    d. Check Correctness of Content Information
8. Curriculum specialists check
9. Proof reading for spellings mistakes, grammatical errors and punctuations
10. Updating of Syllabuses
11. Typesetting, printing and binding
12. Distribution to schools
13. Collecting feedback and evaluation

This process of curriculum development adopted by the Curriculum Research and development Division, according to Essuman (2009) is an ideal syllabus development process which ensure that no one is left out in its preparation while ensuring that it meets the current trends of education as well as the society.

2.4.2 Ghanaian Pupils Mathematics Academic Achievement

Mathematics literacy is the ability to apply skills and concepts, reason through, communicate about, and solve mathematical problems (NCTM, 1989, cited by Sarfo et al, 2014). As purported by Sarfo et al (2014), the importance of mathematics to our lives have made stakeholders of education such as policy makers, educators, employers, and

parents worldwide, to become more and more interested in the mathematics curricula and students' performance in mathematics.

Mathematics teaching in Ghana, at the basic education level especially, is characterized by transmission and command models (Fredua-Kwarteng, 2005). "Pupils are not encouraged to pose questions or engage in hands-on activities and problem-solving activities in order to attain both conceptual and procedural understanding of what they are taught" (Sarfo et al., 2014, p.768). Due to this, most basic school pupils in Ghana have lack the necessary conceptual understanding underlining mathematics and its concepts (Baffoe & Mereku, 2010).

According to Sogbey (2011), data collected from the West African Examination Council (WAEC) has shown that the pass-rate of pupils who take the Basic Educating Certificate Examination (BECE) is nothing to write home about. "The abysmal performance in mathematics of basic school students (Grade 8 – in Ghana also called Junior Secondary School [JSS2] or Junior High School [JHS2]) is evident in the results of the Trends in International Mathematics and Science Studies (TIMSS) 2003 and 2007" (Sarfo et al., 2014, p.766). Students' poor performance can also be seen in the 2008, 2009, 2010 and 2011 Basic Education Certificate Examination [BECE] (Sarfo et al., 2014). Yakubu (2015) posit that the "academic performance of pupils during assessment keeps on declining despite several curriculum reforms intended to improve performance [and that] most candidates perform poorly in English, Mathematics and the Sciences in examinations conducted by WAEC" (p.48).

Findings from the National Education Assessment for 2016 indicated that "primary school pupils were challenged by both English and mathematics, with no more than 37%

of pupils achieving proficiency levels in any grade or subject" (Ministry of Education [MoE], p.8). They add that pupils' performance was "noticeably lower for mathematics than for English, with only 22% of P4 pupils and 25% of P6 pupils achieving proficiency in mathematics compared to 37% of P4 pupils and 36% of P6 pupils achieving proficiency in English" (MoE, 2016), p.8-9). Table 2.1 shows the overall percentage correct score by grade and subject:

Tab 2.1: Overall percentage correct score of primary pupils by grade and subject

	Mean scores by grade	
Subject/Class	P4	P6
Mathematics	41.7 (40.5 – 42.8)	43.8 (43.0 – 44.7)
English	50.9 (49.4 – 52.3)	47.8 (46.4 – 49.2)

Source: National Education Assessment, 2016 (MoE, 2016)

Table 2:1 shows the national means based on percentage correct scores obtained from pupils responses during examinations with regards to their grade and subject. By comparing the average means obtained for both Primary 4 and Primary 6, pupils seem to find mathematics more challenging than English. That notwithstanding, pupils performance in mathematics was below average; thus, 41.7% and 43.8% for Primary 4 and Primary 6 respectively.

According to the Ministry of Education (2016) "the results of the 2016 NEA showed clearly that the performance of P4 and P6 pupils was generally [low and that] There has been no significant or substantive change in pupil performance since the 2013" (p.26). They add that, although scores obtained for both English and mathematics were low,

mathematics seemed to pose a greater challenge to Ghanaian pupils in both the public and private schools.

Table 2.2 shows the performance of JHS 2 pupils in the last three study conducted by the Trends in International Mathematics and Science Study (TIMSS) on student performance.

Table 2.2: TIMSS Results for JHS 2 Pupils

Year	Overall mean mathematic scale score
2003	276 (4.7)*
2007	309 (4.4)*
2011	331 (4.3)*

Source: Yakubu (2015), *Standard error in parentheses

Data presented in Table 2.2 shows the abysmal performance of JHS 2 pupils in the last three study conducted by TIMSS. The mean score attained by pupils (276, 309, and 331 for the year 2003, 2007 and 2011 respectively) is significantly lower as compared to TIMSS average scale of 500. The reason for such performance is due to the poor nature of mathematics pupils experience in the various school across the country thereby causing them to performed poorly when it comes to items that tested pupils ability to use concepts, solve non-routine problems and reason mathematically (Anamuah-Mensah & Mereku, 2005; Anamuah-Mensah, Mereku & Asabere-Ameyaw, 2004).

In todays' society, self-fulfillment and the ability to live a successful life with regards to acquiring a good job, better standard of living and good health is dependent on higher and

quality education which indirectly contributes to a country's growth and economic stability. "All these numerous advantages cannot be achieved in Ghana if a child fails to perform creditably in national examinations such as Basic Education Certificate Examination (BECE) and West Africa Senior Secondary Certificate Examination (WASSCE) to ensure admission into tertiary or higher education" (Iddi, 2016, p.17).

2.4.3 Improving Basic School Pupils' Mathematical Competency

As Iddi (2016) puts it, the development of a nation is linked to the academic performance of the student within it. This is because, if students perform better in school, the nation gets to acquire quality graduates in future who will one day serves as human capital as well as leaders to steer the affairs of the country (Mushtaq & Khan, 2012). The abysmal performance of students may be due to several factors. Mushtaq and Khan (2012) classify these factors into two: internal and external school factors. The internal factors include: teachers' role, students competence in the language of instruction, class schedules; class sizes; availability of textbooks, the conduct of regular assessment, effective internal supervision, the availability of teaching and learning materials; while the external factors comprise: culture, economic status of household, parental educational attainment, religion, family size, etc.

Recent study has revealed that the decline in students' mathematic performance is due to the process by which mathematics is taught in schools (Anthony & Walshaw, 2009). "Constructing a new curriculum, without a corresponding change in teaching pedagogy will not achieve the set aims intended" (Yakubu, 2016, p.52). This attests to the reason why students' performance, especially in mathematics, keeps dwindling almost every year. Teachers are thus encouraged to upgrade their knowledge on lesson delivery

periodically to meet the demands of modern trends in teaching and learning. As Fredua-Kwarteng (2005) puts it, countries that fail to invest in the continuous professional development of their teachers is destined for failure in all of its affairs. This is because such a country will lack the necessary human capital to manage the affairs of the country in future thereby rendering it vulnerable and enslaved.

Additionally, modern methods of teaching which are child-centred and with a considerable evidence of classroom success, such as the constructivist approaches to teaching and learning, should be made the bedrock national curriculum.

> "*Mathematics education relies closely on constructivism, its exploratory and inquisitive strategies [therefore] adopting constructivism would enable the teachers design instructional activities that take into consideration the learning style, ability and interest of pupils; in order to reduce the failure rate of pupils*" (Yakubu, 2016, p.52-53).

Mathematics teachers thus, need to adopt constructivist principles and strategies to teaching and learning to ensure a wholesome development of students' cognitive, affective and psychomotor domain thereby making them reasonable, open minded and more self-reliant.

2.5 Empirical Review on Constructivism

According to Qvortrup et al. (2016), nearly all leading theories of learning today believes in the constructivist view of learning (developed by Piaget) that "learning in school demands students with the ability to relate actively to the academic subject and through dialogue, experiment, reflection etc. thereby creating a personal academic identity" (p.101); showing that learning is subjective involves cognitive construction on the part of

the learner. Amineh and Asl (2015) add that "constructivism is a synthesis of multiple theories diffused into one form [thus] … the assimilation of both behaviorist and cognitive ideals" (p.9).

Herman and Knobloch (2004) are of the view that constructivist approach to teaching and learning generates increases in both the affective and cognitive domains. To them, learners prefer the constructivist approach to teaching and learning because they see themselves actively responsible for constructing their own knowledge. Cunningham (2004), as cited by Yakubu (2015), found out that learners become more engaged in the lesson when discussing ideas in small groups which is also a constructivist method of teaching. He revealed in his study that mathematics learners gained higher reasoning skills and deeper understanding of mathematical concepts (Cunningham, 2004, cited by Yakubu, 2015)

Nayak (2007) conducted an experimental study on the effect of students' learning in Constructivist environment and its subsequent effect on achievement in mathematics at the elementary level of learners vis-à-vis traditional pedagogy in three different urban schools of Odisha, India. His finding revealed that students who were taught through the constructivist approach gained significantly higher achievement score in Mathematics than those who were taught using traditional medium. He added that "students taught in constructivist- learning environment have significantly enhanced their understanding and application abilities as compared to other abilities like knowledge and skill" (p.13).

Kim (2005), as cited by Yakubu (2015), in his study found that using constructivist teaching methods for 6th graders led to better understanding as well as improved pupils' achievement than when using traditional teaching methods. The study also brought to

bear the fact that learners preferred constructivist methods of teaching and learning to traditional ones.

Karaduman and Gültekin (2007) in their study, which sought to investigate whether learning based on constructivist approach has an effect on fifth grade Social Studies students' attitudes, their academic success and their retention, revealed that teaching and learning material prepared with regards to constructivist learning principles increased the academic achievement as well as the retention levels of students in the study of Social Studies. In addition to that, learners found materials prepared according to constructivist learning principles as more appropriate than those based on other approaches.

Barman and Bhattacharyya (2015) conducted a study to ascertain the effectiveness of using the Constructivist Teaching Method on students' academic achievement in the study of Physical Science at the secondary level. The following were their findings after conducting the study:

1. The constructivist teaching method is found to be significantly more effective and fruitful in teaching Physical Science as compared to traditional method of teaching.
2. The constructivist teaching method is found to be significantly more effective to enhance the performance of students in their academic achievement in the subject Physical Science as compared to traditional method of teaching.
3. The constructivist teaching method makes teaching learning process less abstract and meaningful to the students.
4. The constructivist teaching method is found to be significantly more fruitful in the formation of concept among the VIII grade school students as compared to traditional method of teaching.

5. The constructivist teaching method motivates students better to their learning than the traditional method of teaching.

They therefore concluded that, “Constructivist Teaching Method is more effective and fruitful in teaching Physical Science than the Traditional Method of Teaching” (p.75).

Doğru (2007), as cited by Yakubu (2015), studied the effect of traditional teacher-centred approaches to that of the child-centred constructivist methods. Initial test to assess learner performance after the lessons showed no significant difference between traditional and constructivist methods. “However, in the follow-up assessment 15 days later, learners who learned through constructivist methods showed better retention of knowledge than those who learned through traditional methods” (Yakubu, 2015, p.34).

In a study conducted by Chowdhury (2016) to ascertain the effectiveness of the constructivist approach on student’s achievement in mathematics, it was revealed that the orthodox methods of teaching and learning was not enough to develop critical thinking and risk taking attitude amongst students of today. Hence, the need for an urgent reform in our teaching practices in light of the NCF-2005 framework which views the child as a "discoverer" who can actively construct knowledge and build understanding through experimentation (National Council of Educational Research and Training, 2005). According to Chowdhury (2016), “the framework advocates the use of constructivism at every stages of Mathematics teaching” (p.40).

According to Le-Cornu and Peters (2005), South Australia now supports the adoption of teaching and learning practices proposed by constructivists. They believe constructivist pedagogy provides a framework which stimulates generative thought and creativity within the learner; ingredients that are needed for the future. As their commitment to

these beliefs, the South Australian government has produced a new curriculum frameworks and standards documents which emphasizes the importance of constructivism as a theoretical basis for educational improvement in government schools; "it draws on and promotes constructivism as a theory appropriate to rethinking learning processes and moving towards achieving improved meta-learning (Le-Cornu & Peters, 2005, p.52). In addition to this, the National Curriculum Framework, 2005, has confirmed the use of constructivist approaches to teaching and learning in Indian classroom situation (NCERT, 2005). All these studies provide solid empirical evidence to the effectiveness of the constructivist approach to learning over other learning theories hence the need for its adoption and use in the Ghanaian classroom.

2.6 Chapter Summary

In the 21st century, a nation that contributes and place much emphasis on education of its citizen enjoys reaps the benefits of sustained economic development. In fact, a person's education is closely linked to his/her life chances, income and wellbeing (Battle & Lewis, 2002). This is why "the academic performance (learning achievement) of pupils/students' in schools remains a top priority for many educators, parents and national governments" (Iddi, 2016, p.17).

One of the most important subjects studied in our schools today is mathematics. It has been referred to as the mother of all subjects due to its early discovery as a body of knowledge and its appearance in almost all subjects studied in school (Dotse, 2014). "Despite the critical role mathematics plays in intellectual and social development of the students and despite the lavish attention paid to the study of mathematics in Ghana, students at the basic level do not perform well in mathematics examinations" (Sarfo et al.

2014, p.766). According to the President's Council of Advisors on Science and Technology (2012), as cited by Yakubu (2015), though there might be several factors contributing to this, one of the major cause is the use of traditional, teacher-centred methods of lesson delivery which dwindles students' academic growth due to the fact that it does not actively involve them in lessons thereby causing them to drop out of school. They thus, encourage the use of active learning techniques, which is a constructivist approach, to encourage student's participation.

Several other research have advocated the use of the constructivist approach to teaching and learning due to its enormous contribution to student achievement. Herman and Knobloch (2004) are of the view that constructivist approach to teaching and learning generates increases in both the affective and cognitive domains. To them, learners prefer the constructivist approach to teaching and learning because they see themselves actively responsible for constructing their own knowledge. Cunningham (2004), as cited by Yakubu (2015), found out that learners become more engaged in the lesson when discussing ideas in small groups which is also a constructivist method of teaching. He revealed in his study that mathematics learners gained higher reasoning skills and deeper understanding of mathematical concepts (Cunningham, 2004, cited by Yakubu, 2015). If there should be a change in student performance when it comes to mathematics education in Ghana, the government support teachers not only by providing them with the necessary materials but must also invest in the professional development teachers. This will keep them abreast with modern result oriented strategies to teaching and learning such as the constructivist approaches. In line with this, national policies should also be drawn to support and ensure the review, adoption and use of modern methods of teaching which

contributes positively to students' academic achievement so as to guide curriculum implementers as well as ensure national development.

CHAPTER THREE

METHODOLOGY

3.0 Overview

This chapter provides detailed description of the methodology employed in the study. It discusses the research design, population, sample and sampling techniques, the research instruments, validity of the research instruments, reliability of the research instruments, procedure for data collection and method of data analysis.

3.1 Research Design

This study was the descriptive research which adopted the concurrent triangulation mixed method research design. As purported by Salaria (2012), descriptive research is concerned with gathering information about prevailing circumstances for the purpose of description and interpretation of behavior. According to Salaria, this type of research design does not just amass and tabulate facts but incorporates "proper analyses, interpretation, comparisons, identification of trends and relationships" (Salaria, 2012, p.1). Opoku (2005) adds that descriptive research enables the researcher to obtained samples from a given population in a very effective and economic way. The concurrent triangulation design under the mixed method approach was then adopted as a means of data analysis and presentation. Creswell (2014) posits that researchers who are new to this approach most often think of it as just a combination of quantitative and qualitative data. Though this might be true to some extent, he adds that in the concurrent triangulation mixed method design, a researcher separately collects quantitative and qualitative data, analyzes them separately, and then compares the results to see if it agrees with each other with respect to a given phenomenon (Creswell, 2014).

Using the mixed method research approach for a study provides strengths that offset the weakness of both quantitative and qualitative research approach and provides more comprehensive evidence for studying a research problem than either quantitative or a qualitative research approach alone (Creswell, 2008).

3.2 Setting

The research was conducted in the Effutu Municipality in the Central Region of Ghana. The population of Effutu Municipality, according to the 2010 Population and Housing Census, is 68,592 which represents 3.1% of the region's total population of 2,201,863; with males and females representing 48.8% and 51.2% respectively (Ghana Statistical Service, 2014). The municipality is characterized by a youthful population since one-third of the population fall below the ages 15 years and in terms of occupation, majority of the populace (31.4%) are engaged in craft and related trades, followed by service and sales (24.9%); about 27% of the male population are into agriculture (Ghana Statistical Service, 2014). Manufacturing is the most dominant industry in the Municipality, followed by retail services then agriculture, forestry and fishing. A third (33.8%) of the population with school going age are currently in primary school with 13.3% at the Junior High School (JHS) level, less than one-tenth (6.9%) in the Senior High School (SHS) and close to 28% are at the tertiary level (Ghana Statistical Service, 2014). Effutu Municipality is divided into three circuits: the east, west and central circuits. The number of basic schools, both public and private, in the east, west and central circuits are 39, 33 and 23 respectively (Effutu Municipal Education Directorate, 2017). The number of teachers in each circuit is as follows: 395 in the east circuit, 333 in the west circuit, and 211 in the central circuit; making a total of 939 teachers, of which 540 are primary school

teachers and the remaining 399 are Junior High School (JHS) teachers. Figure 3.1 below shows a map of the Effutu Municipality:

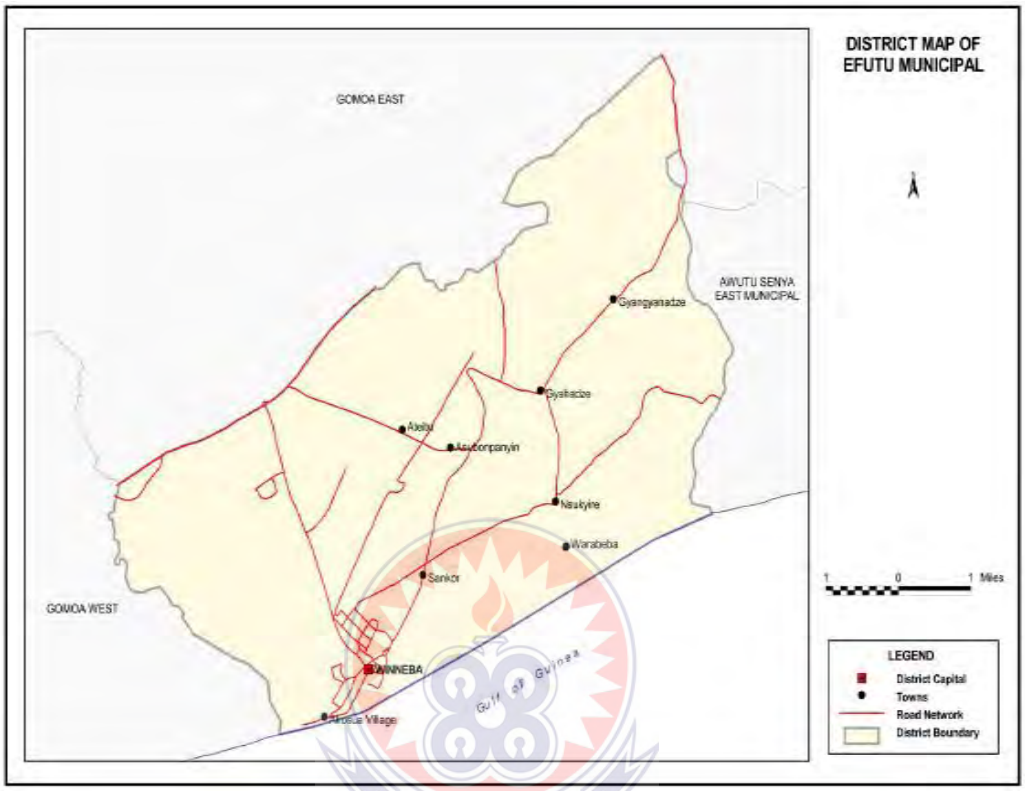

Fig 3.1: Map of Effutu Municipality.

Source: Ghana Statistical Service, 2014

3.3 Population

A research population is a "well-defined collection of individuals or objects known to have similar characteristics" (Explorable, 2012, p.1). According to Polit and Hungler (1999) as cited by Mbokane (2009), the population of a study is the totality of all the objects, subjects or members that conform to a set of a given criteria. Nonetheless, researchers sometimes find it difficult testing every individual in the general population due to the large size thus, sometimes making a research too expensive and time-

consuming (Explorable, 2012). Many researchers therefore tend to rely on sampling techniques.

3.3.1 Target Population

Target population, according to Lavrakas (2008), includes all units for which a study or research data are to be used to make inferences. This is to say that the target population of a study defines the people or objects for which a research finding can be generalized. Explorable (2012) adds that a target population also known as theoretical population refers to the "entire group of individuals or objects to which researchers are interested in generalizing the conclusions" (p.1). The target population of this study comprised of all basic school teachers in the Effutu Municipality totalling nine hundred and thirty-nine (939).

3.3.2 Accessible Population

The accessible population also known as the study population, according to Explorable (2012), is the section of a population the researcher can apply his conclusions to. The accessible population is derived from the target population and as such can be said to be a subset of the target population. The accessible population was composed of all basic school mathematics teachers in the Effutu Municipality totalling three hundred and ninety-nine (399). "It is from the accessible population that researchers draw their samples" (Explorable, 2012, p.2).

3.4 Sample and Sampling Techniques

A sample is defined as "a group of relatively smaller number of people selected from a population for investigation purposes" (Alvi, 2016, p.11). According to Webster (1985) as cited in Mugo Fridah (2002), a sample is "a finite part of a statistical population whose

properties are studied to gain information about the whole" (p. 1). Mugo Fridah (2002) adds that in terms of human beings, it can be said to be a set of respondents taken from a larger population for the purpose of a survey. Alhassan (2006) posits that sampling technique is the process through which a portion of the population is selected to represent the entire population.

The sample size for this study was composed of all Junior High School Mathematics teachers of the Effutu municipality in the Central Region of Ghana with a total of one hundred and thirty-eight (138). The researcher employed the census and purposive sampling technique. The census sampling was used to sample all basic school teachers in the Effutu Municipality while the purposive sampling technique was used to sample JHS mathematics teachers in the Effutu Municipality. In purposive sampling, the sample is obtained having a prior purpose in mind. Purposive also known as the judgmental or purposeful technique is a non-probability sampling technique used to select a sample of the accessible population on the basis of ones' "own knowledge of the population, its elements, and the nature of your research aims" (Babbie, 1990, cited by Latham, 2007, p.9). As purported by Alvi (2016), purposive sampling is used when people within a given population bear certain characteristics that meet the criteria of the researcher or the study. Mugo Fridah (2002) adds that purposive sampling provides rich and in-depth information into cases whereby size and specific characteristics of the sample depend on the study purpose. As Latham (2007) puts it, purposive sampling is usually based on a particular characteristic possessed by the sample to help answer questions about a certain matter or product.

The purposive sampling technique was thus used to select all basic school JHS mathematics teachers for the study due to subject specialisation and their experience in the teaching of mathematics.

3.5 Research Instrument

Annum (2017) defines research instrument as the tools for data collection. Thus, research instruments are tools designed to measure as well as obtain data on a given situation. They include, but are not limited to observations, questionnaires, interviews and reading (Annum, 2017). The research instrument employed for this study comprised of documents, questionnaires and interviews.

3.5.1 Documents

Bowen (2009), refer to documents as "social facts, which are produced, shared, and used in socially organised ways" (p.27). Documents contain texts and images recorded without a researcher's intervention and can be in the form of "advertisements; agendas, attendance registers, and minutes of meetings; manuals; background papers; books and brochures; diaries and journals; event programs (i.e., printed outlines); letters and memoranda; maps and charts; newspapers (clippings/articles); press releases; program proposals, application forms, and summaries; radio and television program scripts; organisational or institutional reports; survey data; and various public records" (Bowen, 2009, p.27-28). Bowen (2009) adds that documentary analysis is often used together with other qualitative research methods as a means of triangulation. Merriam (1988) as cited by Bowen (2009) also pointed out that, "documents of all types can help the researcher uncover meaning, develop understanding, and discover insights relevant to the research problem" (p. 29).

Bowen (2009) provided the following as some importance of using documents in a study:

1. Less time-consuming: since document analysis requires data selection, instead of data collection, it is less time-consuming and therefore more efficient than other research methods.
2. More accessible: gaining access to documents in the public domain has become relatively easy due to the advent of the Internet and computers. Documents are now obtainable with or without the authors' permission. This makes document analysis an attractive option for qualitative researchers.
3. Cost-effective: Document analysis is less costly than other research methods and is often the method of choice when the collection of new data might not be feasible.
4. Stability: Documents are always stable and thus cannot be affected by the presence of the investigator's presence neither does it alter what is being studied (Merriam, 1988, cited by Bowen, 2009).
5. Exactness: The presence of "exact names, references, and details of events makes documents advantageous in the research process" (Yin, 1994, cited by Bowen, 2009, p.31).

The main document used for this study was the Junior High School mathematics curriculum, thus, the National Syllabus for Mathematics (JHS 1-3, 2012). The National Syllabus for mathematics (Junior High School 1-3), serves as the curriculum that guides mathematics education in the Junior High School level across the country. It therefore includes what must be taught, how it must be taught and how to measure the effectiveness of the teaching and learning process (Asafo-Adjei, 2001). It is prepared

under the strict supervision of Curriculum Research and Development Division (CRDD). It begins with a theoretical framework which presents the rationale of the syllabus, its general aims, general objectives, scope of the syllabus, approaches to teaching and learning mathematics and the forms of assessment. This is followed by the actual framework for teaching and learning which is structured in five columns: Units, Specific Objectives, Content, Teaching and Learning Activities and Evaluation. The JHS mathematics syllabus has been planned on the basis of Years and Units. Each year's work is covered in a number of units sequentially arranged and in a meaningful manner such that each unit's work will provide the necessary and enabling skills for the next unit. JHS 1 has 14 units; JHS 2 has 14 units, while JHS 3 has 7 units of work. The unit topics for each year have been arranged in the sequence in which teachers are expected to teach them (CRDD, 2012).

This document was analysed to determine the congruence of its theoretical framework to the constructivist principles of teaching and learning developed by the researcher from studies of existing documents on constructivism (Phillips, 2000; Richardson, 2003; Applefield et al., 2001; Taber, 2011; Koohang, 2009; Chen, 2003).

3.5.2 Questionnaires

According to Yakubu (2015), a questionnaire is a written document in survey research that has a set of questions given to participants. Annum (2017) states that a questionnaire is a data collection instrument normally used in surveys and defines it as a "systematically prepared form or document with a set of questions deliberately designed to elicit responses from respondents or research informants for the purpose of collecting

data or information" (p.1). Thus, questionnaires contain printed list of questions used to find out the views or opinions of people about an issue, product or service.

According to Hague (2006), there are three types of questionnaires: the structured, semi-structured and unstructured questionnaire. Structured questionnaires, in the view of Hague (2006), consist of "closed or prompted questions with predefined answers" (p.136). He adds that with this type of questionnaire, the researcher anticipates all possible answers to a given question and provides respondents with pre-coded responses from which they make a choice. A typical example is 'yes' or 'no' or 'true' or 'false' questions. Unstructured questionnaires consist of open ended question which allows the respondents to express themselves (Hague, 2006). Annum (2017) adds that open ended questions "constitute questions which give the respondent an opportunity to express his or her opinions from a set of options [thus,] the respondent frames and supplies the answer to the question raised in the questionnaire". Semi-structured questionnaires consist of both closed and open ended questions. According to Hague (2006), they help gather a large range of different responses from people and allows for the collection of qualitative and quantitative information for a study.

This study employed the use of a structured questionnaire (see Appendix A for sample of questionnaire). The questionnaire consisted of four sections (A-D). Section A consisted of information with regards to respondents' biographical data. Section B consisted of thirty (30) closed ended questions which sought to determine the learning theory that predominantly influenced JHS mathematics teachers' lessons in the Effutu Municipality. Section C consisted of eighteen (18) closed ended questions which sought to establish the degree to which JHS mathematics teachers in the Effutu Municipality apply the

constructivist principles in their classroom instruction. Finally Section D, which is the last part of the questionnaire, consisted of six (6) items which sought to find out JHS mathematics teachers' perception of constructivism.

Sections B to D were rated based on a five-point likert scale, where 1 = strongly Disagree, 2 = Disagree, 3 = Uncertain, 4 = Agree, and 5 = Strongly Agree. Every section of the questionnaire began with specific instructions as to the intent of the items as well as how to respond to items in that section.

3.5.3 Interview

Annum (2017) posit that an interview is an interaction between two people or a group of people, where oral questions are posed by the interviewer(s) to elicit response from the interviewee(s). Annum is of the view that, "interviews become necessary when researchers feel the need to meet face-to-face with individuals to interact and generate ideas in a discourse that borders on mutual interest" (p.2). Flick (2006) also adds that the purpose of an interview "is to reveal existing knowledge in a way that can be expressed in the form of answers and so become accessible to interpretation" (p. 160). Fox (2009) posits that interviews are research tools commonly used in survey designs, exploratory and descriptive studies; and is an important "data gathering technique involving verbal communication between the researcher and the participant" (p.4). Apart from interviews being face-to-face, they can also be conducted over the phone or the computer terminal via video conferencing technology (Annum, 2017). Turner (2003) cited by Zohrabi (2013) provides the following as some advantages of using an interview:

1. Good for measuring attitudes and most other content of interest.
2. Allow probing by the interviewer.

3. Can provide in-depth information.
4. Allow good interpretative validity.
5. Moderately high measurement validity for well-constructed and well-tested interview protocols.
6. Relatively high response rates often attainable.

According to Fox (2009), there are three types of interview: structured or standardized interviews, semi-structured and unstructured or in-depth interviews. Annum (2017) is of the view that in structured interview, "the interviewer follows a set pattern usually adhering as much as possible to the order of questions on the interview questionnaire whilst posing the questions in a formal manner" (p. 2). Fox (2009) purport that a structured interview is an interview where questions are set in advance to enable the interviewer to ask each respondent the same questions in the same way. Such questions are, as much as possible, geared towards eliciting a specific answer from the respondent.

An unstructured interview, on the other hand, is a less formal type of interview whereby the researcher prepares a set of questions and freely modifies its sequence, changes the wording and sometimes explains them or adds to them during the interaction process (Annum, 2017). Fox (2009) adds that, the interviewer "approaches the interview with the aim of discussing a limited number of topics, sometimes as few as one or two, and frames successive questions according to the interviewee's previous response" (p.7). Semi-structured interviews are "similar to structured interviews in that the topics or questions to be asked are planned in advance, but instead of using closed questions, semi-structured interviews are based on open-ended questions" (Fox, 2017, p. 6). We can also say that it is a mixture of both structured and unstructured interview techniques since it employs the

use of structured questions while providing room for the addition of extra questions to allow the respondent throw more light on an issue. According to Fox (2009), "semi-structured interviews are useful when collecting attitudinal information on a large scale" (p.6).

The researcher carried out a semi-structured face to face interview with ten (10) respondents to obtain data on their perceptions of the constructivist theory of learning (see appendix B). The semi-structured interview guide was made up of two parts: the first part sought to find out participant biographical data while the second part, consisting of thirteen (13) questions, probed their perception in relation to the constructivist theory of learning. The data were collected through audio-recording and later transcribed.

3.6 Validity

Burns (1999), cited by Zohrabi (2013), makes it clear that "validity is an essential criterion for evaluating the quality and acceptability of research" (p.258). To Zohrabi (2013), validity is concerned with "whether our research is believable and true and whether it is evaluating what it is supposed or purports to evaluate" (p.258). Validity is basically defined as the extent the extent to which a test or instrument measures what it is intended to measure. As Yakubu (2015) puts it, "validity of a measurement tool is the degree to which the tool measures what it claims to measure" (p.63). Validity provides trust, usefulness and dependability to a research and therefore, it lies within the onus of the researcher to ensure validity in the different phases of his research, thus, from data collection through to data analysis and interpretation by ensuring the quality of research instruments used (Zohrabi, 2013) since the "conclusions researchers draw are based on the information they obtain using these instruments" (Fraenkel & Wallen, 2003, p.158).

Zohrabi (2013) provides two forms of validity: content validity and internal validity. Content validity, according Zohrabi (2013), is a type of validity whereby an expert in the field of research reviews the different elements, skills and behaviors captured by an instrument in a research to ensure they are adequately and effectively measured. Zohrabi adds that, this helps to eliminate or revise unclear and obscure questions while rewording complex items. To ensure the content validity of research instruments used, four (4) senior lecturers from the University of Education, Winneba (UEW) were used: two from the Basic Education Department and two from the Mathematics Department.

Internal validity, according to Zohrabi (2013), is "concerned with the congruence of the research findings with the reality [as well as] the degree to which the researcher observes and measures what is supposed to be measured" (p.258). Merriam (1998), as cited in Zohrabi (2013), proposed six methods for ensuring internal validity of research instruments: triangulation, member checks, long-term observation at research site, peer examination, participatory or collaborative modes of research and researcher's bias. To ensure the internal validity of research instruments used, the researcher employed triangulation. In the view of Zohrabi (2013), triangulation is the process of collecting data through several sources such as the use of questionnaires, interviews and classroom observations. Zohrabi adds that "gathering data through one technique can be questionable, biased and weak [therefore] collecting information from a variety of sources and with a variety of techniques can confirm findings" (p.258). Denzin (1970) as cited by Bowen (2009), purports that triangulation involves blending different methodologies in a study of the same phenomenon. According to Bowen (2009), "by examining information collected through different methods, the researcher can

corroborate findings across data sets and thus reduce the impact of potential biases that can exist in a single study" (p.28).

3.7 Reliability

According to the Institute for Educational Development and Extension (2003), reliability refers to how well a test provides a consistent set of results across similar test situations and time periods (p.63). In the view of Zohrabi (2013), reliability deals with the consistency, dependability as well as the replicability of the results obtained from a research. Yakubu (2015) adds that reliability is a "measure of consistency of research instruments to obtain the same result with the same measure" (p.63). In this study, a pilot study was conducted and Cronbach Alpha co-efficient of 0.70 served as the criterion for determining the overall consistency of the scales. According to McMillan and Schumacher (2010), a Cronbach alpha coefficient of at least 0.70 is indicative of internal consistency.

According to Zohrabi (2013), ensuring reliability of quantitative research instruments such as the questionnaire, is easier and straightforward because data collected are usually in numerical form. However, "in qualitative approaches to research, achieving the identical results are fairly demanding and difficult [and this is] because the data are in narrative form and [is] subjective" (Zohrabi, 2013, p.259). In view of this, Lincoln and Guba (1985) cited in Zohrabi (2013), points out that when it comes to qualitative research data, such as interviews and documentation, one should not necessarily think about obtaining the same results, but rather think about the dependability and consistency of the data. This can be achieved through the use of three techniques: the investigator's

position, triangulation and audit trial (Lincoln & Guba, 1985, & Merriam, 1998, all cited in Zohrabi, 2013).

3.8 Pilot Testing

Researchers agree that pilot testing of research instruments helps to ensure the validity and reliability of the data it collect (Dillman, 2000). A pilot test was thus, conducted on 30 teachers in the Awutu Senya District, who were not part of the research, to ensure that the research instrument provided a stable and consistent result devoid of any ambiguities (Creswell, 2008).

Data from the pilot test were analysed to determine its reliability using Cronbach Alpha. The Section B part of the questionnaire, which had three categories that measured the predominant learning theory of JHS mathematics: cognitivism, behaviourism and constructivism, yielded a reliability coefficient of 0.70, 0.71 and 0.83 respectively. Similarly, the Section C part of the questionnaire, which sought to determine the extent to which JHS mathematics teachers employed the constructivist principles in the classroom instructions, yielded a reliability coefficient of 0.75 while the section D part which measures the perception of JHS mathematics teachers on constructivism yielded a reliability coefficient of 0.72. McMillan and Schumacher (2010) argue that a Cronbach alpha coefficient of at least 0.70 is indicative of internal consistency. Hence, based on the results obtained for the pilot study it could be concluded that the test instrument was reliable.

The pilot test was very crucial because it helped the researcher to know the internal consistency of the instrument, check the data analysis procedure and also helped to

restructure the items. It also enabled the researcher to identify and correct some research items that were wrongly formulated and could have given some unintended results.

3.9 Data Collection Procedure

The researcher visited some schools with an official letter of introduction (see Appendix E) from the University of Education, Winneba, seeking permission from the heads of schools to carry out the study. The researcher then sought permission from the school heads to organise the teachers for the study. The researcher familiarised himself with teachers and explained to them how the questionnaires should be responded to as well as how the interview will be conducted.

A structured questionnaire which consisted of closed ended questions on a five-point Likert scale was used. Respondents were required to tick the degree to which they agreed with each question after which the researcher collected the questionnaires for analysis. A face to face interview was conducted with nine (9) JHS mathematics teachers in the Effutu Munipality using a semi-structured interview guide. Their responses were audio-taped and later transcribed for analysis.

Also, the Junior High School mathematics curriculum, thus, the national syllabus for mathematics (JHS 1-3, 2012) which served as the main document for the documentary coupled with studies on constructivism by researchers (Phillips, 2000; Richardson, 2003; Applefield et al., 2001; Taber, 2011; Koohang, 2009; Chen, 2003) in the form of journals and books were downloaded and used for the study.

The researcher, in all cases of administering the instruments, openly and honestly communicated the purposes and the uses of the data collected as well as assured

participants of the confidentiality of their responses. This was to ensure that the research was conducted under standard conditions.

The schedule in Table 3.1 guided the data collection phase of the study

Table 3.1: Schedule of data collection

Visit	Purpose
First visit	Distribution of letters and getting acquainted with head teachers and JHS mathematics teachers
Second visit	Taking teachers through the purpose of the exercise and Administration of questionnaires
Third Visit	Interviewing selected teachers

3.10 Data Analysis Procedure

Data were collected from documents, responses from questionnaire and interviews to answer the research questions in this study. Yakubu (2015) define data analysis as the "process of organizing and summarizing data, using descriptive statistics and/or inferential statistics" (p.67). As mentioned earlier, this study employed both quantitative and qualitative methods of data analysis.

3.10.1 Analysis of Qualitative Data

To respond to research question one, content analysis was employed to analyse the National Mathematics Syllabus for JHS (2012), which was the main document used for the documentary analysis. According to Bowen (2009), content analysis just like thematic analysis, is a form of documentary analysis which involves "organizing information into

categories related to the central questions of the research" (p.32). The analysis was done by comparing the contents of the theoretical framework of the JHS mathematics syllabus to the principles of constructivism developed by the researcher based on the literature and study of renowed researchers (Phillips, 2000; Richardson, 2003; Applefield et al., 2001; Taber, 2011; Koohang, 2009; Chen, 2003) in the field of constructivism. These principles include: teachers' duty as a facilitator, building lessons on pupils prior experience (RPK), actively engaging learners in lessons through activities, encouraging the use of manipulative material (TLMs), encouraging social interaction, and assessment is individualistic and based on knowledge application.

To answer research question three, audio records from interview sessions were transcribed by listening to a playback of the audio recorded and writing down the responses provided by interviewees to the interview questions. The result was reported thematically using narrative style with embedded direct quotations in support of the quantitative data collected via the questionnaire in response to this same research question.

3.10.2 Analysis of Quantitative Data

A structured questionnaire was administered to respond to research questions 2, 3 and 4. This contained closed ended questions which were coded and analysed using mean, standard deviation and percentages. Participants' scores for the items within the same sub-scale were added. The mean score for the sub-scales were used to describe the learning theory that predominantly influences teachers' lessons as well as the extent to which the principles of constructivism influences teachers' instructions. In the analysis, 'strongly agree' and 'agree' were categorised as 'agree', 'strongly disagree' and

'disagree' were categorised as 'disagree' while 'uncertain' was categorised as 'neutral'. A mean score above 3.0 was interpreted as 'high' or 'always' while that below 3.0 was interpreted as 'low' or 'never'. A mean score of 3.0 was considered as 'occasionally' or 'sometimes'. Percentage scores were also employed to analyse responses provided to items in Section D of the questionnaire to help answer research question three which dealt with JHS mathematics teachers' perception on the theory of constructivism.

Finally, in order to test the hypothesis formulated for the study, thus the influence of JHS teachers' perception of constructivism on their classroom instruction, a Pearson product-moment correlation analysis was used.

3.11 Ethical Consideration

According to Jack and Norman (2003), it is necessary in every research studies, to treat ethical issues with a high degree of caution. As such, ethical issues governing human subjects in a research were strictly adhered to. The names of pupils, teachers and schools were not released in the research. Secondly, the features of the questionnaires such as ease of completion and sensitivity of the questionnaire were all considered. There were no biases towards any religion, race or culture. Permission was sought from participants to involve them in the study. Their names were not needed on the questionnaire and they were assured of subject anonymity and confidentiality.

3.12 Summary

This chapter discussed the methodological procedure that was followed in the study. Issues relating to population, sampling procedure, instrumentation, data collection and analysis as well as the ethical principles were discussed. Descriptive statistics as well as content and thematic analysis help answered the research questions while inferential

statistics helped to answer the research hypothesis. The next chapter presents the analysis of data collected and the discussion of findings.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.0 Overview

This chapter presents the results of the analyses of data and discussion of the findings. The chapter is organised under four sub-sections. The first section presents the return rate and the reasons that accounted for it while the second section shows the demographic characteristics of the sample for the study. Thereafter, the analysis of data for each research questions follows as well as the testing of hypothesis, then finally, the discussion of the findings.

4.1 Response Rate

Out of the 138 questionnaires distributed to the respondents, 133 were completely responded to and returned, representing a return rate of 96.4%. This return rate was realised because some of the respondents did not return the questionnaire. The researcher made several attempts to retrieve the questionnaires, but it was later realised the teachers had misplaced the instruments. Nonetheless, this response rate was adequate for statistical analysis based on the suggestion of Dillman (2000) that a response rate of 70% is adequate for a surveys study. The next sub-section presents the demographic characteristics of the respondents.

4.2 Demographic Characteristics of the Respondents

The demographic characteristics of respondents obtained using the Section A part of the questionnaire designed for this study. It comprised items as the sex, age, academic qualification, teaching experience and the number of in-service training attended.

The demographic characteristics of the respondents are shown in Table 4.1.

Table 4.1: Demographic Characteristics of Respondents (n = 133)

Variables	Frequency	Percentage
Sex		
Male	75	56.4
Female	58	43.6
Age		
Less than 30	1	0.8
31 to 40	66	49.6
41 to 50	54	40.6
51 and above	12	9.0
Academic Qualification		
Cert. A	3	2.3
Diploma	73	54.9
Bachelor's Degree	47	35.3
Master's Degree	10	7.5
Experience		
1-5	28	21.1
6-10	76	57.1
11-15	21	15.8
16 and Above	8	6.0
In-Service Training Attended		
Nill	74	55.6
1	16	12.0
2	15	11.3
3	13	9.8
4 and Above	15	11.3

Source: Survey Data, 2017

It could be seen from Table 4.1 shows that there were more male teachers (n = 75, 56.4%) than female teachers (n = 58, 43.6%) who participated in the study. Majority of the respondents fell between the ages of 31-40 years (n = 66, 49.6%) while a few were between the ages of 41-50 (n = 54, 40.6%) as well as 51 and above (n = 12, 9.0%). Only one of the respondents was less than 30 (n = 1, 0.8%) years.

The composition of the respondents based on academic qualification showed that the frequency of those who had diploma (n = 73, 54.9%) was more than bachelor's degree

holders (n = 47, 35.3%), and masters (n = 10, 7.5%) holders respectively. The distribution of the respondents by years of teaching experience in mathematics revealed that majority (n = 76, 57.1%) had spent 6-10 years, followed by those who have spent 1-5 years (n = 28, 21.1%), 11-15 years (21, 15.8%) and 16 years and above (n = 8, 6.0%). More than half of the respondents indicated never to have attended any mathematics in-service training (n = 74, 55.6%), followed by those who had attended it once (n = 16, 12.0%), twice (n = 15, 11.3%), four times and more (n = 15, 11.3%), and then those who had attended it three times (n = 13, 9.8%).

4.3 Presentation and Analysis of Data

Research Question 1: To what extent does the basic school mathematic curriculum (syllabus) conform to the constructivist principles of teaching and learning?

This research question was formulated to determine whether the curriculum for mathematics education at the Junior High School (JHS) level, thus the National Syllabus for Mathematics Education (JHS 1-3), conforms to the constructivist principles of learning as it guides teacher instruction in the classroom. Content analysis was employed to analyse theoretical framework of syllabus with respect to constructivist principles developed by the researcher based on the literature and study of renowed researchers in the field of constructivism.

Determining the conformity of the JHS mathematics syllabus to constructivist principles

With the rationale of producing citizens who are mathematically competent so as to help them reason or use their minds logically in solving problems for the benefit of the society (CRDD, 2012), the JHS mathematics syllabus has served as the curriculum for

mathematics education in the Junior High School level throughout the nation and has undergone several reforms (Eshun, 2013) with the most current one in use being the 'National Syllabus for Mathematics (Junior High School 1 - 3)' which was introduced in September, 2012. According to the Ministry of Education (2017, p.8), the following have been the usual reason for curriculum reforms due to the burden it places on learners:

1. Curricula that is dissociated from their personal and social context.
2. Teachers who are not able to respond to individual needs.
3. Poor development of numeracy and literacy skills among pupils.
4. Teachers lack the skills and resources required to integrate ICT into teaching.
5. There is a lack of emphasis on critical thinking, innovation, creativity and problem solving skills in the school curriculum.

These reasons provided might be true due to the fact that society is dynamic, therefore factors that guided the construction of the curriculum in the last three to five decades might have changed drastically due to shift in the preference of the people and the nation at large. This explains why there has been several educational reforms, such as those led by the Dozdo Committee in 1974 and Anamoah Mensah committee in 2002 as well as the Free Compulsory and Universal Basic Education (FCUBE) providing an action plan for the years 1996 to 2005 (Eshun, 2013; UNESCO, 2010), which has led to the restructuring of the Ghanaian education system and its functions.

With the continuous reformation and restructuring of the educational system in Ghana coupled with a global shift from the teacher centred system of education to the adoption of the child centered system of education (Mungoo & Moorad, 2015), one may ask if the curriculum meets the current needs of learners or follows the current trends education

worldwide. Report from a study conducted by UNESCO (2006) states that high and quality education requires trained teachers who are well acquainted with the learner centred methods of instruction. "Consequently, the demand for quality education has led to the proliferation of constructivist approaches and Leaner Centred Education (LCE) has been promulgated in many developing countries" (Mungoo & Moorad, 2015, p.161). Sahlberg (2007) as cited by Mungoo and Moorad (2015), purport that the constructivist approach originate from strong global educational policies which opt for the move for change and an improvement in the educational system. Mungoo and Moorad (2015) adds that "the promulgation of such policies elsewhere is intended to emulate best educational practices" (p.161).

Teacher are known to be the final implementers of the curriculum since they are responsible for ensuring that its' intended purpose is achieved through the lessons they teach daily in the classrooom. Though a teacher is allowed to flexible and creative during the implementation of the curriculum with regards to the situation that might arise in the teaching and learning process (Adentwi, 2005; CRDD, 2012), majority of their instruction is directly influenced by the dictates of the curriculum. If teachers are to successfully employ the constructivist principles in their teaching and learning of mathematics at the JHS level to fully reap its benefit as purported by researchers (Herman & Knobloch, 2004; Nayak, 2007; Mungoo & Moorad, 2015; Yakubu, 2015), it is important that the mathematics curriculum is prepared to conform to the constructivist principles of teaching and learning. Hence the need to determine whether the National Syllabus for Mathematics (Junior High School, 1 – 3) conforms to the constructivist principles of teaching and learning.

The JHS Mathematics syllabus is organised into several aspects however to determine its conformity or otherwise to the constructivist principles of teaching and learning, its analysis will be restricted to the: aims and objectives, approaches to teaching learning, medium of instruction, use of teaching and learning materials and assessment. The analysis will be made by examining the contents of the aspects identified under the following benchmarks developed by the researcher based on the study of other renowned researchers in the field of constructivism (Piaget, 1954; Phillips, 2000; Applefield et al., 2001; Koohang, 2009; Chen, 2003: Richardson, 2003; Taber, 2011):

1. Teachers' duty as a facilitator.
2. Building lessons on pupils prior experience (RPK).
3. Actively engaging learners in lessons through activities.
4. Encouraging the use of manipulative material (TLMs).
5. Encouraging social interaction.
6. Assessment is individualistic and based on knowledge application.

Teachers' duty as a facilitator

Central to the constructivist principle of teaching and learning is that learners are capable of constructing knowledge for themselves given the right environment and activities. According to Gore (2001) as cited in Pitsoe (2008), contrary to the traditional practice, the role of the constructivist teacher in a classroom is to be a coach, thus, serving as a guide or a facilitator by helping learners to process information independently as well as facilitating learners' thinking process. Alzahrani (2013) agrees to this by stating that the teachers' role in a constructivist classroom is to help learners build their own knowledge. Olusegun (2015) adds too this by stating that "constructivism requires a teacher to act as

a facilitator whose main function is to help students become active participants in their learning and make meaningful connections between prior knowledge, new knowledge, and the processes involved in learning" (p.69). Smith (1999), as cited by Pitsoe (2008), therefore outlines the following as facilitative role of the teacher in the constructivist classroom:

1. Having faith in his or her learners.
2. Seeing each child as a different person that can succeed in their own unique way.
3. Encouraging learners by asking open-ended, probing questions that encourages the learner to share their knowledge and experiences with other members of the class
4. Helping children feel confident in whatever they can do.
5. Provides a "meaningful path" for the learners by providing assistance to help learners create their own understanding.
6. Helping pupils to understand that it is alright to make mistakes so as to make them feel confortable to tryout different ideas.

Ndon (2011) summarises this by saying "a teacher as a facilitator, should provide rich environments, experiences, and activities for learning by incorporating opportunities for collaborative work, problem solving, authentic tasks" (p. 253).

The JHS mathematics syllabus developed by the CRDD (2012) explicitly states, under heading 'Medium of Instruction', that teachers should ensure they "*facilitate* the development and acquisition of mathematical concepts" (p.vii). With regards to catering for the individual needs of learners, which is clearly in support of child-centredness – a position strongly supported constructivists –, the syllabus states that all learners should be

given the chance to achieve the maximum of their potential and it is the duty of the teacher to ensure this by relating whatever they are to learn to knowledge they have acquired in the past. It further adds that "the extent to which teachers are able to *facilitate* this process significantly affects how well children learn" (p.ix). Also, teachers are encouraged to *facilitate* pupils understanding of mathematical language through the use of flash cards, pictures and real-life objects.

Nowhere in the JHS mathematics syllabus are teachers encouraged to instruct or spoon-feed learners with the knowledge they need, though it encourages the use of mental exercises to begin lessons which some might argue as being a traditional approach to teaching since it basically encourages the recall of facts; but rather it provides room for learners to "discover, adapt, modify and be innovative in facing changes and future challenges" (p.iii). It is thus safe to conclude that the JHS mathematics syllabus developed by the CRDD (2012) supports the constructivist principle which places the role of the teacher as a facilitator rather than an instructor or a dispenser of knowledge.

Building lessons based on learners' experiences (RPK)

Another well acclaimed principle of constructivist is the idea that learners construct their own knowledge based on prior experiences through their interaction with the environment (Surgenor, 2010). As Olusegun (2015) puts it "the theory suggests that humans construct knowledge and meaning from their experiences" (p.66). Olusegun further adds that as learners receive each new experience, they continually update their 'mental models' to reflect the new information, thereby constructing their own interpretation of reality. Oliver (2000) supports this by stating that it is the duty of the teacher to always ensure he builds lessons on learners' experiences by making sure he

understands the students' pre-conceived ideas and with that knowledge provide activities to address them and then build upon them. By so doing they become engaged "by applying their existing knowledge and real-world experience, learning to hypothesize, testing their theories, and ultimately drawing conclusions from their findings" (Olusegun, 2015, p.67).

In line with the view of Surgenor (2010) and Olusegun (2015), the CRDD's JHS mathematics syllabus, 2012, notes that "new experiences cause children to refine their *existing knowledge and ideas* [and that] some children fail to reach their potential because they do not see the applicability of mathematics to their daily lives and because they are not encouraged to connect new mathematical concepts and skills to experiences, knowledge and skills they already have. As a result these children develop a negative attitude towards mathematics" (p.ix). This statement indicates that the CRDD the important role the prior experience of learners play in the teaching and learning activity. It equally show that they place high premium on teachers building lessons on pupils prior experiences as it helps them to appropriately connect with new mathematical concepts and skills.

According to the syllabus, "children learn mathematical thinking most effectively through the application of concepts and skills in interesting and realistic contexts that are *personally meaningful to them*. This implies that mathematics is best taught by helping children to solve problems drawn from *their own experiences*" (p.vi). This statement clearly falls in line with the constructivist principle which supports that lesson are built based on pupils prior experiences. However, the syllabus provides room for the teacher, in some cases (not all) to "add some more information based upon [their] own training

and based also on current knowledge and information" (p.xvii). It states that "there are times when the teacher must show, demonstrate, and explain [but immediately follows by saying] … the major part of a pupil's learning experience should consist of opportunities to explore various mathematical situations in their environment to enable them make their own observations and discoveries" (p.xvii). We can thus conclude that the JHS mathematics syllabus, 2012, supports the constructivist view of building lessons on pupils' experiences, that is, learning from the known to the unknown.

Actively engaging learners in lessons through activities

Engaging learners in the teaching and learning process through well-structured activities is one of the premise for the constructivist theory of learning. As Olusegun (2015) puts it, "teachers cannot simply transmit knowledge to students, but students need to actively construct knowledge in their own minds [this is to say] they discover and transform information, check new information against old, and revise rules when they do not longer apply" (p.66). This constructivist view of learning, according to Olusegun (2015), views the learner as an active agent in the process of knowledge acquisition hence must be actively involved in the teaching and learning process. According to Ngussa and Makewa (2014), active participation of learners is at the heart of constructivist theory. They further outline the following as characteristics that indicate active participation from constructivist point of view:

1. Students are allowed to ask questions.
2. Students are allowed to analyze, interpret and predict information.
3. The learner is the key player in the teaching- learning transaction.

4. The learners cannot passively accept information by mimicking others' wording or conclusion.
5. Students connect new learning with already existing knowledge.
6. Learners actively seek solutions to problems and share ideas of what they constructed themselves.

Smaldino, Lowther and Russel (2008) postulate that the constructivist approach to teaching seeks to engage students in problem solving as well as experimental and experiential or exploratory activities. This is to say, "learning occurs most effectively when students are directly involved in problem solving activities and measurement of learning is based on the ability for learners to solve problems and use knowledge to facilitate critical thinking in real life situations" (Ngussa & Makewa, 2014, p.2).

It has already been established that the 2012 JHS mathematics syllabus prefers the use of child-centred methods of instruction over teacher centred methods and advocates to a large extent that teachers should serve as facilitators in the classroom rather than instructors. For this to be possible, the syllabus ought to provide learning experiences as well as activities that would ensure that the learner is made the focus of teaching and learning and this can be possible if, as suggested by Smaldino, et. al. (2008), students are engaged in problem solving as well as experimental and experiential or exploratory activities.

The JHS mathematics syllabus of the CRDD (2012) postulates the teaching and learning activities it provides ensures "maximum pupil participation in the lessons" (p.xvii). It adopts the 'problem solving approach' as its main approach to the teaching and learning of Mathematics. Though it does not treat "Problem solving and Application as a distinct

topic, nearly all topics in this syllabus include solving word problems as activities" (p.vi). It adds that "children learn mathematical thinking most effectively through the application of concepts and skills in interesting and realistic contexts that are personally meaningful to them [implying that] mathematics is best taught by helping children to solve problems drawn from their own experiences" (p.vi). In line with Smaldino, et. al. (2008), the syllabus states that "pupil's learning experience should consist of opportunities to explore various mathematical situations in their environment to enable them make their own observations and discoveries" (p.xvii). It further states that this can be done by beginning each lesson with a practical problem which will in turn help pupils acquire the capacity for analytical thinking and the capacity for applying their knowledge to problems and issues they may face daily.

It is however worth noting that teachers are encouraged to "re-order the suggested teaching/learning activities and also add to them where necessary in order to achieve optimum pupil learning" (CRDD, 2012, p.xvii). It further suggests when necessary, the teacher must show, demonstrate, and explain issues based on their experience, yet, it warns against the use of teacher centred methods of teaching such as "rote learning and drill-oriented methods [while emphasizing] participatory teaching and learning" (CRDD, 2012, p.xvii).

Encouraging the use of manipulative materials (TLMs)

Due to the abstract nature of mathematics certain concepts can be difficult for students to understand. It is therefore adviced that teaching that facilitates students understanding in mathematics through multiple representations should be encouraged (National Council of Teachers of Mathematics, 2000; Cope, 2015). One of these representations is the use of

manipulative or teaching and learning materials. Browning and Willis (2012) define Manipulative materials as "concrete models that can be touched and moved around by the students, thereby providing tangible investigative experiences for abstract mathematics concepts as well as how concepts are related" (p.9). According to Cope (2015), manipulative materials can be in the form of "physical (concrete), pictorial (static visual), and virtual (dynamic electronic) representations" (p.11). Dienes (1960) as cited by Cope (2015), in a study revealed that "learners' whose mathematical understandings are firmly grounded in manipulative experiences would be more likely to make connections between the world in which they live and the abstract world of mathematics".

It will be almost impossible to talk about constructivism without talking about the use of manipulative (Teaching and learning materials). Inculcating the use of manipulative materials in the teaching and learning process therefore forms one of the major principles of constructivism (Phillips, 2000; Applefield et al., 2001; Chen, 2003 & Koohang, 2009). As Shaw (2002, p.1) puts it "manipulatives help students develop conceptual understanding of mathematical ideas by representing the ideas in multiple ways" thereby making it easy for learners to assimilate and grapple with complex concepts.

The JHS mathematics syllabus of the CRDD (2012), talks about the need for the use of teaching and learning materials throughout the instructional process. It refers to teaching and learning materials as "concrete materials or manipulatives" (p. x). It agrees with Shaw (2002) on the importance of manipulative or teaching and learning materials in helping children form mathematical concepts. The JHS mathematics syllabus clearly shows how important the need for and the use of manipulative materials by stating that it "provides a foundation of practical experience on which children can build abstract ideas.

It [again] encourages them to be inventive, helps to develop their confidence and encourages independence" (p.x). The syllabus further goes on to encourages teachers to make use of the "appropriate range of apparatus to focus the children's thinking on the concept to be developed [as well as] modifying the TLMs as the learner's understanding grows" (p.x). It can thus be said that the JHS mathematics syllabus encourages the use of manipulatives as it facilitates the children's thinking during the problem solving process.

Encouraging social interaction

Interaction among learners through collaborative activities is another major tenet of constructivism. This is because according to Piaget's theory of cognitive development, children develop mental structures known as 'schemas' and through exploration or interactions with the environment and with one another, the child assimilates or accomodates changes to existing knowledge thereby gaining a clearer representation of the world (Lutz & Huitt, 2004). As purported by Amineh and Asl (2015), constructivists strongly believe that "meaningful learning occurs when individuals are engaged in social activities such as interaction and collaboration" (p.9). This is to say that, individuals are likely to make more meanings through interactions with each other as well as with the environment they live in. Wertsch (1997) cited by Amineh and Asl (2015), adds that "young children develop their thinking abilities through interaction with other children, adults and the physical world" (p.14).

Surgenor (2010) emphasizes that one way of ensuring social interaction among learners collaborative activities. He defines collaborative learning as a "process of peer interaction that is mediated and structured by the teacher" (p.6). Social interaction among learners is usually through collaborative activities such as scaffolding, reciprocal teaching,

cooperative learning, situated learning, projects and anchored instruction (Surgenor, 2010). Surgenor (2010) adds that discussions, which is a good social interaction tool, should be promoted in classrooms through specific concepts, problems or scenarios, as well as guiding pupils interaction through directed questions, the introduction and clarification of concepts and information, and references to previously learned material.

The JHS mathematics syllabus of the CRDD (2012) provides little information with regards to the use of social interaction through collaborative activities among learners. However, there are several clues that suggest the use of collaborative activities to ensure social interaction. For instance, it states that "children need to be given various opportunities to work on open-ended problems" (p.vii). It adds that teachers should "provide opportunities for the pupils to work co-operatively in small groups to carry out activities and projects which may require out-of-school time" (p.vi). This helps to sharpen their thinking abilities as purported by Amineh and Asl (2015) while at the same time help pupils to tolerate the other. The syllabus also acknowledges that the skill of critical reflection, which is an essential skill needed for pupils to think mathematically, can be developed by encouraging children to share ideas (CRDD, 2012) which will invariably expose them to seeing and tackling problems from different perspectives rather than just in a particular way while encouraging cooperation and team work.

Assessment is individualistic and based on knowledge application

Assessment is a vital part of every curriculum design and implementation process (Adentwi, 2005). It provides immediate feedback as to the progress of learning as well as the effectiveness of the methods and activities employed in the teaching and learning process. The constructivist viewpoint of assessment is that, emphasis must be placed on

students' learning process and on their ability to make meaning as well as apply the knowledge gained to solve problems rather than just acquiring knowledge (Dagar & Yadav, 2016). Ertmer and Newby (2013), purports that assessment in the constructivist classroom is more criterion based. This is because it places much emphasis on the performance of an individual learner to a given standard than to the performance of other individuals in the whole class, as in norm-referenced assessment, due to individual differences. Bednar, Cunningham, Duffy and Perry (1992), cited by Abulnour (2016), provides the following as the constructivist way of assessment:

1. First is how well students are able to function within a content domain,
2. Their ability use knowledge gained in a specific domain to solve problems, and
3. If involved in an authentic task, then assessing whether the student successfully completed that task irrespective of their collegues

Abulnour (2016, p.26) postulates that this process relates to the four stages in applying constructivist teaching:

1. Eliciting prior knowledge,
2. Creating cognitive dissonance,
3. Authenticity and applying to new contexts with feedback, and
4. Reflecting on learning.

Also, the constructivist subscribes to the use of formative assessment more than the summative assessment even though they employ both in the evaluation processes (Ertmer & Newby, 2013). This is due to the individual differences that exist among learners, therefore to them, waiting till the end of the lesson to evaluate learning might not provide an accurate picture of students performance since their rate of learning might be different.

Therefore, to them there is the for learners to be constantly monitored throughout the teaching and learning process to ensure no one is left behind while providing varied evaluation exercises to low, average and high performers at the end of the teaching and learning process to ensure the learning needs of all learners are met (Ertmer & Newby, 2013).

Assessment is an integral part of the JHS mathematics syllabus (CRDD, 2012). As a matter of fact, it states that "evaluation of children's achievement is an essential part of mathematics education [and that] assessment should be an integral part of the normal teaching and learning programme" (p.xi). It further provides the following as purpose for assessment:

1. to give teachers feedback on the success of their methods and approaches and to assist planning for new learning (formative); and
2. to evaluate children's readiness for new learning and to find out what they have learnt (summative).

This is to say, as per the JHS mathematics syllabus (CRDD, 2012), both formative and summative assessment is deemed necessary. However, in line with the view of Ertmer and Newby (2013), the syllabus states that "pupils come from various backgrounds and have different learning styles and abilities. It must [therefore] be recognised that each pupil is an individual whose learning development and rate of progress is different from others" (CRDD, 2012, p.vi). It further adds that due to the individual differences that exist among learners "pupils will be ready for particular mathematical content and experiences at different times. It is therefore not expected that all children of the same age will be achieving at the same level at the same time, nor that an individual child will

necessarily be achieving at the same level in all content areas of the mathematics curriculum" (p.vi). This therefore stands to suggest that the curriculum developers of the JHS mathematics syllabus prefers individualised teaching where attention is provided for the varied needs of learners while ensuring they attain the expected competency in the JHS level. This also means that during teaching and learning, the teacher must pay particular attention every child while providing them with the necessary guidance to help them learn at their own. This approach will therefore demand constant evaluation by the teacher throughout the teaching and learning process rather than just at the end of the lesson suggesting an assessment which is more formative and criterion based.

Again line with Abulnour (2016), the JHS mathematics syllabus states that "skills assessed should include the ability to communicate findings, to present an argument and to exploit an intuitive approach to a problem" (p.xi) rather than just recalling of information and stating facts. It adds that "teachers should avoid carrying out only tests which focus on a narrow range of skills (or profile dimensions) such as the correct application of standard algorithms (procedures)" (p.xi). It retorts that though they are helpful, a continuous use of such methods will resort to students learning that way thereby limiting their imaginative and creative skills as well as causing them to view mathematical skills and concepts with "little obvious connection to other aspects of learning or to their world" (CRDD, 2010, p.xi).

The 2012 JHS mathematics syllabus has also adopted a new form of assessment referred to as the School Based Assessment. It consists of "12 assessments a year instead of the 33 assessments in the previous continuous assessment system [thereby showing a] reduction by 64% of the work load [on both teachers and pupils] compared to the previous

continuous assessment system" (CRDD, 2012, p.xiv). It provides the following as the importance of this new form of assessment:

1. To provide a reduced but more effective system of internal school assessment replacing the former Continuous Assessment system which was rather tedious for both teachers and pupils/students.
2. To standardize the practice of internal school assessment throughout the country.
3. To provide teachers with guidelines for constructing assessment items/questions.
4. To provide teachers with advice on how to conduct remedial instruction to improve pupil/student school performance.
5. To provide guidance in marking and grading test items and questions and carry out general appraisal of pupil/student performance.

In all, it can be said that the 2012 JHS mathematics syllabus appreciates the importance of both formative and summative assessment. This notwithstanding, just as the constructivists, the syllabus it opts for a more individualised approach to approach to assessment where each learner is assisted to learn and develop within their own space while at the same time achieving the national mathematics competency.

Conclusion

Reviewing the 2012 JHS mathematics syllabus, developed by the Curriculum Research and Development Division, has provided valuable insight into the vision held by our curriculum developers with regards to mathematics education. The CRDD (2012) reveals that the national constitution makes it clear that "all children should be given the opportunity to achieve the maximum of their potential" (p.xi). The JHS mathematics syllabus therefore emphasizes the acquisition of "mathematical knowledge and skills that

should help the young person to develop basic numeracy competence to be able to function effectively in society" (CRDD, 2012, p.xvii). It adds that general aims of the subject can "only be most effectively achieved when teachers create learning situations and provide guided opportunities for pupils to acquire as much knowledge and understanding of mathematics as possible through their own activities (CRDD, 2012, p.xvii).

With regards to its conformity or otherwise to the main principles of constructivism such as: teachers' duty as a facilitator, building lessons on pupils prior experience (RPK), actively engaging learners in lessons through activities, encouraging the use of manipulative material (TLMs), encouraging social interaction and encouraging individualistic assessment which is based on knowledge application; the 2012 JHS mathematics syllabus leaves little room for one to argue against the fact that, to a greater extent, it agrees with most of the constructivist principle of learning. Though it does not categorically state its allegiance to any theory of learning, amongst the learning theories reviewed in this study (Behaviorist, Cognitivist and Constructivist), evidence gathered from its analysis with regards to the duty of the teachers in the classroom, planning of lessons, engaging learners in lessons, the use of manipulative material (TLMs), encouraging interactions and the kind of assessment used, clearly suggest that it conforms more to the constructivist theory of learning than any other theory of learning.

Research Question 2 - What is the teaching and learning theory that predominantly informs JHS Mathematics teachers' instructional practices in the Effutu Municipality?

The second research question investigated the teaching and learning theory that predominantly informed the instructional practice of participants in the Effutu Municipality. To do this, the mean and standard deviation of responses collected from the questionnaire was calculated such that a mean less than 3.0 (m < 3.0) indicated 'rarely', a mean of 3.0 (m = 0) showed 'sometimes', and a mean above 3.0 (m > 3.0) indicated 'always' based on a 5-point Likert scale used for the data. The results are presented in Table 4.2:

Table 4.2: Mean and Standard Deviation of the Learning theory that predominantly informs teachers' practice

Learning Theories	N	Minimum	Maximum	Mean	Std. Deviation
Constructivist	133	2.10	5.00	4.15	0.54
Cognitivist	133	2.00	5.00	3.81	0.53
Behaviorists	133	1.30	4.90	3.40	0.61

Source: Survey Data, 2017

The results in Table 4.2 revealed that the constructivist learning theory obtained a mean and standard deviation of 4.15 and 0.54, followed by the cognitivist learning theory with a mean and standard deviation of 3.81 and 0.53 respectively and lastly the behaviorist learning theory with mean and standard deviation of 3.40 and 0.61 respectively. It can be clearly seen that the constructivist learning theory predominantly influenced the instructional practices of JHS Mathematics teachers in the Effutu Municipality since it had the highest mean indicating that majority of teachers' instructional practice was

always influenced by it. This is followed by the cognitivist learning theory and lastly the behaviorist learning theory which had the lowest mean. It is however worth noting that the mean score for all the theories were above 3.0 indicating that the facets of all the three learning theories were common in the classrooms of JHS Mathematics teachers in the Effutu Municipality but the dominant one being that of the constructivist learning principles.

Research Question 3: How do JHS mathematics teachers in the Effutu Municipality perceive constructivism as a modern approach to lesson delivery?

This research question was formulated to explore JHS mathematics teachers' perception of constructivism as a modern approach to lesson delivery in the Effutu Municipality. Data was collected using a close ended questionnaire (see Appendix A, Section D) coupled with a semi-structured interview. The interview was conducted for ten teachers who were randomly selected from the three circuits in the Effutu Municipality (see Appendix B for interview guide). Data collected from the questionnaire were analysed using simple percentages together with quotations from responses gathered during the interview. Responses were analysed and discussed based on the following themes:

1. Teachers knowledge of learning theories
2. Learning theories teachers believe in
3. Teachers knowledge of the constructivist theory of learning
4. Application of the constructivist principles in teaching and learning
5. Constructivism as a learning theory that maximizes learning outcome
6. Challenges associated with constructivism and how to overcoming them

Table 4.3 provides a summary of data collected from the questionnaire followed by responses from the interview.

Table 4.3: JHS mathematics teachers' perception of constructivism in the Effutu Municipality

Items	Responses	Frequency	Percentage(%)
54. I am familiar with learning theories	Agree	121	91.0
	Disagree	12	9.0
	Uncertain	-	-
55. I believe mostly in one of the following theories:	Behaviorism	37	27.8
	Cognitivism	29	21.8
	Constructivism	46	34.6
	Others	21	15.8
56. I have received some level of education about the constructivist theory of learning	Agree	68	51.1
	Disagree	50	37.6
	Uncertain	15	11.3
57. I often apply the constructivist principles in my classroom during teaching and learning	Agree	75	56.4
	Disagree	17	12.8
	Uncertain	41	30.8
58. I believe applying the constructivist principles during lessons maximizes learning outcome	Agree	86	64.7
	Disagree	12	9.0
	Uncertain	35	26.3
59. I face challenges applying the constructivist principles in my classroom	Agree	65	48.9
	Disagree	23	17.3
	Uncertain	45	33.8

Source: Survey Data 2017

Result from Table 4.3 revealed that 91.0% of respondents agree to being familiar with learning theories while 9.0% were not. This indicated that majority (n = 121, 91.0%) of the JHS mathematics teachers in the Effutu municipality were familiar with learning theories while the remaining (n = 12, 9.0%) had no idea what it was.

Qualitative data collected from the interview also support this finding as majority of respondents were familiar with learning theories as a system of ideas which guides the teaching and learning process. As one respondent remarked:

> "*Learning theories are theories that shows the teacher what teaching methods or teaching strategies he should use in the classroom*" (Teacher 5, Interview data, 2017).

Another respondent also said:

> "*I see it to be like a set of rules which you can follow to make your lesson successful*" (Teacher 2, Interview data, 2017)

It was however noted that few of the respondent had no idea of teaching theories while others confused teaching theories with teaching strategies.

Again from Table 4.3 it was revealed that majority of the JHS mathematics teachers (n = 46, 34.6%) in the Effutu Municipality believed in the constructivist theory of learning, followed by the behaviorist theory of learning (n = 37, 27.8%), then the cognitivist theory of learning (n = 29, 21.8%). The remaining 21 (15.8%) respondents believed in learning theories other than the behaviorist, cognitivist and the constructivist.

Qualitative data collected from the interview supported these findings as responses from majority of the respondents showed that they believed in child-centred learning which has its foundations from the constructivist theory of learning. One respondent remarked:

> "*Children learn much by observation and imitations, so when they are in a conducive environment for learning it will mean that the behavioral aspect of the*

child is developed. It means that the correlation between the teacher and the pupils helps them to learn" (Teacher 7, Interview data, 2017).

Another respondent had this to say:

"*I believe in the child centred approach because usually when you use the child centred learning it makes the class interactive, the child is able to communicate and you are able to tell if the child has any problem with the topic you are teaching*" (Teacher 3, Interview data, 2017).

It was however noted that a few made mention of the behaviorist or the cognitivist learning theory while some respondents provided other learning theories other than the behaviorist, cognitivist and the constructivist. As one respondent remarked:

"*I believe in the child motivation theory. This is whereby pupils have firsthand experience and are allowed to contribute to the lesson using motivation to reinforce the good aspect of the learning*" (Teacher 6, Interview data, 2017).

Table 4.3 again revealed that majority of JHS mathematics teachers (n=68, 51.1%) in the Effutu Municipality have had some level of education about the constructivist theory of learning. However, 37.6% (n=50) of teachers responded negative to having had any education with regards to the constructivist theory of learning while the remaining 11.3% (n=15) were uncertain. This result shows that quite a sizeable amount of respondents (n=65, 48.9%) were not familiar with the constructivist theory of learning, that notwithstanding, more than half of the JHS mathematics teachers in the Effutu Municipality had received some knowledge of what the constructivist learning theory entails.

Data collected from the interview also revealed that most respondents were familiar with the constructivist learning theory, though some them thought it to be the same as child centred learning. The following are excerpts of their responses with regards to their knowledge of the constructivist learning theory:

> "*What I know is that it talks about the creative aspect of the child, where the child is made to do things and experience things and is involved in finding solutions himself*" (Teacher 6, Interview data, 2017).

> "*I think it talks about groups, the child finds out issues in a group and then tries to work out to find solutions to it*" (Teacher 7, Interview data, 2017).

> "*It is when the child is allowed to search for something for himself in the process of learning*" (Teacher 5, Interview data, 2017).

Results from Table 4.3 also revealed that 56.4% (n = 75) of JHS mathematics teachers in the Effutu Municipality often apply the constructivist principles in their teaching and learning process, 12.8% (n = 17) of respondents did not often apply its principles while 30.8% (n = 41) of respondents were uncertain. This may be due to the fact that they had not received any education on constructivism. That notwithstanding, majority of JHS mathematics teachers (n = 75, 56.4%) in the Effutu municipality often applied the constructivist principles in their classroom instruction.

Data collected from the interview support this finding as the response from majority of the respondents showed they applied some, if not all, of the constructivist theory of learning. The following are excerpts of some of their responses with regards to their

application of the constructivist learning principle when it comes to lesson planning, assessment, using TLMs, and collaborative learning:

> "*Children come from different backgrounds, children in the classroom also have different abilities so when you plan the lesson based on their experience, it will benefit all of them*" (Teacher 1, Interview data, 2017).

> "*When you are assessing throughout the lesson, sometimes you get to know whether they are following the lesson and whether they are getting it or not but if you are going to assess at the end of the lesson, the assessment may not be accurate*" (Teacher 4, Interview data, 2017).

> "*TLMs are good because sometimes it makes the lessons simple and makes teaching easy*" (Teacher 8, Interview data, 2017).

> "*Children learn from each other and also group work makes the children to be confident and everybody talks because they discuss in a group. So when you ask a child to talk maybe because of the population of the class, the child may not be able to talk but when you put that child in a group, that child will be able to talk and he or she will develop experience*" (Teacher 1, Interview data, 2017).

From Table 4.3, it was revealed that 64.7% (n = 86) of JHS mathematics teachers in the Effutu municipality believed applying the constructivist principles in their teaching and learning process maximises learning outcome while 9.0% (n = 12) of respondents believed contrary. The remaining 26.3% (n = 35) of JHS mathematics teachers were uncertein as to whether it maximises learning outcome or not. This may be due to the fact that they do not have any education on constructivism nor apply its principles during

instruction. This notwithstanding, majority of JHS mathematics teachers (64.7%, n = 86) in the Effutu municipality believe that applying the constructivist principles maximises learning outcome.

Qualitative data from the interview also affirmed this as almost all of the respondents professed that applying the constructivist principles maximises learning. As some of them retorted:

> "*When a child is allowed to do things himself, he will not easily forget. So you will see that the child always remembers what has been taught and they apply it in their daily activities*" (Teacher 1, Interview data, 2017).

> "*You realize that the teacher is less active so the children do the activities themselves so it stays longer in their mind*" (Teacher 4, Interview data, 2017).

> "*It boosts their confidence level because once they are able to come out with suggestions which the teacher too have aided, it gives them some amount of confidence that yes, they actually did this thing themselves*" (Teacher 3, Interview data, 2017).

> "*It helps learners to come out with their own idea and ways of solving problems on their own*" (Teacher 6, Interview data, 2017).

Finally, results from Table 4.3 revealed that 48.9% (n = 65) of JHS mathematics teachers in the Effutu municipality face challenges when applying the constructivist principles in their classrooms while 17.3% (n = 23) of the respondents believed otherwise. However, 33.8% (n = 45) of respondents were uncertain as to whether applying the constructivist principles came with challenges or not probably because they do not apply the

constructivist principles during instruction. It can therefore be said that majority of the JHS mathematics teachers (48.9%, n = 65) in the Effutu municipality face some challenges when applying the principles classroom instructions.

Qualitative data collected from the interview affirmed that teachers often faced challenges applying the principle of constructivism during lesson. The following are excerpts of the responses given with regards to the challenges teachers faced applying the principle of constructivism:

> "*When specific rules are not set, the class becomes noisy*" (Teacher 2, Interview data, 2017).

> "*It is very time consuming. Since majority of the work is done by the children, a lot of activities are involved and this makes it time consuming as compared to if it is teacher centred where you come to do lecturing, that one moves fastor*" (Teacher 7, Interview data, 2017).

> "*When you are teaching a practical lesson, you may spend a lot of time*" (Teacher 8, Interview data, 2017).

> "*It is a tedious task because they want us to deal with the children as an individual. So you have to be moving from child to the other*" (Teacher 4, Interview data, 2017).

> "*The class sometimes become playsome because when the children interact with one another, they easily begin to play if the teacher does not supervise them*" (Teacher 5, Interview data, 2017).

As a follow-up question, respondents were asked how some of the problems they have identified could be solved and these were what some of them said:

> "*Setting objectives that will meet the time that you are using to teach the lesson*" (Teacher 6, Interview data, 2017).
>
> "*Setting rules and regulation whenever you decide to use activities or group work to guide children's behavior*" (Teacher 9, Interview data, 2017).
>
> "*The way of teaching using the TLM should be child centred because children at the elementary level usually believe in manipulating with items but many at times it is either the TLM is less used or sometimes we don't even use it at all. So we should modernize our TLM using in the classroom*" (Teacher 3, Interview data, 2017).
>
> "*The teacher should always supervise the work of the pupil*" (Teacher 5, Interview data, 2017).

In all, it could be derived from the results provided that generally, JHS mathematics teachers in the Effutu Municipality have a positive perception of the constructivist principles of learning though they acknowledged it had some few challenges which can easily be overcome through careful planning and supervision.

Research Question 4 - To what extent do JHS mathematics teachers in the Effutu Municipality employ the principles of constructivism in teaching and learning?

Research question four sought to investigate the extent to which JHS Mathematic teachers in the Effutu Municipality apply the principles of constructivism in their instructional practices. This was done by calculating the mean and standard deviation of

responses collected from the questionnaire such that a mean less than 3.0 (m < 3.0) indicated 'rarely', a mean of 3.0 (m = 0) showed 'sometimes', and a mean above 3.0 (m > 3.0) indicated 'always' based on a 5-point Likert scale used for the data.

The general view of respondents with regards to the extent to which they employ the principles of constructivism in their instructional process is presented in Table 4.4.

Table 4.4: Mean and Standard Deviation of the Extent to which JHS Mathematics Teachers Employ Principles of Constructivism

Principles of Constructivism	Mean	Std. Deviation	Extent of Use
1. Teacher as a Facilitator	4.07	0.62	Always Used
2. Building Lesson on RPK	4.03	0.70	Always Used
3. Assessment based on Knowledge Application	4.01	0.61	Always Used
4. Social Interaction through Collaborative Activities	3.97	0.69	Always Used
5. Active Engagement of Learners	3.94	0.61	Always Used
6. Use of Manipulative Materials	3.75	0.77	Always Used

Source: Survey Data, 2017

Data from Table 4.4 showed that each principle of constructivism, thus, teacher serving as a facilitator, building lessons on pupils RPK, assessment based on knowledge application, encouraging social interactions through collaborative activities, active engagement of learners and the use of manipulative material; yielded a mean and standard deviation of 4.07 and 0.62, 4.03 and 0.70, 4.01 and 0.61, 3.97 and 0.69, 3.94 and 0.61, and 3.75 and 0.77 respectively. A review of results revealed that the mean score obtained from data collected were all above the mean (m > 3.0) indicating that JHS mathematics teachers in the Effutu Municipality "ALWAYS USED" all the principles of constructivism in their classrooms instructions. However, per the level of application, mathematics teachers applied acting as a facilitator (M = 4.07, SD = 0.62) more than the

other principles of constructivism, followed by building lesson on pupils RPK (M = 4.03, SD=0.70), assessment based on knowledge application (M = 4.01, SD = 0.61), social interaction through collaborative activities (M = 3.97, SD = 0.69), active engagement of learners in lessons (M = 3.94, SD = 0.61) and finally the use of manipulative materials (M = 3.75, SD =0.77) being the least applied principle.

In all, it can be said that JHS mathematics teachers in the Effutu Municipality always employed the constructivist principles during classroom instructions.

4.4 Test of the Study's Hypothesis

$H_{0:}$ There is no statistically significant difference between JHS mathematics teachers' perception of constructivism and its influence on their classroom practice in the Effutu Municipality

$H_{01:}$ There is a statistically significant difference between JHS mathematics teachers' perception of constructivism and its influence on their classroom practice in the Effutu Municipality

In testing this hypothesis, a Pearson product-moment correlation analysis was employed and the results are presented in Table 4.5.

Table 4.5: Correlations for Teachers Perception and Influence of Constructivist Principles on Classroom Instructions

		TPC	ACP
Teachers perception of constructivism (TPC)	Pearson Correlation	1	.820**
	Sig. (2-tailed)		.000
	N	133	133
Application of the constructivist principles in classroom instructions (ACP)	Pearson Correlation	.820**	1
	Sig. (2-tailed)	.000	
	N	133	133

Note: ** Correlation is statistically significant at the 0.01 level

The Pearson product-moment correlation result in Table 4.5 showed that there was a statistically significant difference between teachers perception of constructivism and the application of its principles in their classroom instructions [r =.82, p < .01, 2-tailed]. We therefore reject the null hypothesis. This is to say that there is a strong positive correlation between JHS mathematics teachers' perception of constructivism and the application of its principles in their classroom instructions within the Effutu Municipality.

4.5 Discussion of Results

Research question one was formulated in response to the first research objective which sought to determine the conformity of the mathematics curriculum for mathematics education at the Junior High School (JHS) level, thus the National Syllabus for Mathematics Education (JHS 1-3), to the constructivist principles of learning. After analysing the contents of its theoretical framework with the constructivist principles of learning such as: teachers' duty as a facilitator, building lessons on pupils prior experience (RPK), actively engaging learners in lessons through activities, encouraging the use of manipulative material (TLMs), encouraging social interaction and encouraging individualistic assessment which is based on knowledge application; developed from the

study of renowned researchers in the field of constructivism (Piaget, 1954; Phillips, 2000; Applefield et al., 2001; Koohang, 2009; Chen, 2003; Richardson, 2003; Taber, 2011); it could be concluded that the 2012 JHS mathematics syllabus to a greater extent, conforms to the constructivist principles of learning more than any of the learning theories adopted for this study.

Research question two was formulated in response to the second research objective which sought to investigate the teaching and learning theory that predominantly informed the instructional practice of Junior High School mathematics teachers in the Effutu Municipality. This was done using a questionnaire based on the five-point Likert scale where a mean below 3.00 indicated rarely, a mean of 3.00 showed sometimes, and a mean above 3.00 indicated always. With a mean of 4.15 and a standard deviation of 0.54, the constructivist theory of learning proved to be the learning theory which predominantly influenced the instructional practices of JHS Mathematics teachers in the Effutu Municipality. This was followed by the cognitivist learning theory with mean and standard deviation of 3.81 and 0.53 respectively and lastly the behaviorist theory of learning with mean and standard deviation of 3.40 and 0.61 respectively. However, with the mean mark of 3.0 as an indicator for average preference, it could be noticed that all the learning theories were above the mean mark of 3.0 which implies that the facets of these three learning theories were common with JHS Mathematics teachers in the Effutu Municipality with respect to their instructional practices in the schools but the dominant one being that of the constructivist. This disproves to some extent the idea that mathematics teaching in Ghana, at the basic education level especially, is characterised

by teacher centred approach as purported by Fredua-Kwarteng (2005) and Sarfo, et.al (2014).

The third research question was formulated in response to third research objectives which sought to investigate JHS mathematics teachers' perception on constructivism as a modern theory for lesson delivery in the Effutu Municipality since according to Applefield, Huber and Moallem, (2001), teachers' perception of learning theories and teaching in general, have been seen to have a considerable influence on almost all aspects of their instructional decisions. A closed ended questionnaire was administered to JHS mathematics teachers in the Effutu Municipality whose data was analysed using simple percentages coupled with a semi-structured interview conducted for ten JHS mathematics teachers based on teachers knowledge of learning theories, learning theories teachers believe in, teachers knowledge of the constructivist theory of learning, application of the constructivist principles in teaching and learning, constructivism as a learning theory that maximises learning outcome, challenges associated with constructivism and how to overcoming them.

Analysis of responses provided to the questionnaire revealed that majority of JHS mathematics teachers in the Effutu municipality were familiar with learning theories and believed in the constructivist theory of learning. Majority of them had also received some level of education on constructivism and quite often apply its principle in their classroom instructions. They also believed that applying the constructivist principles during teaching and learning maximises learning outcome.

Data gathered from the interview also affirmed these findings as responses provided indicated that they are aware of many learning theories and believed it served as a

foundation for learning. This affirms Davis (2013) view that learning theories help to explain, predict, and influence the part of behavior which is related to the acquisition of knowledge. Majority of them identified the behaiviorist, motivational and child centred learning as some theories of learning they were familiar with and tended to believe most in the child centred learning theory. However, as Semple (2000) purports, child centred learning is not a learning theory but a teaching method whose principles are founded on the theory of constructivism. So it could be said that they believed in the constructivist theory of learning as it served as a foundation for child centred learning.

Further interrogations based on the principles of constructivism showed that though they applied all its principles, either partially or fully, in their teaching and learning activities. This was so because almost all the principles of constructivism were found in the principles of child centred learning which they all believed in backed by the latent support of the JHS mathematics syllabus for the application of constructivist principles in the teaching and learning process. It is therefore not surprising that in response to research question two, majority of them subscribed to the constructivist learning theory, followed by the cognitive learning theory which also served a foundation for constructivism (Chen, 2003).

Majority of the respondents believed applying the constructivist learning principles in classroom instructions maximized learning outcome. This confirms the views of several researchers such as Chen (2003), Applefield et al. (2001) and Koohang et al. (2009) with regards to the fact that applying constructivist principles to teaching and learning allows children to learn in their own pace while allowing them to be in charge of their own learning which leads to better understanding. They however acknowledged that applying

the constructivist principles came with certain challenges as large classes coupled with inadequate TLMs, boredom, inadequate time and the tediousness of tasks involved; which could easily be managed through careful planning and supervision

In all, it could be said that JHS mathematics teachers in the Effutu Municipality had a positive perception about the constructivist theory of learning as it reflected in their attitude towards it use. This affirms the view of Applefield, et al. (2001) that a teachers' perception of learning theories and teaching in general, has a considerable influence on their instructional decisions.

Research question four was formulated in response to the fourth research objective which sought to determine the extent to which JHS mathematics teachers in the Effutu Municipality employ the principles of constructivism in teaching and learning. This was done using a questionnaire based on the five-point Likert scale where a mean below 3.00 indicated rarely, a mean of 3.00 showed sometimes, and a mean above 3.00 indicated always. Questions were asked under the following themes which form the principles of constructivism developed for this study: teacher serves as a facilitator, encouraging social interaction through collaborative activities, use of manipulative material, actively engaging learners, assessment is based on knowledge application, and building lessons on pupils prior experience (RPK) (see Appendix C for items under each theme). The mean mark obtained in each case, was above the mean mark of 3.00 which showed that JHS mathematics teachers in the Effutu Municipality 'always' applied the constructivist principles in their classroom instructions. However, a critical analysis of their responses to each theme showed that they believed more in the teacher acting as a facilitator ($M = 4.07$, $SD = 0.62$), followed by building lesson on RPK ($M = 4.03$, $SD = 0.70$), assessment

of knowledge based on application (M = 4.01, SD = 0.61), encouraging social interaction through collaborative activities (M = 3.97, SD = 0.69), actively engaging of learners in lessons (M = 3 .94, SD = 0.61), and use of manipulative materials (M = 3.75, SD = 0.77).

The result form the correlation analysis to test the hypothesis for the study revealed that there was a strong positive correlation between JHS mathematics teachers' perception of constructivism and the application of its principles in their classroom instructions within the Effutu Municipality. This is to say, the positive the perception of JHS mathematics teacher in the Effutu Municipality towards constructivism, the more likely they were to apply its principles during classroom instructions. This again affirms the view of Applefield, Huber and Moallem (2001) that the attitude of a teacher towards teaching and learning is greatly influenced by his perception towards it and this has a direct effect on pupils learning.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.0 Overview

This chapter presents the synopsis of this study. It comprise of the summary of the findings, conclusions drawn as well as recommendations base on the findings of this study.

5.1 Summary of the Study

This study investigated Junior High School mathematics teachers' perception of the constructivism and the influence of its principles on their teaching in the Effutu Municipality of the Central Region. This was answered by first reviewing the JHS mathematics curriculum (syllabus) to determine its conformity or otherwise to the constructivist learning theory, finding out the learning theory which predominantly influenced JHS mathematics teachers' classroom instruction, investigating their knowledge and perception of the constructivist theory of learning as a modern theory of lesson delivery, and determining the extent to which JHS mathematics teachers in the Effutu Municipality employ the principles of constructivism in teaching and learning. Jean Piaget's theory of cognitive development served as the theoretical framework for the study.

The study was a descriptive survey which adopted a mixed method approach to data analysis and presentation. The purposive sampling technique was used to sample one hundred and thirty-eight (138) JHS mathematics teachers for the study. Instruments used for the collection of data for this study included documents, a structured questionnaire and an interview guide. Data collected through these instruments were further analysed as

follows: documents were analysed using content analysis; responses from the questionnaire was analysed using descriptive statistics; while responses from the interview were transcribed and analysed thematically. The next section highlights the findings of the study.

5.2 Major Findings of the Study

1. The study revealed that, though the Junior High School mathematics curriculum (syllabus) does not categorically state that it derives its inspiration from the theory of constructivism, it construction and processes, to a very large extent, adopts majority, if not all, of the principles of constructivism.
2. The study again revealed that, contrary to the view that classroom instructions in Ghanaian basic schools is characterised by lecture and command models which is basically teacher centred, the teaching and learning process of JHS mathematics teachers' in the Effutu municipality is influenced predominantly by the constructivist theory of learning which is more child-centred.
3. It again revealed that JHS mathematics teachers' in the Effutu municipality have a positive perception about constructivism as it positively affects their classroom instruction.
4. It also was revealed that JHS mathematics teachers in the Effutu municipality always employed majority, if not all, of the constructivist principles in their teaching and learning process.
5. There was a strong positive relationship between JHS mathematics teachers' perception of constructivism and the application of its principles in their classroom instructions within the Effutu Municipality.

6. Finally, it was revealed that some of JHS mathematics teachers in the Effutu Municipality had not received any form of education on constructivism as well as majority of them had not attended any form of in-service training.

5.3 Conclusion

Based on the findings of this study, the following conclusions were made: The JHS mathematics curriculum (syllabus) adopts the constructivist principles of learning more than any other modern theory of teaching and learning and clearly discourages the use of traditional methods of teaching which places much emphasis on the teacher as an instructor rather than a guide. The study also establishes that contrary to the view that classroom instructions in all Ghanaian basic schools is characterised by the traditional approach to education, classroom instructions of JHS mathematics teachers in the Effutu municipality is influenced predominantly by the constructivist theory of learning where majority, if not all, of its principles were applied. This can be attributed to the position of the JHS mathematics syllabus as it adoption and promotion of the use of the constructivist principles. As such, poor performance of pupils or their failure to obtain high academic achievement cannot be attributed to the fact that teachers use outmoded or teacher centred methods in their lesson delivery. This is to say, apart from the teaching methods employed, other factors may account for pupils poor performance in the mathematics education within the Effutu municipality. Finally, the study also affirms the essence of in-service training as it keeps teachers abreast with current developments in the field of education.

5.4 Recommendations

In view of the findings of this study and the conclusions drawn, the following recommendations were made:

1. The Ministry of Education in collaboration with the Ghana Education Service should have a clear policy which periodically ensures the review of teaching methods as well as the adoption of effective modern theories of education, such as the constructivist theory of learning, so as to improve pupils' academic achievement.
2. Also, there should be clear policies to ensure and guide the professional development of teachers of mathematics so as to keep them abreast with modern and effective methods of lesson delivery.
3. Mathematics teachers should be encouraged to constantly attend in-service training, not only to keep them abreast with modern trends, but also ensure they maintain a positive perception towards the teaching and learning of mathematics since it directly affects the long-term and short-term outcome of students' performance.
4. Since the JHS mathematics syllabus conforms to the constructivist theory of learning, the Curriculum Research and Development Division in collaboration with the Ghana Education Service should ensure that teachers' and pupils' Mathematics textbooks as well as work books also conforms to the constructivist principles of education to ensure uniformity and efficiency in classroom instruction.

5. Circuit supervisors should also ensure periodic visitation of schools and together with school heads make sure to supervise the work basic school mathematics teachers to ensure they comply with activities and processes outlined by the syllabus.

5.5 Suggestions for Further Studies

It is suggested that effect of constructivism on JHS pupils' academic performance be investigated in the Effutu Municipality. It is again suggested that this study be replicated in basic schools in the various districts across the country to ascertain a comprehensive picture as to whether classroom instructions is characterised by teacher centred or child-centred methods of instructions, and whether teachers are aware of the constructivist principles of learning and how it influences their lessons.

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APPENDICES

APPENDIX A

QUESTIONNAIRE FOR JHS MATHEMATICS TEACHERS IN THE EFFUTU MUNICIPALITY

Dear Sir/Madam,

Thank you for accepting to be part of this research. This questionnaire is designed to elicit information from teachers in order to investigate JHS mathematics teachers' perceptions of constructivism and the influence of its principles on teaching amongst basic school teachers of Effutu Municipality. You will be contributing immensely towards the successful teaching and learning of Mathematics in Basic Schools if you answer the following questions as sincere as possible. Your name is not required and any information given will be treated as confidential. Thanks for your co-operation.

SECTION A

BIOGRAPHIC DATA

Please, tick [√] the appropriate box [ ] or column; or write in the blank spaces where necessary

1. Sex: Male [ ] Female [ ]

2. Age: Below 20 years [ ] 21– 30 years [ ] 31– 40 years [ ]

   41– 50 years [ ] 51– 60 years [ ].

3. Your highest academic/professional qualification.

   Cert. 'A' 3-Year [ ]

   Diploma [ ]

   First Degree [ ]

Masters Degree [ ]

Others (specify)…… …

4. For how long have you been teaching Mathematics?

Less than 1 year [ ]

1 – 5 years [ ]

6 – 10 years [ ]

11 – 15 years [ ]

16 years and above [ ]

5. How many in-service training in the teaching of Mathematics have you attended?

Nil [ ], 1 [ ], 2 [ ], 3 [ ], 4 and above [ ].

SECTION B

PREDOMINANT LEARNING THEORY AMONG JHS MATHEMATICS TEACHERS

Please respond to all items given below by putting a tick [√] in the appropriate space using the following scale: 1 = Strongly Disagree (SD), 2 = Disagree (D), 3 = Uncertain (U), 4 = Agree (A) and 5 = Strongly Agree (SA).

No.	Item	SD	D	U	A	SA
6	I am much concerned with the process of learning than the end result of learning					
7	I give assignment based on the cognitive level of pupils					
8	I plan lessons based on the cognitive level of pupils					
9	I assess pupils' learning at every stage of the learning process and not necessarily at the end of the learning process					
10	I encourage pupils to memorize core points of every lesson					
11	I place much emphasis on the mental processes of learning					
12	I use much of problem solving activities					

13	I use more mnemonics to ensure pupils can memorize core points of a lesson					
14	I evaluate the content of every lesson I cover					
15	I give assignments which is within the learning scope of pupils					
16	I enjoy conducting drills exercises before class begin					
17	I punish those who are unable to answer questions in class					
18	I commend those who are able to answer questions in class					
19	I assess pupils' learning mainly through their actions					
20	I provide a very conducive environment for learning					
21	I see learning to have taken place if learners can recall facts learnt					
22	I am always in charge during lesson delivery					
23	I believe pupils come to school with little or no experience necessary for learning					
24	I give a lot of exercises to ensure pupils practice and remember lesson taught					
25	I focus on the end product of learning and not necessarily the process					
26	I direct pupils to explore when learning					
27	I use methods that encourage interaction and collaborative learning among pupils					
28	During teaching and learning I serve as a guide to pupils					
29	I plan lessons in ways that allow pupils to acquire knowledge for themselves as they explore					
30	I see learning to have taken place if learners can apply knowledge acquired from a lesson					
31	I appreciate divergent views from pupils					
32	I reflect on every lesson in order to make modifications to subsequent lessons					
33	I always use examples from pupils environment and experiences					

34	I use a lot of teaching and learning materials during lessons					
35	I appreciate a democratic learning environment					

SECTION C

USE OF CONSTRUCTIVIST PRINCIPLES IN TEACHING AND LEARNING

Please respond to all items given below by putting a tick [√] in the appropriate space using the following scale: 1 = Strongly Disagree (SD), 2 = Disagree (D), 3 = Uncertain (U), 4 = Agree (A) and 5 = Strongly Agree (SA).

No.	Item	SD	D	U	A	SA
36	I always allow pupils to explore through activities rather than telling them what to do					
37	I use strategies that always encourage interaction among students irrespective of topic treated					
38	I use group assignment regularly to ensure collaboration among pupils					
39	During teaching and learning I always serve as a guide to pupils					
40	I always plan lessons in ways that allow pupils to acquire knowledge for themselves than telling them what they need to know					
41	I see learning to have taken place only if learners can apply knowledge acquired from a lesson to solve other problems					
42	I always encourage divergent views from pupils irrespective of whether it an appropriate or inappropriate.					
43	I always reflect on every lesson in order to make modifications to subsequent lessons					
44	I use activities and examples which pupils are familiar with in their environment than those provided by their textbooks					
45	I build lessons more on pupils experiences than on my experience					

46	I ensure the use of manipulative materials in every topic I treat regardless of its nature					
47	I always encourage a democratic learning environment where everyone contributes to lessons					
48	I always access pupils learning throughout a lesson rather than at the end of the lesson					
49	I always cue and clues to guide pupils explore and discover knowledge for themselves without directly telling them what to do					
50	I place much emphasis on the learning process by actively engaging in pupils in activities irrespective of the time allocated					
51	My classroom environment is usually comfortable and non-threatening					
52	I structure lessons in a way that challenge pupils thinking always					
53	I more often than usual, use exercises to test pupils ability to apply knowledge gained than to recall vital information taught					

SECTION D

MATHEMATICS TEACHERS' PERCEPTION ON CONSTRUCTIVISM

Please respond to items given below by putting a tick [√] in the appropriate space using the following scale: 1 = Strongly Disagree (SD), 2 = Disagree (D), 3 = Uncertain (U), 4 = Agree (A) and 5 = Strongly Agree (SA).

No.	**Item**	**SD**	**D**	**U**	**A**	**SA**
54	I am familiar with learning theories					
55	I believe mostly in one of the following theories:					
	Behaviorism					
	Cognitivism					
	Constructivism					
	Others					
56	I have received some level of education about the constructivist theory of learning					

57	I often apply the constructivist principles in my classroom during teaching and learning					
58	I believe applying the constructivist principles during lessons maximizes learning outcome					
59	I face challenges applying the constructivist principles in my classroom					

APPENDIX B

INTERVIEW SCHEDULE (GUIDE) FOR TEACHERS

SECTION A - BACKGROUND INFORMATION

1. Gender

a. Male [ ]

b. Female [ ]

2. Age

a. 20 - 30 [ ]

b. 31 - 40 [ ]

c. 41 - 50 [ ]

d. 51 and above [ ]

3. Academic Qualification

a. Cert A [ ]

b. Diploma [ ]

c. Bachelor's Degree [ ]

d. Master's Degree [ ]

e. Others Specify.....

4. How long have you been teaching?

a. 1 – 5 year(s) [ ]

b. 6 – 10 years [ ]

c. 11 – 15 years [ ]

d. 16 – 20 years [ ]

e. 21 years and above [ ]

5. How long have you been teaching **Mathematics**?.....

.....

6. At what class are you teaching **Mathematics** in your school?.....

SECTION B

1. Do you know any theory of learning?
2. Can you mention some of them?
3. Which one do you believe in?
4. Which learning theory do you think predominantly influences your teaching?
5. Do you know of the constructivist theory of learning?
6. Tell me what you know about the constructivist theory of learning.
7. What are some of its principles?
8. Does the constructivist principles guide your teaching and learning process?
9. In what ways do you employ its principles in your teaching?
10. Do you think applying its principles maximizes learning outcome?
11. How does it maximizes learning outcome?
12. What are some of the challenges associated with the constructivist principles of learning that prevents you from using it?
13. How do you think that challenge can be overcome?

APPENDIX C

CLASSIFICATION OF QUESTIONS UNDER VARIOUS THEORIES

	Cognitivist	SD	D	U	A	SA
6	I am much concerned with the process of learning than the end result of learning					
7	I give assignment based on the cognitive level of pupils					
8	I plan lessons based on the cognitive level of pupils					
9	I assess pupils' learning at every stage of the learning process and not necessarily at the end of the learning process					
10	I encourage pupils to memorize core points of every lesson					
11	I place much emphasis on the mental processes of learning					
12	I use much of problem solving activities					
13	I use more mnemonics to ensure pupils can memorize core points of a lesson					
14	I evaluate the content of every lesson I cover					
15	I give assignments which is within the learning scope of pupils					

No.	Behaviourist	SD	D	U	A	SA
16	I enjoy conducting drills exercises before class begin					
17	I punish those who are unable to answer questions in class					
18	I commend those who are able to answer questions in class					
19	I assess pupils' learning mainly through their actions					
20	I provide a very conducive environment for learning					
21	I see learning to have taken place if learners can recall facts learnt					
22	I am always in charge during lesson delivery					
23	I believe pupils come to school with little or no experience					

	necessary for learning					
24	I give a lot of exercises to ensure pupils practice and remember lesson taught					
25	I focus on the end product of learning and not necessarily the process					

No.	Constructivist	SD	D	U	A	SA
26	I direct pupils to explore when learning					
27	I use methods that encourage interaction and collaborative learning among pupils					
28	During teaching and learning I serve as a guide to pupils					
29	I plan lessons in ways that allow pupils to acquire knowledge for themselves as they explore					
30	I see learning to have taken place if learners can apply knowledge acquired from a lesson					
31	I appreciate divergent views from pupils					
32	I reflect on every lesson in order to make modifications to subsequent lessons					
33	I always use examples from pupils environment and experiences					
34	I use a lot of teaching and learning materials during lessons					
35	I appreciate a democratic learning environment					

APPENDIX D

PRINCIPLES OF CONSTRUCTIVISM

THEMES	QUESTIONS
Teacher serves as a facilitator	39. During teaching and learning I always serve as a guide to pupils 40. I always plan lessons in ways that allow pupils to acquire knowledge for themselves than telling them what they need to know 43. I always reflect on every lesson in order to make modifications to subsequent lessons
Encouraging social interaction through collaborative activities	37. I use strategies that always encourage interaction among students irrespective of topic treated 38. I use group assignment regularly to ensure collaboration among pupils 51. My classroom environment is usually comfortable and non-threatening
Use of manipulative material	46. I ensure the use of manipulative materials in every topic I treat regardless of its nature 49. I always cue and clues to guide pupils explore and discover knowledge for themselves without directly telling them what to do
Actively Engaging learners	36. I always allow pupils to explore through activities rather than telling them what to do 42. I always encourage divergent views from pupils irrespective of whether it an appropriate or inappropriate 47. I always encourage a democratic learning environment where everyone contributes to lessons 50. I place much emphasis on the learning process by actively engaging in pupils in activities

	irrespective of the time allocated
Assessment is based on knowledge application and occurs throughout lesson	41. I see learning to have taken place only if learners can apply knowledge acquired from a lesson to solve other problems 48. I always access pupils learning throughout a lesson rather than at the end of the lesson 52. I structure lessons in a way that challenge pupils thinking always 53. I more often than usual, use exercises to test pupils ability to apply knowledge gained than to recall vital information taught
Building lessons on pupils prior experience (RPK)	44. I use activities and examples which pupils are familiar with in their environment than those provided by their textbooks 45. I build lessons more on pupils experiences than on my experience

APPENDIX E

LETTER OF INTRODUCTION

UNIVERSITY OF EDUCATION, WINNEBA
FACULTY OF EDUCATIONAL STUDIES
DEPARTMENT OF BASIC EDUCATION
P. O. Box 25, Winneba, Ghana
beducation@uew.edu.gh
+233 (050) 9212015

Date: June 15, 2017

The Director
Effutu Municipal Education Directorate
Winneba

Dear Madam,

INTRODUCTION LETTER

I write to introduce to you, Mr. David Kwame Dotse, an M.Phil student of the Department of Basic Education, University of Education, Winneba, with registration number 8150030002.

Mr. David Kwame Dotse is to carry out a research on the Topic *"Investigating Mathematics Teachers' Perception of Constructivism and Influence of its Principles on Teaching Amongst Basic Schools Teachers of Effutu Municipality"*.

I would be grateful if he could be permitted carry out this study.

Thank you.

Yours Faithfully,

.....
MR. KWEKU ESIA-DONKOH
(Ag. Head of Department)

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