UNIVERSITY OF EDUCATION, WINNEBA

PRIMARY SCHOOL MATHEMATICS TEACHERS' CONCEPTIONS AND PRACTICES OF CONSTRUCTIVIST INSTRUCTIONAL STRATEGIES

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DECLARATION

STUDENT'S DECLARATION

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

SIGNATURE: ....

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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.

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This work is dedicated to my mother, Rosina Kaba and my grand-mother, Hawah Kaba.

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ABSTRACT

The study explored Ghanaian primary school mathematics teachers' conceptions and practices of constructivist instructional strategies (CIS). The study employed a descriptive survey research design to collect data from 205 primary school mathematics teachers in the Upper East region of Ghana. Out of the number, eight (8) teachers were selected for classroom observations and interviews. Purposive sampling was used to sample public primary school mathematics teachers in the Upper East region, while cluster sampling and simple random sampling were used to arrive at the sample size. The study employed both quantitative and qualitative method of data analysis. The findings brought to bare two different teachers' conceptions of CIS which included pupils' ability to construct their own understanding, and also willingness to follow a learner-centred method of instruction. The findings also indicated that teachers are aware of two aspects of CIS; social interactions and authentic learning tasks. It was however observed that teachers sometimes practice CIS. Additionally, it was determined that as teachers' perceptions of CIS increase, their frequency of use of selected CIS increases. Factors hindering the teaching of mathematics using CIS were identified as, teachers' inadequate content and pedagogical knowledge, lack of teaching resources, limited instructional period, large class size and pupils' limited proficiency in the English language. The study recommends that stakeholders should organise in-service training for teachers, in order to keep them abreast of CIS. Furthermore, they should provide resources and incentives that will encourage teachers to teach mathematics using CIS, which will go a long way to improve pupils' academic performance.

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 organization of the study.

1.1 Background to the Study

The future of every country's development is dependent on the quality of education it provides for its pupils. Pupils undoubtedly, are the future leaders of every nation. This assertion is supported by the Policy Document on Early Childhood Care and Development that states that "children constitute the future leadership and workforce of each nation and therefore require serious commitment from the adult population, particularly state institutions, to ensure their proper growth and development into adulthood" (Ministry of Women and Children's Affairs, 2002, p. 1). Closely linked to this statement is the fact that positive beginning on academic and social experiences that pupils have in early learning centres can start them off on a path to academic excellence by spurring their curiosity and desire to learn (Loop, 2009). To this end, there is the need for every nation to provide quality education for its citizens, especially, the young ones.

In the past decade, much has been done globally to provide quality basic education for pupils. Quality education according to United Nations International Children and Education Fund [UNICEF] (2000) consist of:

1. Learners who are healthy, well-nourished and ready to participate and learn, and supported in learning by their families and communities.

2. Environments that are healthy, safe, protective, gender-sensitive, and provide adequate resources and facilities.

3. Content that is reflected in relevant curricula and materials for the acquisition of basic skills, especially in the areas of literacy, numeracy and skills for life, and knowledge in such areas as gender, health, nutrition, HIV/AIDS prevention and peace.

4. Processes through which trained teachers use child-centred teaching approaches in well managed classrooms and schools and skilful assessment to facilitate learning and reduce disparities.

5. Outcomes that encompass knowledge, skills and attitudes, and are linked to national goals for education and positive participation in society.

This exposition gives an understanding of education as a complex system embedded in a political, cultural and economic context. Improvement can focus on any or all dimensions of system quality: learners, learning environments, content, process and outcomes (UNICEF, 2000). The ultimate aim of quality education is to train people to fit well into the society, earn a decent living and solve societal issues. With society being dynamic and our classrooms filled with pupils from different backgrounds, there is the need for a paradigm shift in our instructional strategies in order to achieve the ultimate educational aim.

Learning differences cause pupils to have different experiences in our schools. "Pupils who are the same age differ in their readiness to learn, their interests, their styles of learning, their experiences, and their life circumstances" (Tomlinson, 2000, p. 1). There is therefore the need for educators to adopt the child-centred approach to teaching. This approach employs multiple teaching methods that meet the learning needs of all pupils.

Child-centred teaching is an approach to education that is focused on practice of activities, explicit skill instruction, reflective practice, collaborative learning, and child-controlled learning process (Weime, 2012), rather than focusing on teachers and administrators in the educational process. This approach emphasizes a variety of different types of methods that shift the role of teachers from givers of information to facilitators of pupils' learning (Blumberg, 2008). Child-centred teaching puts pupil's interests first. In contrast to traditional education methodologies, child-centred teaching enables teachers to direct the learning process, while pupils assume a receptive role in their education. Armstrong (2012) claims that traditional instructional methods ignore or suppress child responsibility. For Blumberg (2008), traditionally teachers focus on what they do, and not on what pupils' learn. This emphasis trains pupils as passive learners who do not take responsibility of their own learning. In the 21st century, a lot of educators and psychologists are advocating for the replacement of teacher-centred methods of teaching with the child-centred methods of teaching. This is evident in the Ghanaian mathematics syllabus.

After perusing the Ghanaian mathematics syllabus, one is not far from right by suggesting that it places prominence on child-centred method of teaching. In the syllabus, teachers are entreated to take pupils through activities (project work, experiments, and investigations) to enable them own the knowledge they gain during learning processes and apply this knowledge in their day-to-day experiences (Curriculum Research and Development Division [CRDD], 2012).

This classroom teaching method acknowledges child voice as central to the learning experience of every learner. This view is central to constructivist approaches to teaching. The term constructivism, even though has existed for many years, it has started gaining prominence in educational circles.

Brooks and Brooks (1999) support this assertion by stating that for years, the term constructivism appeared only in journals read primarily by philosophers, epistemologists and psychologists. Nowadays, constructivism regularly appears in teachers' manual, textbook series, state education department curriculum framework, educational reform literature and education journals. Constructivism now has a face and name in education. Slavin (2000) posits that constructivism is a view of cognitive development that emphasizes the active role of pupils in building their own understanding of reality. For Prince and Felder (2006) the inductive teaching and learning methods can be characterised as constructivist methods, "where individuals actively construct and reconstruct their own reality in an effort to make sense of their experiences" (p. 124).

Mckeown and Beck (1999) sum it all up by stating that the constructivist approach to teaching gets pupils to do the talking and the thinking. There are numerous ideas from different constructivists as to what a constructivist approach to education should entail, but the main ideas that run through most of them are:

1. Pupils construct their own knowledge based on their experiences.
2. Learning is facilitated by social interactions.
3. Learning is by doing.
4. Lessons begin with a clear goal.
5. Assessing pupils occurs at every stage of the learning process.
6. Multiple representation of content.
7. Teachers act as facilitators.
8. Teachers assign authentic tasks to pupils.

Kauchak and Eggen (1998) assert that a misconception associated with constructivism is that: A clear goal and careful planning is not important, learning automatically takes place when pupils are involved in social discourse, and the role of the teacher is less important. In reality, in preparing for a constructivist lesson, teachers need to have clear goals in mind in order to build on previous understanding of pupils; teachers sometimes have to modify these goals as lessons progress. As the teachers' role become sophisticated, they guide and assist pupils to understand and engage in meaningful discussions.

Another concern of teachers associated with constructivism, is time factor. Herman and Knobloch (2004) observe that a larger workload come into play when developing constructivist lessons. Topics may also be seen as more quickly taught through direct instruction (Santrock, 2001).

Although, direct instruction quickly allows pupils to restate a procedure, they usually end up missing the underlying factors of the procedure. Such us the "how" or "why" of a procedure, which would decrease their ability to retain and reuse the procedure.

According to Jones and Brader-Araje (2002), social constructivism and educational constructivism (including theories of learning and pedagogy), have had the greatest impact on instruction and curriculum design because they seem to be the most conducive to integration into current educational approaches. In Ghana, there are growing numbers of programmes which incorporate child-centred methods in lesson delivery methodologies to meet pupil's needs, and constructivism encompasses most of these child-centred methods (Associates for Change, 2011).

Constructivism's perspectives on the role of an individual, on the importance of meaning-making, and on the active role of the pupils are the very elements that make the theory appealing to educators. The main goals of public education should be the facilitation of acquisition of knowledge so that pupils construct their knowledge and move through the academic ladder with confidence.

There is a general consensus in literature regarding the positive impact of constructivist approaches on pupils' dispositions (Burris & Garton, 2007). Even though most teachers have been introduced to the constructivist instructional strategies, and there is enough literature that presupposes that the constructivist strategies improve pupil's academic performance (Abbot & Fouts, 2003; Herman & Knobloch, 2004; Cunningham, 2004; Opoku-Asare, 2004; Kim, 2005), there is little research that has examined teachers' conceptions and practices of constructivist instructional strategies in the Ghanaian context. Also, there is little literature that probes, the full scope of challenges faced by teachers in creating constructivist classrooms (Windschitl, 2002).

1.2 Statement of the Problem

Improving pupil's education has over several decades been an issue of concern for educators. It is therefore not surprising that there are a whole lot of literature, expressing divergent views on the need and the manner to carry out early educational programmes. To ensure that these programmes are successfully achieved, teacher's content and pedagogical knowledge comes into play. According to Strong, Thomas, Perini and Silver (2004), teachers need to have adequate content and pedagogical knowledge to enable them design instructional activities that take into consideration the learning style, ability and interest of pupils.

The world has reached a state where great disparities still exist among pupils. This disparity exists as a result of pupil's background, which is duly acknowledged in the basic school mathematics syllabus. Due to pupils of various backgrounds, teachers have to re-look at teaching and instructional practices, to enable them provide additional support, aid, guide and services to the various strata of pupils in the classroom (Subban, 2006).

But evidence from research findings (Subban, 2006; Hobson, 2008) show that, the situation has made the work load of today's classroom teacher more challenging and daunting than yesteryears' work load, forcing teachers to overlook some important aspects of instructions and at times haphazardly undertaking their duties. Teachers usually struggle between their desire to cover a lot of material and the necessity of using more time-consuming methods that allow pupils to construct meaning from their lessons (Franklin, 2001). In Ghana, according to Anamuah-Mensah, Mereku and Ghartey-Ampiah (2008), there seems to be a general haste to cover topics without giving pupils the opportunity to acquire deeper understanding of any particular topic.

These situations might be the cause of the wide spread failure of pupils in the basic schools.

For Ghanaians, our test score in Trends in International Mathematics and Science Study (TIMSS) teaches us that our mathematics methodology and pedagogy must change to give pupils opportunities for problem-solving, problem-posing, and active participation in mathematics learning in the classroom (Fredua-Kwarteng, 2005). Figures from West African Examinations Council (WAEC) showed that the pass-rate of pupils who sat for the basic education certificate examination has been on a constant downward decline (Sogbey, 2011).

The National Education Assessment, which is an indicator of Ghana's educational quality at the basic level showed that between 2005 and 2007, there has been a decrease in the percentage of pupils achieving the minimum level of competency in class three mathematics. Although the scores slightly increase for class six mathematics by 8.5%, the overall scores were very low (Ghana Education Service [GES], 2008).

The decrease in performance at class three is attributed to the significant increase in enrolment in recent years, which has drawn attention to the issue of ensuring that quality of education is improved as access expands. Oduro (2000) claims that with the increase in enrolment, the quality of the mathematics curriculum is questionable.

The falling standards of pupil's achievement have triggered the growing attention for researchers, parents and educational authorities in their quest for the way forward over the last two decades (Blum, 2002). Pedagogical issues, such as the quality and nature of instructional delivery by most basic school teachers is viewed as non-interactive, encouraging pupils to learn by rote alone (Dramani, 2003; Gyasi, 2003); didactic and rote learning approaches in themselves do not assist in prescribing solutions to the myriad of problems one encounters in life; neither do they help in building an intelligent and active citizenry (Ghana Education Service, 2008).

Yet, little or no research has been done in Ghana to ascertain the instructional strategies teachers use and how often they use them in accommodating differences among pupils (Gyimah, 2011). These grounds warrant an investigation into Ghanaian primary school mathematics teachers' conceptions and practices using the constructivist instructional strategies as a lens. Since, constructivist strategies have been found to assist pupils to construct knowledge; better grasp concepts and move from simply knowing the material to understanding it (Ward, 2001).

1.3 Purpose of the Study

The purpose of the study was to explore Ghanaian primary school mathematics teachers' conceptions and practices of constructivist instructional strategies. Specifically, the ultimate reason for this study was to bring to light the instructional strategies used by primary school mathematics teachers in Ghana.

Additionally, it was to find out whether teachers are equipped during their training to adopt the constructivist approach to instruction and also find factors that hinder the constructivist approach to teaching. It also sought to provide information that would aid educators to effectively practice constructivism, fill the current gap in literature in relation to constructivism, and review current methodologies and practices which are in line with constructivism.

1.4 Objectives of the Study

The study sought to achieve the following objectives:

1. To determine teachers' understanding of constructivism in Ghana.

2. To find out how constructivist instruction is being implemented in Ghanaian primary schools.

3. To determine the relationship between teachers' perception of constructivist instructional strategies and their use of selected constructivist instructional strategies.

4. To find out the challenges of adapting constructivist instruction in Ghanaian primary schools.

1.5 Research Questions

The study was guided by the following research questions:

1. What knowledge and perception do primary school mathematics teachers possess or hold about constructivist instructional strategies?

2. What levels of selected constructivist instructional strategies do primary school mathematics teachers use in their instructions?

3. What relationship exists between primary school mathematics teachers' perception of constructivist instructional strategies and their use of selected constructivist instructional strategies?

4. What factors impede primary school mathematics teachers' use of constructivist instruction?

1.6 Significance of the Study

Constructivists of different points of view still agree that the development of understanding requires active engagement on the part of the learner (Jenkins, 2000). Thus, constructivists shift the focus from knowledge as a product to knowing as a process. The research aims at highlighting practices that bring out the primary educational institutions strengths and weaknesses in relation to instructions. Through this study, various educational entities would see the need to encourage the use of constructivist instructional strategies.

1.6.1 Ghana Education Service

Any country that fails to engage in a program of continuous improvement of its teachers' way of teaching is destined to the dustbin of history (Fredua-Kwarteng, 2005). The research findings can be adapted by the Ghana Education Service to organize in-service training programmes to update the pedagogical knowledge of teachers. This would enhance teachers' knowledge and skills in relation to constructivist instruction, which have a tendency to build in pupils more positive attitudes towards education.

1.6.2 Educational Institutions

The findings of the study can serve as the basis for organizing professional development courses. It would also serve as a source of literature for teacher training institutions that emphasis teaching skills that enhance teacher trainees' capacities to support pupils with learning difficulties as well as the gifted pupils.

1.6.3 Teachers

Examining teachers' conceptions and practices of constructivist instruction in Ghana is essential; in order to ensure that, the comprehensive curriculum that is being developed to train teachers on inclusive education addresses some of their concerns at both the training and policy making levels. The findings of this study would help teachers improve upon their instructional strategies to enable them cater for individual differences in the learning environment. Today, there is extensive evidence that if pupils are engaged in mathematics communication where they are expected to explain their ideas clearly and follow other pupil's reasoning rather than just the teacher's instruction, they are much more likely to develop a deep understanding of concepts (Acquah, 2011).

1.6.4 Researchers

The recommendations of this study would add up to the already ongoing research about the best approach to instruction at the basic school level. Other researchers can use the findings as reference for conducting further research into constructivist instruction.

It is hoped that the study would have a positive impact on the teaching and learning of mathematics in general. In addition, it would help the various stakeholders of education to realize the need to assist teachers to practice constructivist-based instruction.

1.7 Delimitation of the Study

Child-centred approaches provide the opportunity for pupils to construct their own understanding, which is in line with the philosophy behind constructivism. For the purpose of this study, the focus was on some selected constructivist instructional strategies. The interest was on whether teachers possess the requisite pedagogical knowledge and resources to handle the learning needs of pupils in our regular classrooms.

In terms of population, the study was restricted to teachers in the Upper East region. The teachers were selected from the Upper East region in Ghana due to the purpose of the research, the performance of pupils in the region and what the researcher wants to know. Additionally, the researcher is familiar with the environment of the study area and would get assistance from teachers and circuit supervisors to ease the collection of data.

1.8 Limitations of the Study

First, the researcher assumed that all participants would understand the survey questions and answer them truthfully to the best of their knowledge. However, the wording of some of the questions caused some misunderstandings to some participants.

Second, it was difficult for the researcher to check whether all the participants told the truth since some of them could deliberately falsify their responses.

Third, purposive sampling was used in selecting participants in only one region out of the ten regions in the country. As a result, the findings of this study cannot be generalised to all primary schools mathematics teachers in Ghana. To obtain a more accurate representation, a larger sample could have been used to cover many regions in Ghana.

Fourth, since Ghanaians have conducted little studies on constructivism, Ghanaian content in the literature review was not enough.

1.9 Definition of Terms

The contextual meaning of concepts differs. It is therefore imperative to give operational definitions to the following significant terms used in the study:

1. Constructivist instructional strategies: Is an approach to teaching, intended to assist pupils to construct their own knowledge. It includes all child-centred methods of teaching. In this study, constructivist instructional strategies, child-

centred methods of teaching or learner-centred methods of teaching are used interchangeably at certain stages of the study.

2. Instructional strategies: Refers to the various techniques employed during teaching. They are the same as instructional approaches.
3. Teachers' conception: Refers to the knowledge and perception teachers possess or hold about a situation or principle.

1.10 Organisation of the Study

The focus of the study was to investigate primary school mathematics teachers' conceptions and practices of constructivist instructional strategies. The study was developed under five chapters.

Chapter one considers the following: background to the study, the statement of the problem, the purpose, the objectives, research questions, significance of the research, delimitation and limitations of the study, operational definitions of terms, and organisation of the study.

Chapter two presents review of related literature. It provides theoretical and empirical evidences on constructivist-based instruction. The issues reviewed are broken down into sub-sections to cover salient aspects of the study.

Chapter three deals with the methodology adopted for the study. It looks at the research design, the population and sampling, research instruments, validity, reliability, data collection and data analysis procedures in the context of a descriptive research survey.

Chapter four presents the results and findings of the study, while chapter five summarises the key findings, conclusions, implications and recommendations of the study.

CHAPTER TWO

LITERATURE REVIEW

2.0 Overview

This chapter discusses review of related literature to the study. Sub-headings included in the literature are: theoretical framework; teachers' conceptions of constructivist instructional strategies; constructivism and learner motivation; underlying assumptions of constructivism; pedagogies based on constructivism; constructivist classroom; challenges in educational constructivism implementation; empirical review of the study; brain research; learning styles; forms of instruction; the basic education mathematics curriculum; teachers' instructional and assessment practices; pupils' academic performance and a chapter summary.

2.1 Theoretical Framework of the Study

The theoretical framework underpinning the study was hinged on cognitive representations ascribed to Jean Piaget, Jerome Bruner and Lev Vygotsky, and dwelling also on the Constructivism learning theory.

2.1.1 Cognitive Representations

Cognition is defined as "the act of knowing or acquiring knowledge. The mental processes involved in the act of knowing are called cognitive processes and these include perceiving, attention, reasoning, judging, problem solving, self-monitoring, remembering, understanding and so forth" (Phillips, 2009, p. 44).

Representations on the other hand are components of learning that can be used to help pupils move from concrete thought to more abstract thought. They signify something other than themselves (Goldin & Shteingold, 2001). Representations are needed to enhance pupils' understanding and ability to make connections in mathematics (National Council for Teachers of Mathematics [NCTM], 2000). Cognitive psychologists are researchers who study the underlying mechanism of solutions; the processes and skills that lead to a certain achievement. They are mainly concerned with the way in which the information has been represented, organised and transformed to direct the action of an individual or how organisms come to know or learn something (Phillips, 2009).

According to Tomic and Kingma (1996), the development of cognitive representation is the main theme of three classic theories on how pupils learn new concepts (Piaget, Bruner, and Vygotsky). The three theorist offer complementary views on the mental development of pupils, Piaget introduces the ideas of adaptation processes. Bruner builds on these ideas by adding the concept that appropriate teaching techniques can aid these processes. Vygotsky closes the circle by introducing the idea that social interaction can facilitate transition from one stage to the next (Rains, Kelly & Durham, 2008).

2.1.2 Development of Cognitive Representations

According to Piaget (1936), cognitive development is a progressive reorganization of mental processes as a result of biological maturation and environmental experience. Pupils construct an understanding of the world around them through their experiences. To Piaget (1954), the cognitive development of pupils toward formal thought could be facilitated through three cognitive processes: assimilation, accommodation and reorganization or equilibration.

Assimilation is the cognitive process by which a person integrates new information or experiences into existing or readily available schema (Phillips, 2009). This may occur when new experiences of pupils are aligned with their existing schemata (Piaget, 1954). Accommodation however, results as pupils modify their existing schemata or mental representations of the external world to fit their new experiences for learning to occur (Piaget, 1954). New schemas may also be developed during this process. Disequilibrium occurs when new information cannot be fitted into existing schemas (assimilation), and therefore, has to be resolved via equilibrium process. Hence, as pupils exercise existing mental structures in particular environmental situations, accommodation-motivating disequilibrium results and the pupils construct new mental structures to resolve this disequilibrium (Piaget, 1954).

Bruner on the other hand, theorised that learning occurs by going through three stages of representation: enactive (hands-on), iconic (image-based), and symbolic (symbols, numbers, and words/discussion). Each stage is a way in which information or knowledge is stored and encoded in memory (Mcleod, 2008).

Enactive, sometimes called the concrete stage, involves a tangible hands-on method of learning. Several types of enactive representations, such as manipulative can be used to provide a solid foundation for knowledge and understanding of underlying ideas in mathematics. The act of manipulation of materials allows for connection to be made through different experiences (Drews, 2007).

Iconic, sometimes called the pictorial stage, involves an internal representation of external objects visually in the form of a mental image or icon (Bruner, 1966). One way of doing this is to simply draw images of the objects on paper or to picture them in one's head.

Symbolic, sometimes called the abstract stage, which is also the last stage, takes the images from the second stage and represents them using words and symbols. Such symbols and words can promote pupils' abilities to relate ideas and explain their reasoning. When using symbolic representations, pupils are no longer dependent upon the physical actions and imagery. Additionally, symbolic representations help pupils condense information into a form that fits into a given attention span (Bruner, 1960). For example, when learning about the commutative properties of numbers, pupils should first work with enactive materials, such as colure blocks, proceed to iconic representations, and finally convert the idea to symbols.

Bruner's stages of representation, alternatively, play a role in the development of the constructivist theory of learning (Culatta, 2012). It is aligned with active learning and encourages comparison of new ideas to prior knowledge (Piaget, 1954; Piaget, 1970; Piaget, 1973; Von Glasersfeld, 1997; Vygotsky, 1978). Constructivism emphasis that pupil's control their own learning, and work in groups to share ideas with the teacher being a facilitator. It also, addresses pupils' different backgrounds, while encouraging pupils to construct, accept and respect different opinions.

According to Farr (2014), Vygotsky's theory of cognitive development centres on the ideas that social interaction and imaginative plays are large contributors to the process of cognitive development in pupils. For Ball and Bass (2000), there is great importance in the facilitation of correct mathematical language, justification of ideas, and sharing ideas with others. The perceptual, attention, and memory capacities of pupils are transformed by vital cognitive tools provided by culture, such as history, social context, traditions, language, and religion (Lemke, 2001).

Vygotsky (1978) also believes that some of the most important learning pupils could experience is in the social interactions they have with a more knowledgeable person or 'teacher', often an adult, such as a parent, coach, or an expert. Social interaction extends pupil's zone of proximal development (ZPD): the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peer (Vygotsky, 1978). Vygotsky believes adults in a society foster pupil's cognitive development in an intentional and systematic manner by engaging them in challenging and meaningful activities.

2.1.3 Piaget's, Bruner's and Vygotsky's Views of Development and Learning

Constructivism is the philosophical orientation that assumes that knowledge arises through a process of active construction (Mascolol & Fischer, 2005). Knowledge is therefore, not a mirror of the world but is created or 'constructed' from an individual's continuous revision and reorganisation of cognitive structures in conjunction with experience (Piaget, 1954).

With respect to instructional approach, concepts sink in better when pupils discover them by themselves (Piaget, 1958; Bruner, 1966). As pupils use concrete representations in the learning process, they enable them to develop a conceptual understanding of concepts. They also develop understanding of future theorems due to exposure to intuitive situations (Bruner, 1966).

Manipulative materials serve as exploratory tools for the development of concepts. They play a crucial role in the teaching and learning of mathematics, as they begin with a concrete representation and progresses to a more abstract one. White, Swan and Marshall (2009) believe that mathematics manipulatives do not give instruction on their own; rather they open pathways to learning. It is therefore important for teachers to know the wealth of resource materials they can readily lay hands on to effectively teach mathematics (Nabie, 2013).

Teachers, in this regard, provide guidance as pupils' progress through cognitive development; in order to foster retention, and maintain a balance between applying previous knowledge and changing behaviour to account for new knowledge. Thus pupils would be able to perform more challenging tasks when assisted by more advanced and competent individuals (Vygotsky, 1978). Creating an environment where pupils develop their own understanding, construct their own meanings through the use of learning aids, requires that school learning takes place in a meaningful and real world context.

2.2 Teachers' Conceptions of Constructivist Instructional Strategies

Research shows that teachers have varied conceptions of constructivist instructional strategies and their classroom practices. Mathematics teachers' beliefs about mathematics teaching and learning have critical influence on what happens in the classroom (Golafshani, 2001). Classroom teaching practice is likely to be more effective when it is informed by an understanding of how pupils learn. It is therefore important that major implications of learning theory should be reflected in classroom practice (Palmer, 2005).

Teaching requires teachers who understand pupils' existing conceptions and can create learning experiences that will allow pupils to either accommodate or restructure their knowledge frameworks for new learning (Mayer, 2004). Changing teachers' beliefs about knowledge, learning, and teaching is assumed to be important in helping them develop effective teaching strategies encouraged by educational reformers (Darling-Hammond, 1995). A promoted or more fashionable and fruitful conception of mathematics among teachers is constructivism (Philip, 2000).

Although, pupils' prior knowledge is a central feature of constructivist instructional strategies, research findings suggest that, while novice teachers hold insufficient conceptions of prior knowledge and its role in instruction to effectively implement constructivist teaching practices; expert teachers hold a complex conception of prior knowledge and make use of pupils' prior knowledge in significant ways during instruction (Mayer, 2004).

A workshop conducted by Mayer in 2004 for teachers indicated that although most participants shifted from a behaviourist-based approach or direct instruction, only a few were able to adopt constructivist-based methods conceptually. Contrived curricula and teaching and limited experiences prevented most participants from embracing the strategy that was strikingly different in conception from those with which they were familiar (Mayer, 2004).

Multiple studies of pre-service teachers have found that, despite method courses and teacher preparation programs based on constructivist learning theory, students find it difficult to implement appropriate instructional practices to support constructivist learning in their classrooms (Haney & MacArthur, 2002). Windschitl (2002) acknowledges this in his review of research on constructivist teaching practices; "that the most profound challenges for teachers are not associated merely with acquiring new skills but with making personal sense of constructivism as a basis for instruction..." (p. 131).

Holding a constructivist view of mathematics, Golafshani (2001) points out, enables teachers to develop mathematics to describe their observations of the world. Teachers might see mathematics as continually growing, changing and being revised, as solutions to new problems are explored by pupils with teachers acting as facilitators.

2.3 Constructivism and Learner Motivation

Motivation is defined as an "internal state that activates, guides, and maintains behaviour" (Green, 2002, p. 989). From the educational viewpoint, motivation is any process that arouses and maintains optimum learning behaviour. Motivation has been recognized as an important factor in the construction of knowledge and an integral component of constructivist-informed teaching (Palmer, 2005).

With the constructivist theory, learning is an active process requiring effort on the part of the learner. If effort is required for learning, then pupils need to be motivated because pupils will not make that effort unless they are motivated to do so (Palmer, 2005). Hence, motivation would be required to get pupils involve in constructing their own knowledge.

According to Sinatra and Pintrich (2003), sustaining motivation to learn is strongly dependent on pupil's autonomy to control their work and develop understanding that is practical and makes sense to them. This creates feelings of confidence and mastery that are self-reinforcing, so pupils will be more inclined to engage in future learning activities, simply for the enjoyment of succeeding (Palmer, 2005). These feelings of confidence and competence are derived from first-hand experience of mastery of challenging problems.

Closely related to this is Vygotsky's ZPD, where learners are challenged slightly above their current level of development. By experiencing the successful completion of challenging tasks, pupils gain confidence and are highly motivated to embark on more complex challenges. All situate learning in real-situations that provide contexts for applying ideas motivates pupils to learn and apply their new knowledge (Hmelo-Silver, 2004; Savery, 2006). The constructivist environment promotes pupils' curiosity and motivates them to investigate their interests that promote independent learning. Constructivist theory, thus, implicates motivation as a necessary prerequisite and co-requisite for learning (Palmer, 2005).

Palmer (2005) opines that in order to enhance pupil motivation, teachers should:

1. challenge pupils by setting tasks at a moderate level of difficulty so they can regularly experience success;
2. use novel or discrepant experiences to arouse curiosity;
3. use fantasy;
4. increase the meaningfulness of content and tasks by relating them to the pupils' lives;
5. use a variety of different types of activities and tasks;
6. allow pupils to be active participants in the lesson;
7. allow pupils a realistic level of choice in work partners, activities and task formats;

8. allow pupils to work individually or collaboratively in situations that do not encourage competition;
9. provide assessment feedback, and use praise that rewards effort and improvement (these should be given privately, to avoid social comparison);
10. model enthusiasm, thinking, dealing with errors, and dealing with challenge; and
11. be supportive, reassuring, and attentive to the pupils.

These are particularly important points because it indicates that classroom strategies can be used to optimize pupil motivation and learning.

2.4 Underlying Assumptions of Constructivism

Jonassen (1994), propose 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.

Furthermore, according to Kauchak and Eggen (1998), although constructivists disagree on some aspect of the knowledge construction process, most agree on the following common characteristics:

1. Learners construct their own understanding: The basic tenet of constructivism is the idea that pupils develop their own understanding and the develop understanding that makes sense to them, rather than receiving it from teachers or materials.
2. New learning depends on current understanding: The importance of pupils' background knowledge is very crucial in constructivism. Constructivism views learning interpreted in the context of current understanding, not first as isolated information that is later related to existing knowledge.
3. Learning is facilitated by social interaction: Social interactions in a constructivist view encourage pupils to verbalise their thinking and refine their understanding by comparing them with those of others in a friendly atmosphere.
4. Authentic task promote learning: Authentic task simulate the original world, providing pupils the opportunity to think in reality terms, which entail learning activity that require understanding that is similar to the situations encountered

outside the classroom; for instance, creating a miniature super market in the classroom to introduce pupils to measurement of time and money.

2.5 Pedagogies Based on Constructivism

Constructivist perspectives on learning have given rise to a number of models of constructivist classroom teaching (Palmer, 2005). As it can be seen from the forgoing, the term constructivism can refer to one of many different but related instructional approaches; few of such approaches are currently receiving significant attention. These include: Case-based learning, discovery learning, inquiry-based learning, problem-based learning, project-based learning, and active learning (Mayer, 2004; Prince & Felder 2006). These approaches are in alignment with constructivist strategies to instruction.

Case-based learning (CBL) has its roots in the well-proven method of learning by doing. It is a child-centred learning approach that allows pupils to take greater responsibility and play a more active role in the learning process than they do in traditional classroom learning. CBL, as Herreid (1997) explains, uses real-life examples to build knowledge by resolving questions about specific cases.

Usually these questions have no single right answers. Generally, CBL focuses on small groups and the interactions between the participants. In CBL, teachers are facilitators- they make both formative and summative assessments of pupil’s performance. Pupils benefit from this type of instruction because they are given an opportunity for decision making and addressing different viewpoints 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.

Discovery learning on the other hand, engages learners in problem solving to make a discovery (Mayer, 2004). According to Prince and Felder (2006), discovering learning is an inquiry-based approach in which pupils are given questions to answer, problems to solve, or sets of observations to explain, and then work in a largely self-directed manner to complete their assigned tasks and draw appropriate inferences from the outcomes, thereby discovering desired factual and conceptual knowledge in the process. The role of the teacher in discovery learning is to provide pupils with problems and provide feedback when necessary, without actually directing their efforts. Discovery learning works on the assumption that pupils are more likely to retain knowledge if they discover it on their own. Pupils benefit from this type of instruction because it fosters curiosity and creativity.

Inquiry-based learning mainly involves the learners and leads them to understand concepts. As discussed by Edelson, Gordin, and Pea (1999), inquiry-based learning places the responsibility for learning and understanding concepts on pupils. In other words, inquiry learning requires pupils to determine the content, the learning process, and the assessment of learning. Inquiry-based methods use questions to guide instruction rather than predetermined topics.

Usually this instructional design begins with a general theme that serves as a starting point for learning. Then the instruction builds upon the responses and interactions of the pupils. Teachers monitor the learning process through interviews, journaling, and group discussions.

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 (Lee, 2004). The same could be said about problem-based learning, project-based learning, discovery learning, certain form of case-based instruction, and student research, so that inquiry learning may be considered an umbrella that encompasses several other learner-centred methods (Prince & Felder, 2006).

Problem-based learning begins when pupils are presented with open-ended and authentic problem and work in teams to find hints and develop solutions with teachers acting as facilitators (Tan, 2003). Learners decide how to approach a problem and what activities to pursue. Problem-based learning teaches pupils to think critically, analyze problems, and use appropriate resources to solve real-life problems. Through this process, pupils are able to identify the nature of problems and determine what resources they need to utilize to solve the problems, as described by Boud and Feletti (1997). Throughout this process, the teacher's role is to guide and advise, rather than to direct and manage 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. A well designed problem guides pupils to use course content and methods, illustrates fundamental principles, concepts, and procedures, and perhaps induce the pupils to infer those things for themselves instead of getting them directly from the instructor. As well as engages pupils in the type of reflection and activities that lead to higher order learning (Prince & Felder, 2006).

A project is usually described as a piece of whole-hearted and purposeful activity carried to completion in its natural environment (Ngman-Wara, 2008). In Project-based learning, pupils work in groups to solve challenging problems that are authentic and often interdisciplinary. By providing pupils with an authentic problem, project-based learning offers learners a meaningful experience that promotes the development of research skills. Dochy, Segers, Van and Gijbels (2003) argue that learners may acquire more knowledge in the short term when taught conventionally but are likely to retain knowledge longer when taught with project-based learning.

Active learning engages learners in two aspects, doing things and thinking about the things they are doing (Renkl, Atkinson, Maier, & Staley, 2002). Active learning has been compared with project work, learning communities and various forms of simulation used in education. It has been more widely used recently for organizational problems (Yorks, 2000). Active learning create an environment in which learners solve problems, answer questions, formulate questions of their own, discuss, explain, debate, or brainstorm during lessons. This motivates the learners as they are actively engaged in the learning process.

2.6 The Constructivist Classroom

A constructivist teacher and a constructivist classroom exhibit a number of discernable qualities distinctly different from a traditional or teacher-centred classroom. A constructivist teacher is able to flexibly create an opportunity for pupils to construct their own knowledge and use their energy in a meaningful way in the learning environment. This is affirmed by Crawford and Mary (1999), when they stated that teachers in constructivist classrooms direct their learners' energy by engaging them actively in the learning process. They motivate pupils' need to learn and apply their new knowledge in everyday situation (Savery, 2006).

Most pupils' time is spent performing authentic tasks, rather than listening to the teacher. Some talk about such task-based instruction in terms of the learner as a worker and the teacher as a manager, rather than the teacher as a worker (Schlechty, 2002).

A constructivist teacher observes, ask critical questions, and listens attentively to learners' responses. They take advantage of learners' natural curiosity and help them to further their understanding of concepts. In such a climate, pupils are able to think, reason, communicate, reflect upon, and critique the mathematics they encounter; their classroom relationships become a resource for developing their mathematical competencies and identities (Turnuklu & Yesildere, 2007). The learning environment is democratic, the activities are interactive and child-centred, and pupils are empowered by teachers who operate as facilitators.

Another quality of a constructivist class is its interactive nature. Learner-learner and learner-teacher dialogue is very important in a constructivist classroom. The classrooms are structured in ways that fosters group work, and ensure that knowledge moves in three directions; from teacher to learner, from learner to learner, and even from learner to teacher (Crawford et al., 1999). This arrangement encourages social interactions in which pupils get the opportunity to air their views about a topic. These interactions are labelled report ways, inquiry and argument (Wood & Turner-Vorbeck, 2001). As long as learners are asking each other questions for clarification, we have a constructivist classroom. Constructivism, the study of learning, is about how we all make sense of our world and that really has not changed (Brooks, 1999). Consequently, constructivist activities in the classroom focusing on speaking and listening promote not only constructivist thought, but also important connections between teacher and learners.

In a constructivist classroom, pupils are encouraged to use varied resources to help them form and reform interpretations. These resources are very crucial in the teaching and learning of mathematics, especially manipulative materials. Manipulative materials play a vital role in basic school mathematics because at that stage most pupils face difficulties in thinking in abstract terms. The use of manipulative materials in mathematics has always been justified by the saying that "I hear I forget", "I see I remember" and "I do I understand". Marshall and Swan (2008), argue that for manipulative to be effective there should be a fourth line, which is "I talk about it I connect".

When teachers have a lot of resources they are able to use "multiple representations to facilitate learner's development of mathematical concepts" (Pape & Tchoshanov, 2001, p. 120). Multiple representations of concepts aid pupils to construct meaning to different perspectives of the same concept. These multiple representations include real life situations, which are referred to as authentic task (Kauchak et al., 1998), and teaching and learning through problem solving (Siemon & Booker, 1990).

Moreover, there are established routines in a constructivist classroom, which plays an important role in developing learners' mathematical thinking and reasoning. The everyday practice of inviting learners to contribute responses to a mathematical question or problem may do little more than promote cooperation. Teachers need to go further and clarify their expectations about how learners can and should contribute, when and in what form, and how others might respond as it is in a constructivist classrooms (Turnuklu & Yesildere, 2007).

Constructivist classrooms are structured so that learners are immersed in experiences within which they may engage in meaning-making inquiry, action, imagination, invention, interaction, hypothesizing and personal reflection. Teachers need to recognize how pupils use their own experiences, prior knowledge and perceptions, as well as their physical and interpersonal environments to construct knowledge and meaning. The goal is to produce a democratic classroom environment that provides meaningful learning experiences for autonomous learners.

This perspective of learning presents an alternative view of what is regarded as knowledge, suggesting that there may be many ways of interpreting or understanding the world. The meaning of 'knowing' has shifted from being able to remember and repeat information to being able to find and use it (National Research Council, 2007). The teacher is no longer seen as an expert, who knows the answers to all questions, but act as a facilitator to assist learners to construct their own meanings.

Using constructivist strategies, teachers are more effective. They are able to promote communication and create flexibility so that the needs of all learners could be met. The constructivism learning theory will allow pupils to develop critical thinking skills, research skills, creative skills and the skills and confidence to analyze the world around them, and create solutions for developing issues. Nabie (2013) posits that pupils are introduced to the basic mathematical skills such as mathematical thinking, problem solving and mathematical investigation to enhance their chances in the numerous job opportunities in the society. To support this view is the idea of the National Research Council (2009) that the new demands of international competition in the 21st century require a workforce that is competent in and comfortable with mathematics. Ideas such as these are supported based on the knowledge that in the 21st century, most careers require the use of mathematical knowledge. Is it petty trading, engineering, surveying, or ICT specialising? You name it; they all require some aspect of mathematics.

2.7 Challenges in Educational Constructivism Implementation

While some constructivists argue that "learning by doing" enhances learning, critics of this instructional strategy argue that little empirical evidence exists to support this statement, especially as it applies to the development of instruction for novice learners (Mayer, 2004; Kirschner, Sweller, & Clark, 2006).

Mayer (2004) argue that not all teaching techniques based on constructivism are efficient and effective for all learners, suggesting many educators misapply constructivism to use teaching techniques that require learners to be behaviourally active. He describes this inappropriate use of constructivism as the "constructivist teaching fallacy".

Moreover, Barron and colleagues (1998) suggest that constructivist approaches remain under implemented and underutilised because constructivist teaching practices are foreign to learners and teachers, and difficult to apply. The question of how to implement classroom teaching that is consistent with a constructivist view of learning is still an issue of concern (Palmer, 2005)

2.8 Empirical Review of the Study

Every theory needs to be backed with solid empirical evidence. That is, there is need for data to confirm theories. While the theoretical views presented above emphasises the need for constructivist-based instruction to learning, what kind of empirical evidence is there to support this views? There is a general consensus in literature regarding the positive impact of constructivist approaches on learners' dispositions (Burris & Garton, 2007). Although, certain constructivist approaches may not be an appropriate teaching strategy in some learning situation.

Felder and Brent (1996) point out that successful outcomes have now been widely documented in educational literature; that in fact, child-centred instruction provides "increased motivation to learn, greater retention of knowledge, deeper understanding, and more positive attitudes toward the subject being taught" (p. 44). Also, Abbot and Fouts (2003), found a significant correlation between constructivist teaching and higher achievement.

Herman and Knobloch (2004) posit that the constructivist approach generated increases in affective and cognitive outcomes. They reported that learners preferred the constructivist approach because they had been actively responsible for their own educational process. In a study utilizing constructivist teaching approaches involving problem posing, Cunningham (2004), found learners to become more engaged in the lesson when discussing ideas in small groups of three to four pupils. With his examination of numerous examples of learner's responses, the results revealed that mathematics learners gained higher reasoning skills and deeper understanding of mathematics, as well as more reflection from the concurrent engagement.

Guthrie, Wigfield, Barbosa, Perencevich, Taboada, Davis, Scafiddi, and Tonks (2004), compared three instructional methods for third-grade reading: A traditional approach, a strategies instruction only approach, and an approach with strategies instruction and constructivist motivation techniques including learner choices, collaboration, and hands-on activities. The constructivist approach, called CORI (Concept-Oriented Reading Instruction), improved learners' reading comprehension, cognitive strategies, and motivation. Learners taught with instructional materials absorbed more knowledge from demonstrations they saw and the exercises they did with the resources and appeared to understand what was taught faster than was the case in classrooms where the teachers taught by the lecture method (Opoku-Asare, 2004).

Kim (2005) found that using constructivist teaching methods for 6th graders resulted in better pupils' achievement than traditional teaching methods. This study also found that learners preferred constructivist methods over traditional ones. However, Kim (2005) did not find any difference in learner self-concept or learning strategies between those taught by constructivist or traditional methods.

Doğru (2007) compared science classrooms using traditional teacher-centred approaches to those using child-centred constructivist methods. In their initial test of learner performance immediately following the lessons, they found 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.

Hammerman (2008), presented a research findings that the child-centred approach enables teachers to identify and address misconceptions learners may have developed and assess the effectiveness of the instructional process. He also reported that child-centred instruction is a high-quality instruction with a 21st century approach.

A significant difference was established in the science achievement of pupils taught using the constructivist strategy. The pupils taught using the constructivist strategy achieved significantly better than those taught using the expository instructional strategy. Also, pupils from urban schools achieved significantly more than pupils from rural schools, possible because pupils in the rural schools failed to master the language of instruction, lack of home support for academics and lack of well qualified teachers (Etuk, Etuk, Etudor-Eyo & Samuel, 2011).

Acquah (2011), in his study found the use of tasks on Adinkra symbols structured within the realm of problem-based learning, improved pre-service teachers' achievements in geometric transformations. Similarly, The President's Council of Advisors on Science and Technology (2012) in their report found that students in traditional lecture courses were twice as likely to drop out of college entirely compared with students taught using active learning techniques.

While learner-centred instructions offer many benefits of building life-long skills necessary for learners to function in the real world, Chall (2000) found that child-centred instruction failed to produce increased academic achievement for all pupils. He found that the traditional teacher-centred approach yield higher academic achievement within all social classes and race, for learners with disabilities, and with at-risk learners. Learners from low socio-economic backgrounds were found to show greater achievement when taught with traditional methods. The low functioning learners and learners from low-income families were found to thrive better in a more traditional setting due to lack of content knowledge. He argued that learners from middle-class or higher-class distinction proved to perform at a higher achievement level when taught with the child-centred approach, possible due to home factors and exposures.

Chall (2000), reported on teachers' experiences with learner-centred instruction. The teachers had implemented methods that are favored by learner-centred but the results lead to sleepless nights for one teacher and lower reading achievement scores. This brings to light the issue of inadequate time for teachers to prepare and implement child-centred methods.

Finally, Ward (2001) also recognised that the primary concern of using the constructivist approach is the time required to conceive, design and carry out the activities. Another concern of teachers associated with time is that in many cases, such as initially learning how to add and subtract, direct instruction can get the job done much more quickly (Santrock, 2001).

From the discussions above, it is obvious that there are divergent views with regards to the impact of constructivist approaches on pupils' academic performance. While one school of thought claimed that constructivist methods improves pupils' academic achievements, another assumed that the traditional teacher-centred method is better, when it comes to improving pupils' academic performance. It is on these bases that this study is conducted to confirm one of these schools of thought as well as contribute to literature.

2.9 Brain Research

Recent research into how the human brain works has significant influence for educators (Greenleaf, 2003; Levine, 2003; Nunley, 2003; King-Friedrichs, 2001; Scherer, 2001; Tuttle, 2000). Brain-based instruction is about understanding the principles of brain research and using strategies in line of those principles. All brain functions do not mature at the same rate. Maturation of the brain influences learning readiness. For teachers, this is especially important when designing lessons and selecting which strategies to use (Semrud-Clikeman, 2014). Brain research suggests four accepted potential applications for educational practice (Wolfe, 2014) that necessitate a constructivist approach to teaching.

Firstly, experience shapes the brain. Learning is enhanced by a rich environment with a variety of stimuli. Pupils should be surrounded with a variety of instructional opportunities such as physical activities, individual learning times, group interactions, artistic variations, and musical interpretations to help orchestrate their experiences

(Southwest Consortium for the Improvement of Mathematics and Science Teaching [SCIMAST], 2000).

Secondly, memory is not stored in a single location in the brain. When an experience enters the brain, it is "deconstructed" and distributed all over the cortex. Therefore the more ways learners have the information represented in the brain (through seeing, hearing, being involved with others) the more pathways they have for reconstructing, the richer the memory (Wolfe, 2014).

Thirdly, memory is not static. It decays naturally over time as new experiences infiltrate older ones. Fortunately, this natural decay can be minimized by using elaborative rehearsal strategies such as visualizing, writing, symbolizing, singing, semantic mapping, simulating and devising mnemonics to reinforce and increase the likelihood of recall (Wolfe, 2014).

Fourthly, memory is not unitary. There are two distinct types of memory each of which involves different brain structures. Declarative Memory is our everyday memory, the conscious ability to recall information. Procedural Memory refers to skills and habits that you engage in without conscious recall of information. Rote rehearsal is essential for procedural memory while elaborative rehearsal strategies are much more effective for declarative memory (Wolfe, 2014).

The findings of brain research offer educators the opportunity to make informed decisions. However, this knowledge about the workings of the human brain has yet to have an impact on classroom practice and teacher preparation programs (Levine, 2003).

2.10 Learning Styles

Learners preferentially take in and process information in different ways, such as seeing, listening and doing. In likewise manner, teaching methods also vary, some instructors lecture, others demonstrate or lead pupils to self-discovery; some emphasise memory and others understanding. When there is a mismatch between pupils' preferred style of learning and the teacher's instructional method, it often leads to boredom or poor performance on the part of pupils.

Strong et al. (2004) identify four learning styles. The mastery style, where pupils tend to work step-by-step; the understanding style, where pupils tend to search for patterns, category, and reasons; the interpersonal style, pupils in this category tend to learn through conversation and personal relationship; and the self-expressive style, pupils in this category tend to visualise, create images and pursue multiple strategies. It is apparent that an awareness of different learning styles is a significant tool to understand differences and assist learners' development (Strong, Silver & Perini, 2001).

Models of education based on learning styles have equipped teachers with the ability to plan their lessons and their curriculum, bearing in mind how learners learn best (Strong et al., 2001). Fine (2003), reports a significant gain in the test scores of learners on special education programs, after their preferred learning style was incorporated into instruction. Addressing learning style tends to result in improved achievement even if the final assessment is not a match for the learner's preferences.

2.11 Forms of Instruction

Allan (2010), in a study identified two forms of instruction, teacher-centred and learner-centred. These two forms of teaching are anchored in different views of knowledge and the relationship of teachers and learners to that knowledge. Teacher-centred instruction is described as, learners passively receive information, here emphasis is on acquisition of knowledge, and teacher's role is to be primary information giver and primary an evaluator (Huba & Freed, 2000). However, learner-centred instructional procedure encompasses variety of instructional approaches that are intended to address the distinct learning needs, interests, aspirations, and backgrounds of learners. Brown (2008) claims that child-centred learning approach gives learners ownership over their learning and helps them make necessary decisions and value judgments about the relevance of the content and the methods of teaching to their own lives and interests.

These methods include active learning, inquiry-based learning, case-based instruction, problem-based learning, project-based learning, discovery learning, and just-in-time teaching. They are all inductive methods, and can be characterised as constructivist methods (Prince et al., 2006).

Learner-centred approach provides the opportunity for pupils to construct their own understanding, which is in line with the philosophy behind constructivism. The base of understanding is present, and thus allows the pupils to build upon prior knowledge, as realised by constructivist practitioners. With the assimilation and accommodation used when learning new ideas, learners are able to make connections and develop deeper meanings through the comparison of new ideas to previously learned ideas (Piaget, 1954). Teachers who practised learner-centred method do not employ a single teaching method.

This approach emphasises a variety of different types of methods that shifts the role of the instructors from givers of information to facilitating pupils teaching (Blumberg, 2008). By this way, teachers do less telling; pupils do more discovering (Weimer, 2002). The role of the teacher in the learner-centred approach is to create a springboard for learners to discover their potential.

However, the major challenges that sometimes discourage teachers from implementing learner-centred instructions are the issue of standardized tests and inadequate human and material resources. According to Popham (1995), standardized test is a test, either norm-referenced or criterion-referenced, that is administered, scored, and interpreted in a standard manner. Standardized tests can be referred to as tools for assessing learners achievement, and can be used to focus instruction on desired outcomes.

Teachers are faced with the pressures of high-stakes testing and that has become the driving force behind what learners are expected to learn. Meier, Hovde, and Meier (1996) report that with many time constraints and administrative pressures to improve test scores, many teachers will not believe they can justify the time necessary for problem-based learning. Passman (2000) concludes that "high-stakes assessment based on standardized scores assumes that everyone must be exactly like me in order to be successful. We are moving toward an era of everyone looking exactly like me, where the me consists of those who define the standards" (p. 14).

Another hindrance is the inadequate financial assistance for teachers. According to Owusu-Mensah (2005), in-spite of all the reviews and reforms in Ghana since independence, the country had not succeeded in raising the standard of education to any appreciable level, nor had it met the utility objectives because they were built on weak financial foundations.

Concluding, Learner-centred learning is in contrast to traditional education. In traditional education methodologies, teachers direct the learning process and learners assume a receptive role in their education. Armstrong (2012) claims that traditional education ignores or suppresses learner responsibility. In the 21st century, a lot of educationist and psychologist are advocating for the replacement of teacher-centred methods of teaching with the child-centred methods of teaching.

2.12 Basic Education Mathematics Curriculum

Mathematics as one of the most useful subjects of human knowledge is now attracting more attention as the years run into more complex scientific evolution. This has made the institutions of higher learning to make it a compulsory entry requirement. It is the understanding of the underlying concepts of mathematics that will help both the teacher and the learner to transfer and apply mathematics to everyday situations.

Consequently, mathematics should be taught well, especially at the basic level of education in order for pupils to have a firm grasp of the content as well as develop a keen interest in the subject. According to Liping (2003), to fully promote mathematics learning, teachers must first have a profound understanding of fundamental mathematics. They must know well the mathematics they teach each day and feel both confident and comfortable talking it. The best teacher is not the one who fills the learner's mind with the largest amount of factual data in a minimum of time, but rather the one who kindles an inner fire, arouses moral enthusiasm, inspires the learners with a vision (Swim, 2008).

As the world moves into technological advancement, so has the definition and understanding of curriculum change over the period of time. According to Marsh and Willis (2003), the curriculum is what the learner constructs from working with the computer and its various networks, such as the internet. Kelly (2009) opines that curriculum means two things, the range of courses from which learners choose what subject matters to study, and a specific learning program. In the latter case, the curriculum collectively describes the teaching, learning, and assessment materials available for a given course of study. Mereku (2004) describes the mathematics curriculum as all the mathematical experiences of a learner under the guidance of the school.

What is more, Reys and Long (1995) are of the view that "teachers are curriculum architects charged with ensuring the quality of the mathematical tasks in which their learners engage" (p. 81). It is therefore the task of the curriculum instructor to select those experiences that are beneficial to the learners. The curriculum addresses issues such as content, resources, methods of teaching and assessment.

The rational for the introduction of mathematics in the basic education program include:

1. To develop mathematical concepts and skills to help pupils to understand and play a responsible role in society.
2. Employing activity oriented methods to develop pupils' competencies in a broad range of numeracy skills.
3. To equip pupils with problem solving and decision making skills in this technological era.

The mathematics syllabus designed for the primary school has five general aims and twelve general objectives. Among the general aims are:

1. To help pupils appreciate the value of mathematics and its usefulness to them.
2. To develop in pupils the skills, concepts, understandings and attitudes, which will enable them to cope confidently with the mathematics of everyday life.

3. To foster a sense of personal achievement and to encourage a continuing and creative interest in mathematics.
4. To help pupils become mathematically literate in a world which is technologically and information oriented.

The general objectives include:

1. To work co-operatively with other pupils and develop interest in Mathematics.
2. To use appropriate strategies to perform number operations.
3. To recognise and use patterns, relationships and sequences and make generalizations.
4. To relate solids and plane shapes and appreciate them in the environment.
5. To use the calculator to enhance understanding of numerical computation and solve real-life problems.

Achieving the above 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).

The mathematics curriculum serves as a framework for the various stakeholders in mathematics education. This framework outlines the beautiful ideas behind promoting mathematical concepts in young pupils, but the worrying questions are; to what extent are authorities seeing to the implementation of these aims and objectives? Are there adequate material and human resources for the successful achievement of the set goals?

Perusing the mathematics curriculum, emphasis is placed on developing problem solving skills in the context of group and project work. Teachers are required to give pupils Class Assessment Task (CAT) each term. With CAT, pupils are expected to undertake project work in task 4, 8 and 12 in term 1, 2 and 3 respectively, but observing the Ghanaian classroom, most teachers do not give their pupils' project work nor engage them in problem solving for reasons best known to them.

Teachers are asked to provide pupils with opportunities that encourage them to practise and learn simple strategies in investigation and experimentation. They are expected to ask higher order questions and promote good dialogue and interaction. Given pupils the opportunity to interact and explain their thinking causes them to refine their existing knowledge and ideas, so they construct new knowledge. By offering appropriate tasks and opportunities for dialogue, guides the focus of pupils' attention, thus unobtrusively directing their learning (Bruner 1986). Kwang (2002), also view contemporary belief in mathematics education as learners being active learners rather than passive recipients of mathematical concepts to be learnt meaningfully.

The mathematics curriculum places considerable emphasis on child-centred pedagogy, the use of appropriate teaching and learning materials, and the use of the local environment as an important learning resource to assist pupils to construct their own knowledge. It is important to add that this reflects a movement away from behaviourism and towards constructivism with its emphasis on pupils' active learning. Despite the fact that the Ghanaian curriculum places prominence on child-centred pedagogies, little or no research has been done in Ghana to ascertain the instructional strategies teachers use and how often they use them in accommodating differences among learners (Gyimah, 2011).

2.13 Teachers' Instructional and Assessment Practices

The success of any educational program is largely dependent on the quality and quantity of its teaching force, and Ghana is no exception. This lends credence to the common saying that, no education system rises above the quality of its teachers just as no nation rises above the level of her education (Abdulai, 2013). This saying places prominence on teachers' content and pedagogical knowledge, since they have direct impact on the quality of teaching.

According to Anthony and Walshaw (2009), current research findings "show that the nature of mathematics teaching significantly affects the nature and outcomes of students learning, this highlights the huge responsibility teachers have for their students' mathematical well-being" (p. 27). Mathematics educators are entreated to represent ideas through multiple forms of languages and expressions to meet the different learning styles of pupils. They need to use pedagogical approaches that engage learners. Pupils are in nature curious about their world and learn by exploring in real-world context, which provides opportunities for pupils to connect what they are learning to their own environment (Nabie, 2013), and teachers should take advantage of such opportunities.

Osafo-Affum (2001), observes that many mathematics teachers 'lecture' instead of 'teach'. In Ghana, the common practice of teaching has always been the traditional talk and chalk method (Nabie, 2013). Teachers give definitions; make no use of concrete materials and practical ways to explain mathematical concepts. Drews (2007), is of the view that a lot of pupils have difficulty in moving from the concrete or pictorial representations to the more formal (general) aspects of mathematics. Pupils who are given materials to manipulate struggle to make meaning of mathematics, can one now imagine what happens to those who are taught mathematics without adequate activities and materials. Moreover, if teachers do not know how to translate those abstractions in mathematics into a form that enables learners to relate the mathematics to what they already know, they will not learn with understanding (Turnuklu et al., 2007).

Fletcher (2003) is of the view that irrespective of the level at which mathematics is taught; the task of the Ghanaian mathematics educator has almost always been that of a lecturer and interpreter, communicating the structure of mathematics methodically. The mathematics educator explains, illustrates, demonstrates and in some cases gives notes on procedures and examples. The learner is led deductively through series of examples and tends to fellow these steps without any meaningful understanding. According to Bencze (2000), teachers need to provide flexibility so learners can, to some extent, decide what they need to do in order to accomplish learning.

The manner in which teacher education programs are conducted was identified as one factor inhibiting implementation of certain child-centred methods (Albion & Gibson, 2000). Most of the teacher education programs still rely heavily on rote learning and traditional lecture formats. It is difficult for teachers to give what they do not have. We cannot expect teachers to adopt learning methodologies that they have not experienced personally or through their teacher education programs.

The assessment procedure presently in use in our basic schools is product driven and knowledge based. According to Anamuah-Mensah, Mereku, and Ghartey-Ampiah (2008), when it comes to assessment, most (77%) of the items in the Basic Education Certificate Examination (BECE) elicit responses in the lowest cognitive domain, which is 'knowledge of facts and procedures", none of these items require some higher level reasoning from the pupils.

Teachers' and pupils' performances are examined in light of standardized testing that does not address critical thinking process skills. This line of assessment tends to influence teaching; and direct it towards teacher-centred method.

Odland (2006) suggests that teaching to test reduces flexibility for teachers and interferes with instructional styles. The teachers desire to construct challenging child-centred instruction decreased in a test-frenzied environment. Furthermore, Harlen and Crick (2003) reported that this type of testing may have a negative impact on learner motivation, particularly the weaker learners who may "become overwhelmed by assessments and de-motivated by constant evidence of their low achievement" (p. 196).

Very sadly, our traditional ways of teaching discourages problem solving techniques. It makes the learner less prone to investigating ways of solving questions as they move through their grade levels; they just listen and repeat expected answers, without an understanding of the underlying principle and procedure behind their answers. This is may be due to teachers' lack of understanding of the constructivist view to learning.

The impact study of the World Bank (2004), on primary education in Ghana revealed that about a third of teachers use learner-centred approach and simulation on a regular basis. Modern methods of teaching are far from unknown, but their use cannot be described as widespread, being utilised by minority of teachers.

For basic school mathematics educators in Ghana to be effective, they must have a sound understating of relevant content and how to teach it. They should learn and apply models and theories that advance pupils' thinking as well as sound instructional strategies. Also, mathematics teachers must be educated both on "mathematics knowledge" and "pedagogical content knowledge" aspects in universities (Turnuklu et al., 2007).

2.14 Pupils' Academic Performance

The academic performance of pupils during assessment keeps on declining despite several curriculum reforms intended to improve performance. It has been established that most candidates perform poorly in English, Mathematics and the Sciences in examinations conducted by WAEC. Figures from WAEC showed that the pass-rate of pupils who sat for the basic educating certificate examination has not been encouraging (Sogbey, 2011). This assertion is confirmed by the Ministry of Education (2013) as shown in figure 2.1 below.

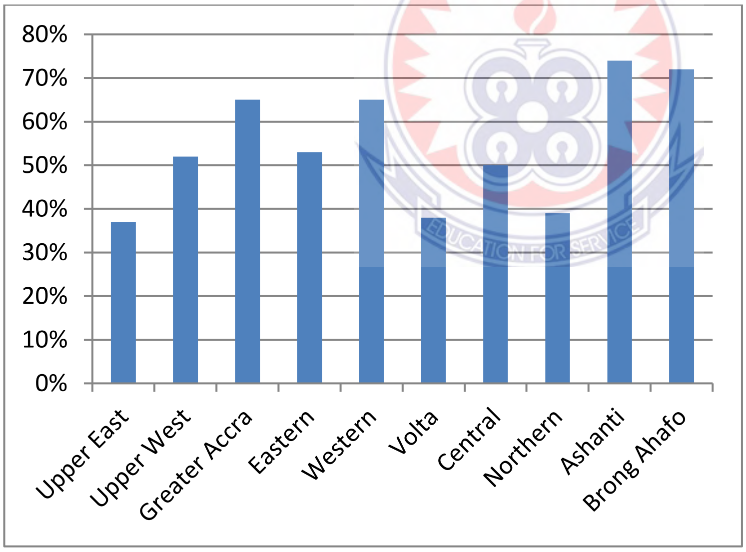

Figure 2.1: BECE Mathematics Pass Rates, by Region, 2010/2011

The National Education Assessment (NEA), which is an indicator of Ghana's educational quality at the basic level, shows that recently, there has been an increase in the percentage of pupils falling below the minimum level of competency in class three and six mathematics. Yet it is not encouraging. This is shown in Table 2.1 below.

Table 2.1: NEA Results in 2005, 2007, 2009, 2011, and 2013

	PRIMARY 3 MATHS			PRIMARY 6 MATHS		
Year	Minimum Competency	Proficiency	Below Minimum Competency	Minimum Competency	Proficiency	Below Minimum Competency
2005	47.2	18.6	34.2	47.2	9.8	43.0
2007	42 .6	14.6	42.8	46.2	10.8	43.0
2009	61.2	25.2	13.6	61.9	13.8	24.3
2011	52.6	18.2	29.2	56.9	16.1	27.0
2013	35.0	22.1	42.9	50.0	10.9	39.1

[Source: Mereku (2012) and Ministry of Education (2014)]

The decline in the standards of education leaves much to be desired as the years run by. Pupils' performance in mathematics has lagged behind grade expectations, with the percentages of primary 3 and primary 6 pupils achieving proficiency in mathematics falling below 26%. The Ministry of Education (2014), suggest that there should be changes in instructional methods for mathematics. Also, better methods and practices should be adopted for training and coaching teachers.

Furthermore, the Early Grade Mathematics Assessment (EGMA) study revealed that pupils did reasonably well on the most procedural of items. However, on the more conceptual items, there was a sharp drop in performance; with nearly 70% of the pupils unable to answer a single subtraction level two item correctly (Ministry of Education, 2014). This stark difference in performance between the more procedural and more conceptual subtasks suggests a lot about how pupils in Ghana are likely to experience school mathematics.

The results of the EGMA study in Ghana strongly suggest that the teaching of mathematics focuses on memorisation of facts, rules and procedures. This approach does not appear to be working, since pupils are unable to apply their memorised knowledge and are not well prepared to learn more complex mathematics in the higher grades as well.

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)*

*Standard error in parentheses

[Source: Anamuah-Mensah, Mereku & Ghartey-Ampiah (2008)]

The performance of the JSS2 pupils in the TIMSS (Table 2.2) was unsurprisingly very poor because of the nature of mathematics pupils were made to experience at school in this country (Anamuah-Mensah & Mereku, 2005). The mean scores were significantly low compared to TIMSS scale average of 500. Pupils performed poorly on items that tested their ability to use concepts, solve non-routine problems and reason mathematically (Anamuah-Mensah, Mereku & Asabere-Ameyaw, 2004).

The following recommendations were stipulated by the Ministry of Education (2014), with the intentions of improving pupils' performance at the basic level.

1. The Ministry of Education and the GES need to identify effective, evidence-based practices regarding the teaching of early grade mathematics in Ghana.
2. Such an approach should place emphasis on pupils' conceptual understanding.
3. Once this approach is established, attention should shift to implementing the approach.
4. The implementation should be achieved through both in-service and pre-service teacher training programmes.
5. Suitable learning materials need to be developed for the basic schools.

Teachers need to receive specific training on how to teach mathematics in the early grades, to enable pupils understand and apply the knowledge acquire in the classroom. Unless pupils develop conceptual knowledge and practise them more, they will fall further behind and continue to struggle in the basic schools.

2.15 Chapter Summary

According to Anthony and Walshaw (2009), current research findings show that the nature of mathematics teaching significantly affects the nature and outcomes of pupils learning. Constructing a new curriculum, without a corresponding change in teaching pedagogy will not achieve the set aims intended. This is evidence in the constant decline in the performance of pupils at the basic education level despite several curriculum reforms. Osafo-Affum (2001) states that many mathematics teachers 'lecture' instead of 'teach'.

Ghanaian mathematics educators should continuously improve and adapt to modern methods of teaching. Any country that fails to engage in a program of continuous improvement of its teachers' way of teaching is destined to the dustbin of history (Fredua-Kwarteng, 2005).

Learners repeatedly complain in private that they cannot make sense of what is being taught in classrooms. We have enough empirical evidence to show that some learners drop out of school because of the manner in which teachers teach (Fredua-Kwarteng, 2005). Similarly, The President's Council of Advisors on Science and Technology (2012), in their report found that students in traditional lecture courses were twice as likely to drop out of college entirely compared with students taught using active learning techniques. Mathematics teachers need to adopt constructivist instructional strategies, despite the issues of time and resources, since the benefits outweigh the disadvantages. Additionally, mathematics education relies closely on constructivism, its exploratory and inquisitive strategies; 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.

Education helps in the development of the human mind, and it increases the powers of observations, analysis, integration, understanding, decision making, and adjustment to new situations. In other words, education is concerned with increasing one's knowledge and understanding of the total environment and therefore should be done well (Rise, 2006).

There are a multitude of theories applicable to learning. In the field of education, there are many theories that support child-centred methods. Among these are; Piaget's (1965) theory of stage development which describes how pupil's progress through certain stages of development. Bruner's (1973) theory which is a strong advocate for constructive learning, Vygotsky's (1978) theory of zone of proximal development which implies a stage development through which pupils' pass with the aid of social interaction (Rains et al., 2008), and constructivism that emphasises the active role of learners in constructing their own knowledge.

For each theory, there are many independent factors brought to the learning environment by the learner. If educators understand these theories and the developmental stage of their learners, they will be able to develop instructions that will assist learners to have a firm grip of concepts taught in mathematics.

CHAPTER THREE

RESEARCH METHODOLOGY

3.0 Overview

This chapter deals with the research 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

Selecting a research design depends on the reason for the study (Cohen, Manion & Morrison, 2004). The study adopted a descriptive survey design. In order to obtain information about the target population, basically, surveys enable researchers to draw samples from small and large population in the most effective and economic way (Opoku, 2005). In order to perfectly answer the research questions, mixed method approach was employed. Mixed method approach allows for various methods of data collection and analysis (Creswell, 2008). This research approach was selected because mixed method research provides information from both quantitative and qualitative methodologies, thereby giving adequate information related to the research questions (Creswell, 2002). In view of the research problem, purpose and questions involved in the study, the researcher adopted the concurrent mixed method design. Through concurrent mixed methods design, quantitative and qualitative data were collected at the same time and analysed to determine if there are convergence, differences or some combination (Creswell, 2009).

In this study, qualitative data were obtained from observations, interviews and the open-ended questionnaire items. Quantitative data were obtained from the closed-ended aspect of the questionnaire items.

3.2 Research Context

Figure 3.1: Map of Upper East Region

Figure 3.1 shows the region where the research was conducted (National Commission on Culture, 2015). This study was conducted in the Upper East region of Ghana. The region shares international boundaries with two countries, Burkina Faso to the north and Togo to the east. It has a population of 1,045,545 (Ghana Statistical Service, 2015). There are thirteen districts in this region: Bawku Municipal District; Bawku West District; Bolgatanga Municipal District; Bongo District; Builsa North District; Builsa South District; Garu Tempane District; Kasena Nankana East District; Kasena Nankana West District; Talensi District, Nabdam District; Binduri District; and Pusiga District. These districts are made up of rural and urban communities, and mostly considered to be deprived areas. Majority of the people in the region are peasant farmers and traders. Each district has its own unique challenges such as dilapidated school blocks, lack of infrastructure and inadequate teaching and learning materials when it comes to education. There are 709 public primary schools in the region.

The region has a total number of 4,891 teachers for the public primary schools, out of which 2,506 are professional teachers and 2,385 non-professional teachers (Upper East Regional Education Office, 2015). The school pupils are from diverse backgrounds with individual learning differences. This situation poses a great challenge for teachers who want to improve the performance of the pupils.

The selection of this region was based largely on pupils' poor performance in mathematics during the 2013 BECE examinations as compared to the performance of their peers in the other regions in Ghana, and accessibility of the region to the researcher. The researcher, having schooled in the region for years was familiar with the region of study, and as such had the support of teachers and circuit supervisors for easy collection of data.

Also, the reason for selecting these participants in this study was that they have completed similar educational programmes, which included training on child-centred methods of teaching. Therefore the sample could effectively reveal teachers' conceptions and practices of constructivist instructional strategies.

3.3 Population

A research population is generally a large group of individuals or objects to which researchers sometimes generalise their findings (Trochim, 2006). The population consisted of all primary school teachers in the Upper East region of Ghana. In Ghana, teachers are trained with similar curriculum. As a result, they have similar conceptions and approaches toward teaching and learning, no matter which part of the country they attain their training. Cohen et al. (2004) define a target population as a group of elements or cases that match to specific criteria and to whom a researcher intends to generalise a study.

In this study, the target population was all primary school mathematics teachers in the Upper East region. However, the accessible population for the study comprised of public primary school mathematics teachers in the Upper East region of Ghana. There are 709 public primary schools and 4,891 teachers in the region. The teachers are made up of 3,250 males and 1,641 females. 51.2% of the teachers are trained (male = 23.3%, female = 27.9%). Forty-eight point eight percent of the teachers are untrained; male = 26.2%, female = 22.6% (Upper East Regional Education Office, 2015).

3.4 Sample and Sampling Techniques

A sample is any part of a population regardless of whether it is representative or not (George & Mensah, 2012). Sampling is the process of selecting a portion of the population to represent the entire population (Alhassan, 2006). Sampling techniques for the study were a combination of purposive sampling, simple random sampling and cluster sampling. Purposive sampling technique is a non-probability technique that is used when researchers build up a sample that is likely to suit certain precise needs (Cohen et al., 2004). Simple random sampling on the other hand, is a process of selecting a sample from a population where every member of the population has an equal chance of being included in the sample (Opoku, 2005). With cluster sampling, the primary sampling units is not the individuals of the population to be sampled but the groupings of those units (George & Mensah, 2012).

The sample size that was used in the study was 252, made up of 126 lower primary school mathematics teachers and 126 upper primary school mathematics teachers.

According to Cohen, Manion and Morrison (2008) "a sample size of 30 is held by many to be the minimum number of cases if researchers plan to use some form of statistical analysis on their data" (p. 101).

Hence, the sample size is highly representative and can be used to draw valid conclusions. However, the use of purposive sampling techniques might limit the probability of the participants being representative of the entire population. Table 3.1 below shows the summary of the participants in this study.

Table 3.1: Summary of Participants in the Study

District	Number of schools	Sampled number of schools	Number of teachers
Bawku Municipal	50	7	42
Bawku West	79	7	42
Bongo	71	7	42
Bolgatanga Municipal	73	7	42
Kasena Nankana East	57	7	42
Kasena Nankana West	64	7	42
Total	**394**	**42**	**252**

The researcher obtained the sample above by purposively selecting Public primary school mathematics teachers in the Upper East region. The selection of this region was based largely on pupils' poor performance in mathematics during the 2013 BECE examinations as compared to the performance of their peers in the other regions of Ghana (Figure 2.1). However, cluster sampling and simple random sampling were applied to arrive at the number of teachers, who formed the sample size. The combination of these three techniques yields accurate estimates. In using cluster sampling, the districts in the Upper East region were grouped into zones: Eastern zone (Bawku Municipal District, Bawku West District, Garu Tempane District, Binduri

District and Pusiga District); Central zone (Bongo District, Bolgatanga Municipal Districts and Nabdam District); and Western zone (Kasena Nankana East District, Kasena Nankana West District, Builsa North District and Builsa South District).

The Talensi District was intentionally excluded from the zones because that is where the questionnaire was pilot tested. The code number for each district was then written on a piece of paper, folded and kept in the appropriate zone. The use of cluster sampling was to avoid bias in sampling participants and to obtain samples that were representative of the Upper East region.

After this, simple random sampling was applied. Two districts were then picked from each zone above and 7 schools were randomly selected from each district using random number table to form the sample size of 252. Simple random sampling was used because each school had an equal chance of being selected and also, it was to avoid bias in sampling participants.

3.5 Research Instruments

Opoku (2005) indicates that the collection of information in a survey typically involves personal interviews (which normally use either a structured or unstructured questionnaire), mail questionnaires, panel interview, telephone, and controlled observation. For this study, a modified version of the Teaching Style Scale questionnaire, developed by Henry in 2003 was used for data collection.

The other instruments (semi-structured interview and observation checklist) were developed by the researcher from studies of existing literature (Kauchak & Eggen, 1998; Prince & Felder, 2006; Mckeown & Beck, 1999; CRDD, 2012). Data for this study were gathered through the use of a questionnaire, interviews and observations made. The researcher considered the use of a questionnaire since the participants could read, write and understand. Although, there was a probability of having a low return rate of participants' response to the questionnaire items, it enabled the researcher to collect large amount of data in a minimum time and at a lower cost.

Hence, a questionnaire was used to collect data on all the four research questions. Also, some of the sampled mathematics teachers were interviewed for their views in relation to the research questions. In addition, the researcher observed the teaching and learning processes in some of the sampled schools. The instruments used are explained as follows.

3.4.1 Questionnaire

A questionnaire is a written document in survey research that has a set of questions given to participants (Neuman, 2003). A single questionnaire (Appendix A) was used. The questionnaire was made up of three parts (A, B and C). Section A sought to find out about the demographic attributes of the mathematics teachers who were sampled. The demographic attributes included information related to participants' gender, qualification, and number of years of teaching. Section B was made up of forty-four items describing mathematics teachers' perception and their instructional strategies.

Section B was further sub-divided into categories: Perception on constructivism, classroom management strategies, teaching and learning activities, and pupils' assessment procedures. Section C was made up of seven short-answer items, which sought to reveal the teaching approaches used by the teachers, factors that hinder such approaches and their conceptions of constructivism. Additionally, each section of the questionnaire began with specific instructions regarding how to respond to items in that section.

3.4.2 Likert Scale

A likert scale is a type of quantitative data measure often used in survey research that covers the level or potency of a variable construct along a continuum (Neuman, 2003). The closed-ended items on the questionnaire were designed to capture a range of responses in a Likert-type rating scale. The Likert scale consisted of a five point type which involved using "Always = 5, Frequently = 4, Sometimes = 3, Rarely = 2, and Never = 1". And "1 = strongly Disagree, 2 = Disagree, 3 = Not Applicable, 4 = Agree, 5 = Strongly Agree".

3.4.3 Interview

According to Polit and Beck (2006), an interview is a method of data collection in which a person (an interviewer) asks questions of another person (a participant); interviews are normally conducted either by face-to-face or by telephone. An interview was granted to eight mathematics teachers from the sampled population. The interview was semi-structured. The eight teachers interviewed were selected from the 203 teachers whose responses to the questionnaire item 1 under section C indicating that they teach mathematics using the constructivist approach. The teachers mostly had similar ideas on majority of the questions. The interview lasted for approximately 20 minutes for each participant. The interview used in the study helped to clarify and give a deeper understanding of some of the responses of participant on constructivist instructional strategies.

The semi-structured interview guide (Appendix C) in this study was made up of two parts. The first section sought to find out participant personal data and the second part addressed their perspective in relation to constructivism. The data were collected by tape-recording and later transcribed. The mathematics teachers' perspectives were than analysed as to whether they were in line with their classroom practices.

3.4.4 Observation

The researcher observed the teaching and learning environment of some of the selected schools. In addition, the delivery lessons of 8 mathematics teachers were observed. Three main variables were observed: the physical environment, the instructional practices and pupils' academic performance. With the consent of the teachers, a video camera was placed at the back of the classroom to record the observations. Data were also gathered using observational checklist. The observation checklist (Appendix D) contained 18 items.

3.6 Validity of Research Instruments

The validity of a measurement tool is the degree to which the tool measures what it claims to measure. It refers to the appropriateness and effectiveness of inferences that may be drawn from findings after using a particular instrument (Cohen et al., 2004). To check for validity of the instruments and enable inferences to be drawn from the sample population to the research population (Creswell, 2008), the instruments were presented to four(4) lecturers in the mathematics education department of the University of Education, Winneba, and nine graduate students from the Department of Basic Education, Winneba, for close scrutiny. This was to ensure that the survey items properly described teachers' conceptions of constructivist instructional strategies, teacher-centred strategies and constructivist teaching strategies. Additionally, the data were triangulated as a means to validate the findings.

3.7 Reliability of Research Instruments

Reliability refers to how well a test provides a consistent set of results across similar test situations and time periods (Institute for Educational Development and Extension, 2003). Reliability is a measure of consistency of research instruments to obtain the same result with the same measure. In this study, Cronbach Alpha was used to describe the overall consistency of the scales. The value of the reliability coefficient of the questionnaire was 0.81. A value of 0.8 is generally considered reliable (Vergis & Hardy 2010). Based on this, the value 0.81 is above 0.8 and hence considered to be reliable.

3.8 Triangulation

Triangulation refers to the mixing of data or methods so that diverse viewpoints or standpoints cast light upon a topic (Olsen, 2004). When a topic is examined through different perspectives, a researcher is more likely to get a detailed picture of the situation as well as develop more confidence with the result obtained; hence the use of theory and methodological triangulation in this study.

3.9 Pilot-testing of Research Instrument

In order to ensure that the research instruments produced data that are stable, consistent and devoid of any ambiguities (Creswell, 2008), and to reveal defects in the research instrument (Jack & Norman, 2003), the questionnaire was pilot-tested. Researchers have agreed that pilot testing of surveys helps to ensure valid and reliable results (Dillman, 2000). The researcher selected Talensi district in the Upper East region for the pilot study due to its easy accessibility, familiarity of the district to the researcher and similar characteristics of teachers in the district to the teachers sampled.

The questionnaire was pilot tested on 23rd March, 2015. 40 primary school mathematics teachers in the Talensi district were involved in the pilot study. On the whole, it took the teachers about 10 minutes to complete the questionnaire. The questionnaire was administered and collected on the same day.

The pilot study 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 questions that were wrongly formulated and could have given some unintended results. For instance, it was realised after piloting that those within the age range of 32 to 35 were not catered for at the personal data section of the questionnaire.

3.10 Analysis of Pilot Study

Data from the pilot test were statistically analyzed to determine the reliability of the test instrument using Cronbach Alpha. In the pilot study, the three categories: perception on constructivism, traditional strategies scale and constructivist instructional strategies scale, yielded reliability coefficient of 0.6, 0.71 and 0.8 respectively. According to Ary, Lucy and Asghar (2002), if measurement results are to be used for making a decision about a group or for research purposes, then scores with modest reliability coefficients in the range of 0.50 to 0.60 may be acceptable. The above reliability coefficient for each category therefore signifies that the test instrument is considerably reliable.

3.11 Data Collection Procedure

With a letter of introduction from the Department of Basic Education, Winneba (Appendix F), permission was sought from the regional director of education of the Upper East region on 19th March, 2015 (Appendix G). This was to ensure effective and easy collection of data.

With the help of some circuit supervisors and letter of introduction from the regional education office, a familiarization visit was undertaken to some selected schools for the formal introduction of the researcher to the appropriate school heads on 24th March, 2015. This gave the researcher an opportunity to explain the purpose and benefits of the study and to establish a cordial relationship with the teachers involved in the study.

I used self-administered questionnaire to collect data from teachers in public primary schools in the 2014/2015 academic year. The researcher read and explained some items on the questionnaire to some respondents. Most of the questionnaire were collected through the head teachers. This was found to be helpful in the study.

Apart from the questionnaire, personal interaction in the form of interview and an observation was held with eight respondents. Also I used probing techniques to ensure that the interviewees understood the questions during the interview, which ensured that no item was ambiguous.

3.12 Administration of the Questionnaire

The questionnaire was administered to 252 participants. The researcher personally administered and took the questionnaire from the participants. The participants took a week to complete the questionnaire. In all, it took the researcher approximately three weeks to retrieve the entire questionnaire. Moreover, two days after the collection of the questionnaire, an interview was granted to eight teachers, and also on the same day their instructional procedures were observed based on their responses to the questionnaire items.

3.13 The Observation Processes

The researcher observed the lessons of eight primary school mathematics teachers. Each observation lasted for about an hour. Two teachers were observed in a day. Additionally, the scores of their pupils in class assignment, homework, and class test were observed.

Observation notes and video recording were taken to compensate for the findings of the observation checklist. The observation processes were completed in four days. The construction of the observation checklist was guided by the purpose of the study, available literature and research questions for the study.

3.14 The Interview Processes

The researcher interviewed eight primary school teachers. The researcher gathered the information from the participants in a face-to-face situation, which gave her an opportunity to probe participants' answers with follow-up inquiries. Each interview took between 19 - 23 minutes and it took four days to complete the interview processes. The construction of the interview guide was guided by the purpose of the study, available literature and research questions for the study.

3.15 Data Analysis

Data were collected from the questionnaire, interviews and observations to answer the research questions in this study. Data analysis is the process of organizing and summarizing data, using descriptive statistics and/or inferential statistics (Opoku, 2005). The study employed both quantitative and qualitative method of data analysis.

3.14.1 Quantitative Data Analysis

In relation to data that were collected through the closed-ended aspect of the questionnaire, statistical analysis was done using Statistical Product and Service Solution (SPSS). Descriptive statistics in the form of simple percentages, frequency, mean and standard deviation were investigated in the analysis.

Participants' scores for the items within the same sub-scale were added and the mean of means obtained for each sub-scale. The mean score for the sub-scales were used to describe teachers' perceptions and practices of selected constructivist and traditional instructional strategies. The item mean scores and the mean frequencies were also used during the description.

In the analysis, 'strongly agree' and 'agree' were categorised as 'agree', 'strongly disagree' and 'disagree' were categorised as 'disagree' while 'always' and 'frequently' were categorised as 'frequently', and 'rarely' and 'never' were categorised as 'rarely'. A mean score above or below 3 was considered positive and negative respectively while 3 was considered as neutral.

Correlation coefficient is a standardised measure of an observed effect, values of ± .1 represent a small effect, ± .3 is a medium effect and ± .5 is a large effect (Field, 2005). Pearson correlation coefficient was used to determine the relationship between teachers' perception of constructivist instructional strategies and their use of selected constructivist instructional strategies using the idea of Field (2005) as a guide.

3.14.2 Qualitative Data Analysis

The qualitative data; open-ended questionnaire, interviews and lessons observed were analysed thematically in order to answer the research questions. Based on the responses to the questionnaire items, codes were assigned to each item, and themes were identified in the process. The results were presented using frequency counts and percentages.

The interview data were transcribed to support the findings from the questionnaires by listening to a playback of the audio tape recorder and writing down word-for-word all participant responses to the interview questions (Appendix E). The analysis was reported using narrative style with embedded direct quotations. However, data collected through the observational checklist were analysed using textual matrix for easy discussions.

Although data were generated regarding the use of both traditional and constructivist teaching strategies, the researcher focused much on the use of constructivist teaching strategies while using the findings of the traditional teaching strategies to support major findings of the study.

3.16 Ethical Consideration

In research studies, researchers are expected to cautiously and ethically analyze any ethical concerns (Jack et al., 2003). The researcher adhered to ethical guidelines governing human subjects in research. The names of pupils, teachers and schools were not released in the research. Secondly, the features of the questionnaires such as ease of completion, sensitivity of the questionnaire were all considered.

The names of participants were not needed on the questionnaire and they were informed about subject anonymity and confidentiality. The researcher conducted the research without disturbing the learning atmosphere of the schools. The data collected through interviews and observations were made available only to persons who had interest in this study.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.0 Overview

This chapter presents the results of the data analysis and addresses each of the four research questions posed followed by a discussion of each research question. The study explored primary school mathematics teachers' conceptions and practices of constructivist instructional strategies (CIS) and factors that impede their instructions. The following research questions were examined:

1. What knowledge and perception do primary school mathematics teachers possess or hold about constructivist instructional strategies?
2. What levels of selected constructivist instructional strategies do primary school mathematics teachers use in their instructions?
3. What relationship exists between primary school mathematics teachers' perception of constructivist instructional strategies and their use of selected constructivist instructional strategies?
4. What factors impede primary school mathematics teachers' use of constructivist instruction?

The results of the data using three instruments: semi-structured questionnaire, semi-structured interview and an observational checklist, are presented in six major sections.

The first section provides the questionnaire return rate. The second section provides the demographic characteristics of the participants. The other sections provide answers to research question one, two, three and four respectively, followed by a discussion of each question.

4.1 Questionnaire Return Rate

The questionnaire was administered to 252 primary school mathematics teachers in Bawku Municipal, Bawku West District, Bongo District, Bolgatanga Municipal, Kasena Nankana East District and Kasena Nankana West District in the Upper East region of Ghana. Out of this number, 216 participants returned their questionnaire, making a return rate of 85.7%. However, only 205 questionnaires (81.3%) were completed. The result is shown in Table 4.1 below.

Table 4.1: Questionnaire Return Rate

Questionnaire	Frequency	Percentage (%)
Returned	216	85.7
Not returned	36	14.3
Usable	205	81.3
Not usable	11	4.4

4.2 Demographic Information of Participants

Regarding the usable questionnaires, the demographic information of each participant was collected. The results of the analysis of item 1 to 6 under section A of the questionnaire are shown in Table 4.2.

Table 4.2: Summary of Demographic Characteristics of Participants

Demographic factors	Category	Frequency	Percentage (%)
District of participants	Bawku Municipal	29	11.5
	Bawku West District	32	12.7
	Bongo District	36	14.3
	Bolgatanga Municipal	40	15.8
	Kasena Nankana East District	35	13.9
	Kasena Nankana West District	33	13.1
	Total	**205**	**81.3**
Gender	Male	63	25.0
	Female	142	56.3
	Total	**205**	**81.3**
Age	18-23 years	10	3.9
	24-31 years	103	40.9
	Above 31 years	92	36.5
	Total	**205**	**81.3**
Teaching Experience	1-4 years	73	29.0
	5-10 years	81	32.1
	Above 10 years	50	19.8
	Missing	1	.4
	Total	**205**	**81.3**
Grade level taught by participants	Lower Primary	118	46.8
	Upper Primary	75	29.8
	Missing	12	4.7
	Total	**205**	**81.3**
Qualification	Professional teacher	175	69.4
	Non- Professional teacher	29	11.5
	Missing	1	.4
	Total	**205**	**81.3**
Professional Qualification	Cert. ‘A’	11	4.4
	Diploma	102	40.4
	1st Degree	61	24.2
	Post graduate	1	.4
	Total	**175**	**69.4**
Non-Professional Qualification	O level/SSSCE/WASSCE	29	11.5
	Total	**29**	**11.5**
Number of pupils in Participants class	1-20	15	5.9
	21-35	34	13.5
	36-45	51	20.2
	Above 45	102	40.5
	Missing	3	1.2
	Total	**205**	**81.3**

From Table 4.2, twenty-nine of the participants (11.5%) belong to Bawku Municipal, 32 of them (12.7%) were from Bawku West District, 36 (14.3%) were from Bongo District, 35 (13.9%) were from Kasena Nankana East District and 33 (13.1%) from

Kasena Nankana West District. Majority of the participants 40 (15.8%) were from Bolgatanga Municipal.

Furthermore, it is indicated from Table 4.2 that the number of teachers at the primary schools were dominated by females (56.3%). Majority of the participants (40.9%) were within the age range of 24 - 31, which falls within the active age group of many nations. The results further indicates that teachers who had taught for 5 -10 years represented the largest group of teachers responding rate (32.1%), and teachers having taught above 10 years had the lowest responding rate of 19.8%. Also the grade level distribution of teachers was 46.8% for the lower primary and 29.8% for the upper primary. Professional teaching certificates were held by 69.4% of the participants compared to 11.5% with a Non- Professional teaching certificate. It can be deduced that the several efforts made by Ghana Education Service and the Ministry of Education to improve the quality of education in the country by training professional teachers for the classroom is yielding the desired results, although there is more room for improvement. It was also obvious that the class size was large for most schools (Table 4.2).

4.3 Research Question 1: ***What knowledge and perception do primary school mathematics teachers possess or hold about constructivist instructional strategies?***

The results in Table 4.3, 4.4, 4.5 and 4.6 as well as the interview results answer the research question. The following results on the instruments used in the study are sub-headed in italic.

4.3.1 Participants' Perception of CIS

The focus of the study was on CIS. As such, there was the need to find out primary school mathematics teachers' perception of CIS. As a result, questionnaire item 1 to 4 under section B sought information about teachers' perception of CIS. Participants' responses are shown in Table 4.3.

Table 4.3: Participants' Perception of CIS

Item	A	N	D	**T**	MS	SD
1. Constructivist approach improves pupils' academic performance	158(62.7)	42(16.6)	5(2)	**205(81.3)**	4.13	.87
2. I teach mathematics using the constructivist approach	112(44.4)	76(30.2)	17(6.7)	**205(81.3)**	3.65	.95
3. I effectively implement this approach in my classroom	128(50.8)	64(25.4)	13(5.1)	**205(81.3)**	3.79	.95
4. It enables pupils' develop positive attitude towards mathematics	140(55.5)	56(22.2)	9(3.6)	**205(81.3)**	4.05	.94
SMS/SD					3.90	.62

Percentages of responses are in parentheses

Note: A = Agree, N = Neutral, D = Disagree, T = Total, MS = Item mean, SMS = Sub-scale mean, SD = Standard deviation

The frequencies of teachers responses to the questions above, ranged from 5(2%) to 158(62.7%), while the item mean scores ranged from *3.67(SD = .95)* to *4.13(SD = .87)*. Generally, the teachers have a positive perception towards constructivist instructional strategies *(M = 3.90, SD = .62)*. Majority of the teachers 158(62.7%) and 140(55.5%) agreed that constructivist approach improves pupils' academic performance and enables them develop positive attitude towards mathematics respectively, while 5(2%) and 9(3.6%) of the teachers disagreed (item 1 & 4).

One hundred and twelve (44.4%) participants agreed on the statement, I teach mathematics using the constructivist approach, while seventeen (6.7%) participants disagreed on the same statement. When the teachers were further asked if they effectively implement the constructivist approach, 128(50.8%) of the teachers agreed, while 13(5.1%) of the teachers disagreed (item 3). This suggests that the teachers have adequate knowledge or skills of constructivist instructional strategies, and they effectively implement these strategies in their classrooms, which contradicts their response to questionnaire item 3 under section C (Table 4.11).

4.3.2 Primary School Mathematics Teachers' Knowledge of CIS

Teachers play a key role in the mathematics classroom. The decision to implement CIS depends on the teachers' knowledge about CIS. To ascertain teachers' knowledge of CIS, item 4 and 5 under section C in the questionnaire found participants' knowledge of constructivism. Teachers' knowledge of CIS was classified into categories as shown in Table 4.4 and 4.5.

Table 4.4: Primary School Mathematics Teachers' Knowledge of CIS

Category of teachers' conception	Frequency	Percentage (%)
Learners construct understanding	150	59.5
Learner-centred	50	19.8
No idea	5	2
Total	**205**	**81.3**

Table 4.4 indicates that out of the 205 participants, 150 representing 59.5% conceived constructivism as a theory of leaning where teachers assist pupils to construct understanding of concepts. One participant in responding to the item stated: *"it is a theory of learning where teachers help pupils to construct their own understanding through activities".*

Responses of participants are identified below:

T5: "It is the way and manner in which the teacher will help the pupils to construct meaning or understand the topic"

T7: "Is an approach to teaching where teachers help pupils to construct understanding of the topic"

Also, fifty (19.8%) of the teachers, linked constructivism to leaner-centred instructions. A teacher responded that: *"it is the child-centred method of teaching where the teachers' act as a facilitator".*

Another female participant viewed it as:

T2: "When the teacher allows the child to actively get involved in the learning process, like the child-centred method, which is by the use of what? Teaching learning materials".

One participant had this to say;

T6: "Learner-centred approach, I think is all about focusing on the way the delivery can actually go on or go down well with the pupils. Especially, involving them and allowing them to also bring out their views, their contributions".

In addition 5(2%) of the teachers had no idea what constructivism was all about. Although 16 teachers said they have not been introduced to constructivist approach to teaching, only 5 teachers wrote that they had no idea of constructivist instructional strategies (Table 4.4). It is worth noting that the two teachers who wrote that the use teacher-centred strategies and other three teachers who indicated that they had no idea what CIS was all about (making up the 5 teachers), answered no idea to question 4 to 7 under section C.

Table 4.5: Characteristics of Constructivism

Characteristics of CIS	Frequency	Percentage (%)
Social interactions	178	60.5
Authentic examples	116	39.5
Total	**294**	**100**

Note: Some teachers gave more than one response

The total number here is not the same as the total number of participants who answered this item. This was an open-ended question and the responses were computed as 100%.

The results show that, 178 teachers representing 60.5% of teachers indicated social interactions as one of the characteristics of constructivism. Examples of responses are: “encouraging pupils to speak their mind” and “interactions among pupils” on the other hand, 116 teachers representing 39.5% of teachers indicated giving authentic learning task as one of the characteristics of constructivism. Examples of responses are: “using concrete materials during lessons” and “using real life examples”.

4.4.3 Aspects of CIS that Promote Pupils’ Learning

In order to know the aspect of CIS primary school mathematics teachers’ believe promote pupils’ learning, questionnaire item 6 under section C asked participants to mention some of the aspects of CIS that promote pupils’ learning. Teachers’ responses indicated two aspects as presented in Table 4.6.

Table 4.6: Aspects of CIS that Promote Pupils' Learning

Aspect of CIS	Frequency	Percentage (%)
Social interaction	121	38.7
Authentic tasks	192	61.3
Total	**313**	**100**

Note: Some teachers gave more than one response

The total number here is not the same as the total number of participants who answered this item. This was an open-ended question and the responses were computed as 100%.

Table 4.6 shows that, 121(38.7%) of teachers indicated that social interactions promotes pupils' learning, while 192(61.3%) of teachers indicated that giving authentic tasks promotes pupils' learning. It can be said from the results that majority of teachers think that authentic tasks promotes learning. Closely linked to this is the impact of constructivist-based instruction on pupils' academic performance.

4.3.4 Impact of Constructivist-Based Instruction on Pupils' Academic Performance

The Researcher sought to find out from the teachers the impact of constructivist-based instruction on pupils' academic performance. The following are the responses from the teachers during the interview.

T2: "It impact because it allows the child to assess their own hhmm it's like their able to assess the activity themselves, they do the activity by themselves and the get the answers themselves, so that way they get a better understanding of the lesson".

T5: "Mostly, oral like this some of them cannot speak but through that one as they came out to present what they have generated among themselves, it helps to improve their grammar and other things like socialisation and scores".

T6 indicated the significance of constructivist-based instruction and his response was as follows: *"like I said earlier once you involve the pupils in the approaches child-centred and right from the classroom and the exercise they do and the contribution they make you know that actually they are getting it you are achieving your success"*. T7 in responding to the same question said *"When I use the constructivist approach it helps the pupils to understand the topic I teach and they score high marks during exercises"*.

The results indicated that most teachers are aware of the benefits of constructivist instruction. They all agreed that constructivist instruction promotes understanding, interaction and socialisation among pupils. Additionally, it improves pupils' grammar and academic achievement.

4.3.5 Primary School Mathematics Teachers' Reasons for Using the Constructivist Approach

The researcher next sought to find out teachers reasons for using the constructivist approach to teaching. The interviewees stated the following reasons: It enhances assessment, understanding, interactions among pupils and it involves first-hand experience.

In response to the related question, *T1* a male teacher, T4 a male teacher, T5 a female teacher, and T6 a male teacher stated:

T1: "Because it enables the pupils to understand the concept of the topic you are teaching".

T4: "I think it improves the understanding of the pupils".

T5: "I do because it helps the pupils to interact among themselves and also because it involves practical activities".

T6: "Hhmm mathematics is such that you don't have to talk too much. It is practical work, so once you use the constructivist approach you are involving the pupils, so you are doing it with them and it is the assessment is faster than any other method".

Examining the responses of the teachers, it could be deduced that primary school mathematics teachers have different reasons for using the constructivist approach to teaching.

4.3.6 Discussion of Results: *What knowledge and perception do primary school mathematics teachers possess or hold about constructivist instructional strategies?*

Teachers' conceptions undoubtedly inform their decisions in the classroom. The overall mean score of *3.90* for teachers' perception of constructivism, suggests that the teachers have positive perception of constructivist instructional strategies. The teachers believed that constructivist instructional strategies promote understanding, interaction and socialisation among pupils. Additionally, it improves pupils' grammar and academic achievement. According to Vygotsky (1978), social interaction plays a fundamental role in the development of cognition.

The results of this study are consistent with Herman et al. (2004), who reported that the constructivist approach generated increases in affective and cognitive outcomes. Again, Abbot et al. (2003), found a significant correlation between constructivist teaching and higher achievement.

There is a general consensus in literature regarding the positive impact of constructivist approaches on pupils' dispositions (Burris et al., 2007). Teachers' confidence in the constructivist approach remains similar everywhere (Andrew, 2007).

The findings exposed some contradictions in teachers' perception of constructivist instructional strategies. Although, many teachers agreed that they effectively implement constructivist instructional strategies, only a few teachers said that they would be able to effectively implement the constructivist instructional strategies. This contradiction may be due to the teachers' inability to carefully read and analyze the two items on the questionnaire.

The findings further show that majority of the teachers perceived constructivist instructional strategies as capable of assisting pupils to construct their own understanding. This finding is consistent with Slavin's (2000), Mascolol and Fischer's (2005) and Savery's (2006) perception of constructivist instructional strategies. In another perspective, constructivist instructional strategies were perceived by teachers as a learner-centred method. The views of Prince et al. (2006) support this perception of constructivist instructional strategies.

Research evidence shows that teachers have varied conceptions of constructivist instructional strategies. Effective teaching is largely shaped by the kinds of dispositions and thoughts that teachers hold for their teaching (Richardson, 1996).

When the primary school mathematics teachers were asked to express their views about the characteristics of constructivist instructional strategies, the aspect of constructivist instructional strategies that promotes pupils' learning and the aspect of constructivist instruction they use during teaching; they made mention of social interactions and authentic learning tasks. The other aspects of constructivist instructional strategies; pupils constructing their own knowledge and learning new things depend on current understanding were not mentioned. Although they claimed that they assist pupils to construct their own understanding, and it was apparent during the observation that they tried to make use of pupils' relevant previous knowledge.

The teachers' inability to mention these two components may be due to ignorance or an oversight. Research findings suggest that novice teachers hold insufficient conceptions of prior knowledge and its role in instruction to effectively implement constructivist teaching practices (Mayer, 2004). The findings agree with the findings by Wang, Lin and Spalding (2008), who suggested that teachers have difficulties understanding the constructivist perspective of knowledge and learning. Consequently, a deep understanding of this theoretical perspective was challenging for classroom teachers.

4.4 Research Question 2: ***What levels of selected constructivist instructional strategies do primary school mathematics teachers use in their instructions?***

Results from the questionnaire, interview and the observation, followed by a discussion provided answers to the research question. The following results on the instruments used in the study are sub-headed in italic.

4.4.1 Practice of Selected Constructivist Instructional Strategies (CIS)

The CIS section (Appendix A) under section B of the questionnaire was designed to find out the extent to which teachers practice CIS. The teachers' responses to these items are shown in Table 4.7. A sub-scale mean above or below 3 was considered positive and negative respectively, while 3 was considered as neutral.

Table 4.7: Responses to Mean Frequency of use of Selected CIS

Sub-scale	F	S	R	T	SMS	SD
CMS	80(31.7)	115(45.6)	10(4.0)	**205(81.3)**	3.71	.51
CTLA	11(4.4)	150(59.5)	44(17.4)	**205(81.3)**	3.32	.41
CAS	4(1.6)	51(20.2)	150(59.5)	**205(81.3)**	2.35	.77

Percentages of responses are in parentheses

Note: F = Frequently, S = Sometimes, R = Rarely, T = Total, SMS = Sub-scale mean, SD = Standard deviation, CMS = Constructivist management strategies, CTLA = Constructivist teaching and learning activities, CAS = Constructivist assessment strategies

The sub-scale mean scores ranged from *(M = 2.35, SD = .77)* to (*M = 3.71, SD = .51)*, while the frequencies of the selected constructivist instructional strategies ranged from 4(1.6%) to 150(59.5%). The result indicated that teachers have positive perception towards Constructivist management strategies *(M = 3.71, SD = .51)*. Eighty (80) responses representing 31.7% indicated that they frequently use constructivist management strategies in their classrooms, 115(45.6%) of the teachers indicated that they sometimes use constructivist management strategies in their classrooms. However, 10(4%) of the participants indicated that they rarely use constructivist management strategies in their classrooms.

The overall mean score for the sub-scale, constructivist teaching and learning activities *(M = 3.32, SD = .41)* confirmed that the teachers have knowledge about constructivist teaching and learning activities. Eleven (4.4%) of the participants frequently and 150(59.5%) of the participants sometimes designed lessons to incorporate activities such as hands-on learning, multi-option assignments, real-world problems, active investigation, and role play. However, 44(17.4%) of the teachers rarely incorporate these activities in their lessons. This suggests that majority of teachers see the need to actively and meaningfully involve their pupils during classroom instruction.

The overall mean score for the sub-scale, constructivist assessment strategies *(M = 2.35, SD = .77)* was rated the least among the three sub-scales. This indicated that pupils do not have control over the type of assessment being used during instruction. One hundred and fifty (59.5%) of the teachers rarely let their pupils have a say in terms of assessment, while 4(1.6%) of the participants and 51(20.2%) of the participants frequently and sometimes respectively provide the opportunities for their pupils to get involved in their own assessment.

To sum up, the results indicated that most teachers sometimes practice constructivist classroom management strategies; they actively engage their pupils during instructions. Nevertheless, in terms of classroom assessment they do not involve and consult their pupils.

4.4.2 Practice of Selected Traditional Instructional Strategies

The traditional instructional strategies section (Appendix A) under section B of the questionnaire was designed to find out the extent to which teachers practice some selected traditional instructional strategies. The teachers' responses to this item are shown in Table 4.8. A sub-scale mean above or below 3 was considered positive and negative respectively, while 3 was considered as neutral.

Table 4.8: Responses to Mean Frequency of use of Selected Traditional Instructional Strategies

Sub-scale	F	S	R	**T**	SMS	SD
TMS	162(64.2)	39(15.5)	4(1.6)	**205(81.3)**	4.21	.58
TTLA	137(54.3)	68(27.0)	0(0)	**205(81.3)**	4.08	.36
TAS	153(60.7)	38(15.1)	14(5.5)	**205(81.3)**	4.17	.60

Percentages of responses are in parentheses

Note: F = Frequently, S = Sometimes, R = Rarely, T = Total, SMS = Sub-scale mean, SD = Standard deviation, TMS = Traditional management strategies, TTLA = Traditional teaching and learning activities, TAS = Traditional assessment strategies

The sub-scale mean scores ranged from *(M = 4.08, SD = .36)* to *(M = 4.21, SD = .58)* while the frequencies of the teachers scores ranged from 0(0%) to 162(64.2%). Generally, this shows that teachers frequently have a very good perception on the entire three sub-scales: TMS (Traditional management strategies), TTLA (Traditional teaching and learning activities), and TAS (Traditional assessment strategies).

The results indicated that teachers actually take control over classroom management strategies *(M = 4.21, SD = .58)*. One hundred and sixty-two (64.2%) and thirty-nine (15.5%) participants frequently and sometimes respectively said, they determine the physical arrangement of their classrooms, their pupils' works are always filed and pupils always raise hands to talk in class. It is possible that pupils' works are not displayed as they are always filed and there are rarely 4 (1.6%) any interactions among pupils.

The overall mean scores in Table 4.8, proved that classroom instruction is teacher-centred *(M = 4.08, SD = .36)*. One hundred and thirty-seven (54.3%) of the teachers indicated that they frequently use traditional teaching and learning activities, while the rest, 68(27%) said, they sometimes use traditional teaching and learning activities.

Using whole class instruction, teaching to the intellectual level of the pupils and testing for comprehension of information.

Again, the overall mean score *(M = 4.17, SD = .60)* for the traditional assessment strategies sub-scale seemed to suggest a frequent practice of traditional assessment strategies. One hundred and fifty-three (60.7%) and thirty-eight (15.1%) participants frequently and sometimes respectively stated, they practice traditional assessment strategies.

On a whole, it could be concluded, that the teachers frequently practice traditional instructional strategies. They serve as the main source of knowledge in their classrooms instead of facilitating knowledge construction.

4.4.3 Teachers Teaching Styles

The current mathematics curriculum emphasises the use of child-centred approaches, however, a teacher may decide whether or not to teach mathematics using those approaches. Questionnaire item 1 under section C solicited responses from the participants to find out their teaching styles. Table 4.9 presents the results.

Table 4.9: Teaching Style of Teachers

Teaching style	Frequency	Percentage (%)
CIS	203	80.5
Teacher-centred	2	0.8
Total	**205**	**81.3**

The data shows that most teachers 203(80.5%) indicated that they use CIS during lessons. On the other hand, 2 teachers representing 0.8% indicated that they use teacher-centred strategies during lessons. From the results, it can be seen that most teachers practice CIS.

4.4.4 Primary School Mathematics Teachers' Constructivist Approaches

As a subsidiary question to questionnaire item 1 under section C, the researcher wanted to better understand the aspect of constructivism often used by primary school mathematics teachers in their lessons. The abbreviation *T* followed by a number is the identity of the teacher interviewee (as labelled in the transcription report in Appendix E). The responses of the teachers on this item are presented in the excerpt below:

During the interview, *T1* a male teacher who obtained SSSCE and ten years teaching experience, *T3* a female teacher who obtained a degree in basic education and five years teaching experience, *T4* a male teacher with a diploma in basic education and three years teaching experience, T6 a male teacher with a degree in basic education and two years teaching experience, and *T7* a female teacher, who has the same certificate and teaching experience as *T4* mentioned:

T1: "I allow the pupils to demonstrate to stimulate their mind"

Similarly, *T3, T4, T6* and *T7* responses to the same question were:

T3: "Assist pupils to interact with the TLMs"

T4: "Presentations by pupils"

T6: "For example things like giving class work, a lot of class exercise to test understanding. May be the first 15 minutes 10 minutes could be use for explaining and then if the lesson is 45 the rest could be use for exercise and then calling individuals to do some examples. Practical work on the board".

T7: "I involve the pupils in discussions"

They provided details about the aspect of constructivist's instruction they use most to improve teaching and learning. The excerpts of the interview responses of *T1, T3, T4, T6* and *T7* indicated that majority of the primary school teachers' who were interviewed use the interactive component of the constructivist approach to teaching.

4.4.5 Proportion of Primary School Mathematics Teachers who have been introduced to CIS

An experience in an instructional strategy can influence teachers' practice in the classroom. Subsequently, there was the need to find out whether teachers have been introduced to CIS. Table 4.10 below presents the proportion of teachers who have been introduced to CIS as an instructional method.

Table 4.10: Proportion of Primary School Mathematics Teachers who have been introduced to CIS

Introduced to CIS	Frequency	Percentage (%)
Introduced	189	75
Not introduced	16	6.3
Total	**205**	**81.3**

Table 4.10 shows that out of the 205 participants who responded to this item, 189 representing 75% were introduced to CIS, while the remaining 16 representing 6.3% were not introduced to CIS. This suggests that the majority of primary school mathematics teachers have been introduced to CIS. Therefore, it was expected that most of them will be able to effectively implement CIS. Conversely, few teachers said they will be able to effectively implement CIS as shown in Table 4.11.

4.3.6 Proportion of Teachers who Effectively Implement CIS

Having an experience of an instructional method is one thing and being able to effectively implement the method is another ball game. Item 3 under section C dealt with the effective implementation of CIS. Responses are presented in Table 4.11.

Table 4.11: Proportion of Teachers who Effectively Implement CIS

Effective implementation of CIS	Frequency	Percentage (%)
Yes	32	12.7
No	173	68.6
Total	**205**	**81.3**

Table 4.11 shows that out of the 205 participants who responded to the questionnaire item 3 under section C, 32(12.7%) could effectively implement CIS. The majority 173(68.6%) could not effectively implement CIS. This clearly implies that majority of primary school mathematics teachers do not effectively implement CIS, although they have been introduced to CIS. This was evident from the response of *T4* a male teacher, *T5* a female teacher and *T6* a male teacher:

T4: "Not, Sometimes hardly do you get the materials and it is time consuming too".

T5: "Yes , but it is difficult in some other things to get the materials and the time involved, but basically it is the time because by the time everybody will get involved in these activities before you now go to another activity".

T6: "Yes I am on the way, there is room for improvement". "Hhmm it is something you are involving the pupils and then there are some many factors. Time factor, mathematics you need a lot of time but the period you get may by 45 minutes or less. So a lot of external factors come in".

From the foregoing, it could be concluded that though teachers are implementing the constructivist approach to teaching, they are faced with numerous challenges as confirmed by the results of the questionnaire.

4.4.7 Lessons Observed

The researcher observed and ticked any CIS practiced by the teachers in the process of their lesson delivery. There was a post observation interview for the teachers.

The purpose of the post observation interview was to understand why some CIS were not practiced by the teachers during their lessons. Each teacher observed taught for about 46 minutes. The matrix of their instructional practices is shown in Table 4.12 below.

Table 4.12: Matrix of Instructional Practices used by Primary School Mathematics Teachers in the Classroom

Instructional Practices	T1	T2	T3	T4	T5	T6	T7	T8
Introduce the topic in relation to pupils' relevant previous knowledge	1	1	1	1	1	1	1	1
Provide concrete material for pupils	0	1	1	1	1	1	1	0
Provide opportunity for pupils to engage in authentic task	0	1	1	1	1	1	1	0
Pose challenging questions	0	0	0	1	1	1	1	0
Serve as a facilitator by allowing pupils to construct their own knowledge	0	0	0	0	0	0	0	0
Encourage healthy discourse in the classroom	1	1	1	1	1	1	1	1
Allow pupils to work in group	0	0	1	0	0	1	1	0
Pupils determine the assessment tool	0	0	0	0	0	0	0	0
Assessment is ongoing	1	1	1	1	1	1	1	1
Evidence of marking	1	1	1	1	1	1	1	1

Footnotes: 1- means practice present and 0-means practice not present

T1= 1st teacher observed, and T2= 2nd teacher observed

Written documents such as teachers' lesson plans and records of pupils' works were observed to arrive at the various number allocations above. It was observed that all the eight teachers assess the current understanding of their pupils at the beginning of their lessons, and used the current understanding of the pupils as a focal point for their lessons (Table 4.12). This connection between new learning and current understanding serves us the foundation of knowledge construction.

Out of the eight teachers' observed, six provided concrete materials for their pupils to engage in authentic task (Table 4.12). This provided the opportunity for their pupils to experience real life situations in the classroom setting. For instance, *T7* who was dealing with the topic measurement of time and money, created a miniature supermarket in the classroom.

Post observation interview with *T1* and *T8* revealed that the teachers had no idea of any real life example to relate to the topic they taught. Although, four of the teachers observed (Table 4.12), posed challenging questions during their lessons such as "how did you arrive at that answer?" and "would you get the same answer if the numbers are reversed?" They did not have the patience to wait for their pupils to come up with their own views, but rushed to pose leading questions which do not aid better understanding of concepts.

The teachers observed (Table 4.12), responded to pupils' questions in a polite and simple manner. They encouraged their pupils to answer questions by using words like "well done, "thumbs up", "excellent", and "try again". However, only three teachers (Table 4.12) engaged their pupils in group activities. The teachers observed (Table 4.12) in this study were constantly assessing the understanding of their pupils through questions and try work. On the other hand, the pupils did not take part in determining the assessment tools as confirmed by the questionnaire result (Table 4.7). The teachers decided whether to use try work, class test, homework or class exercise to assess the pupils.

The pupils had exercise books designated for mathematics. It was evident that the teachers marked every written exercise they gave their pupils (Table 4.12), although written comments were missing throughout pupils' work. Also, teachers did not assist pupils to revisit the exercises at a later date to correct wrong answers. Moreover, the scores of their pupils in mathematics were not encouraging.

4.4.8 Discussion of Results: *What levels of selected constructivist instructional strategies do primary school mathematics teachers use in their instructions?*

Results showed that majority of primary school mathematics teachers have been introduced to constructivist instructional strategies and they used this approach in their classrooms. It also indicates that teachers were exposed to variety of teaching methods during their teacher education program. This supports the findings of Andrew (2007), that many future teachers receive training in the constructivist approach and if teachers see positive models of constructivism in their college instruction, their experience convinces them to use constructivist-based pedagogy in their classroom. Modern methods of teaching are far from unknown (World Bank, 2004).

To ascertain teachers' levels of use of selected constructivist instructional strategies, a statistical analysis was performed on three dimensions namely, classroom management, teaching and learning activities, and assessment strategies. The mean score obtained for constructivist management strategies was *(M = 3.71)*, while that of the constructivist teaching and learning activities, and assessment strategies were *(M = 3.32)* and *(M = 2.35)* respectively.

This suggests that the teachers actually sometimes used constructivist management strategies, and constructivist teaching and learning activities. These included: Using social negotiation to solve pupils' problems, facilitating learner-centred activities, hands-on learning activities, critical thinking and problem solving skills.

Teachers agreed that constructivist assessment strategies were used rarely; indicating that most often teachers did not involve their pupils during assessment strategies. These included: Pupils' performing authentic task, self-assessing their learning activities and determining the assessment tool. This result is similar to the finding reported by Koul, Fisher and Ernest (2005).

Koul et al. (2005) found that pupils did not have a say in their classroom tasks. Henry (2003) found similar results. Henry surveyed the relationship between teachers' use of constructivist teaching strategies and student academic performance, student social behaviour, and class size. His findings showed that teachers use constructivist management styles, and constructivist teaching and learning activities "sometimes" to "frequently". On the other hand, the teachers claimed that constructivist assessment strategies were used "rarely" to "sometimes".

Teachers' inability to frequently implement the constructivist instructional strategies may be due to their inadequate pedagogical knowledge of constructivist instructional strategies. As Kauchak et al. (1998) put it; to effectively implement constructivist instructional strategies, an expert teacher is required. Also, Schoenfeld (2002) explains that teaching for mathematics understanding is hard. It requires a deep understanding of the mathematics involved and how to create instructional contexts that lead pupils to engage with mathematics in meaningful ways.

In addition, multiple studies of pre-service teachers have found that, despite methods courses and teacher preparation programs based on constructivist learning theory, students find it difficult to implement appropriate instructional practices to support constructivist learning in their classrooms (Haney & MacArthur, 2002). This is in agreement with an earlier research by Mulhall and Taylor (1998), who reported that teachers may have the theoretical knowledge but fail to translate it to practice.

Moreover, the data suggested that traditional teaching strategies were implemented more frequently than constructivist teaching strategies because teachers indicated on the survey that they frequently use traditional teaching strategies with the responses averaging 4 points on the Likert scale, and sometimes or rarely use constructivist teaching strategies with the responses averaging 3 and 2 points respectively on the Likert scale. This is in consonance with the impact study of the World Bank (2004), on primary education in Ghana, which revealed that about a third of teachers use learner-centred approach on a regular basis. Furthermore, the findings agree with a previous study by Henry (2003).

The lessons observed and the interviews conducted also confirmed that primary school teachers involved their pupils during instruction to some extent. During the interview, the teachers mentioned that they actively engage their pupils. They adopt the social interaction and authentic learning task components of constructivist instructional strategies. This was confirmed during the lessons observed. For instance, during the lesson observations, it was evident that the teachers tried to create a connection between pupils' previous knowledge and the current concept being taught. The extent to which teachers are able to facilitate this process significantly affects how well pupils' learn (Mayer, 2004).

In view of the fact that, when pupils' exercise existing mental structures in particular environmental situations, accommodation-motivating disequilibrium results (Piaget, 1954), and new learning interpreted in the context of current understanding helps resolve the disequilibrium. This finding is also in line with Mayer (2004), who reported that expert teachers hold a complex conception of prior knowledge and make use of their pupils' prior knowledge in significant ways during instruction.

Again, majority of the teachers' observed provided concrete materials for the pupils to get engaged in real life situations, in order to aid their understanding of the topics under study. According to Bruner (1966), concrete representations enable pupils to develop a conceptual understanding of concepts, as well as develop an understanding of future theorems due to exposure to intuitive situations.

The use of physical actions, one component of constructivism, can prevent pupils from simply memorizing information, and therefore, promote use of senses to obtain underlying meaning (Vygotsky, 1978). This action promotes pupils' control of their own learning situation.

Burns (2004) posits that the action of explaining reasons behind ideas in mathematics promotes pupils' abilities to further their understanding. However, with respect to the questions posed, it was found that although teachers ask high level questions at the beginning of the lesson, they end up often using the lead question approach, which does not facilitate pupils' construction of their own knowledge. Lead questions according to Tamakloe, Amedahe and Atta (2005), do not allow pupils to do critical thinking, which affect their future analytical skills.

In terms of assessment, it was observed that teachers assess their pupils through oral questions, exercises and test. This was confirmed from the pupils' exercise and homework books. Nevertheless, the pupils were not consulted and involved in determining the assessment tool. Given pupils the opportunity to choose work partners or the timing of work to be done, or by allowing choice in assignment tasks enhances their determination to complete assignments (Palmer, 2005).

Generally, pupils have different learning styles and response to specific learning tasks differently. Experts suggest, therefore, that pupils be encouraged to select their own topics for projects that bring them joy (Wolfe, 2001). Also, the feedback given during assessment only indicated that pupils were either wrong or right, without adequate explanation for improvement. According to Barshdale-lead and Thomas (2000), good feedback helps to improve pupils' learning.

4.5 Research Question 3: ***What relationship exists between primary school mathematics teachers' perception of constructivist instructional strategies and their use of selected constructivist instructional strategies?***

The results in Table 4.13 were used to answer the research question.

4.5.1 Relationship between Primary School Mathematics Teachers' Perception of CIS and their use of Selected CIS

Teacher's perception of an instructional strategy can influence teacher's practice in the classroom. Therefore, Table 4.13 dealt with the relationship between primary school mathematics teachers' perception of CIS and their use of selected CIS (Constructivist management strategies, constructivist teaching and learning activities, and constructivist assessment strategies).

Table 4.13: Pearson Correlations: Primary School Mathematics Teachers' Perception of CIS and their use of Selected CIS

Correlations

		Perception	CMS	CTLA	CAS
Perception	Pearson Correlation	1	.319**	.435**	.060
	Sig. (2-tailed)		.000	.000	.390
	N	205	205	205	205
CMS	Pearson Correlation	.319**	1	.459**	.242**
	Sig. (2-tailed)	.000		.000	.000
	N	205	205	205	205
CTLA	Pearson Correlation	.435**	.459**	1	.357**
	Sig. (2-tailed)	.000	.000		.000
	N	205	205	205	205
CAS	Pearson Correlation	.060	.242**	.357**	1
	Sig. (2-tailed)	.390	.000	.000	
	N	205	205	205	205

**. Correlation is significant at the 0.01 level (2-tailed).

CMS = Constructivist management strategies, CTLA = Constructivist teaching and learning activities, CAS = Constructivist assessment strategies

A Pearson Correlation was run between teachers' perception of constructivist instructional strategies and their use of selected constructivist instructional strategies. A medium positive correlation existed between teachers' perception and CMS at .319 and CTLA at .435, which was also statistically significant at $p < .01$. Also, a small positive correlation existed between teachers' perception and CAS at .060.

Generally, the result indicates that as teachers' perception of constructivist instructional strategies increases, their frequency of use of selected constructivist instructional strategies increases.

4.5.2 Discussion of Results: *What relationship exists between primary school mathematics teachers' perception of constructivist instructional strategies and their use of selected constructivist instructional strategies?*

According to Turnuklu et al. (2007) "Teachers' beliefs, knowledge, judgments, and thoughts have an effect on the decisions they make which influence their plans and actions in the classroom" (p. 2). Furthermore, it has been suggested that the differences in teachers' prior school experiences, their ongoing professional development, and places of work affect their beliefs and their classroom practice (Graves, 2000).

The Pearson Correlation Coefficient conducted shows a medium positive correlation between teachers' perception and that of constructivist management strategies (.319) and constructivist teaching and learning activities (.435), which was also statistically significant at $p < .01$. Furthermore, a small positive correlation existed between teachers' perception and constructivist assessment strategies (.060). As teachers' perception of constructivist instructional strategies increases, their frequency of use of selected constructivist instructional strategies increases. Suggesting that, if teachers are effectively exposed to constructivist instructional strategies, it will boast their desire to implement it in the classroom.

The relationship between teachers' perception of constructivist instructional strategies and their use of selected constructivist instructional strategies was not a large positive correlation, although the teachers had positive perception of constructivist instructional strategies. It appears that teachers are more likely to find adaptations for pupil variance method to be more desirable than feasible (Schumm & Vaughn, 1991).

The findings of the current study confirmed the findings of Graves, Suurtamm, and Benton (2005). They found out that, teacher know that an inquiry approach supports mathematical learning and they possess adequate professional development experiences with regards to this approach. However, there seems to remain a tension between the reform-oriented and traditional approaches which interferes with implementing the inquiry approach.

4.6 Research Question 4: ***What factors impede primary school mathematics teachers' use of constructivist instruction?***

The following are results from the questionnaire, the interviews conducted and the observations made.

Table 4.14: Factors Hindering Teachers Teaching Style

Categories	Users of CIS Frequency	Users of teacher-centred Frequency	**Total**
Lack of TLMs	157(55.1)	2(0.7)	**159(55.8)**
Fluency in English	23(8. 1)	0(0)	**23(8. 1)**
Limited time	42(14.7)	0(0)	**42(14.7)**
Large class size	61(21.4)	0(0)	**61(21.4)**
Total	**283(99.3)**	**2(0.7)**	**285(100)**

Percentages of responses are in parentheses

Note: Some teachers gave more than one response, TLMs = teaching and learning materials

The total number here is not the same as the total number of participants who answered this item. This was an open-ended question and the responses were computed as 100%.

Four major categories of responses emerged. The most frequently occurring response was lack of TLMs. There were 159 responses representing 55.8% of the responses in this category, comprising of 157(55.1%) users of CIS and 2(0.7%) users of teacher-centred methods. Lack of TLMs was expressed in one questionnaire response as: "Lack of appropriate TLMs sometimes for demonstration".

The next most frequently occurring response was large class size. There were 61 responses representing 21.4% of responses in this category. Examples of the responses are "the ratio of teacher to pupil is too much" and "the pupils are too many and you can't give them individual attention".

The next response was limited time. Forty-two (14.7%) teachers wrote that teaching mathematics using CIS consumes a lot of time during lesson delivery. As one participant stated "the time for mathematics is limited for you to involve all pupils in your lesson".

The least frequently occurring response was fluency in English language. There were 23(8.1%) responses in this category. Some of the participants' responses are as follows: "some pupils cannot speak good English", and "some of the pupils feel shy to speak because others will laugh at them". Considering the results so far, it can be deduced that lack of TLMs hinders majority of the teachers' instructional strategies.

4.6.1 Challenges of Teaching Mathematics Using CIS

Questionnaire item 7 under section C asked participants to enumerate the challenges of teaching mathematics using CIS. Teachers written responses were classified into five distinct categories as shown in Table 4.15.

Table 4.15: Challenges of Teaching Mathematics using CIS

Challenges	Frequency	Percentage (%)
Lack of TLMs	129	39
Fluency in English	31	9.4
Limited time	34	10.3
Large class size	59	17.8
Lack of experience	78	23.5
Total	**331**	**100**

Note: Some teachers gave more than one response

The total number here is not the same as the total number of participants who answered this item. This was an open-ended question and the responses were computed as 100%.

The results show that, 39% of the teachers indicated lack of TLMs as a huge challenge as far as teaching mathematics using the CIS is concerned. An excerpt from one participant was: “there are no TLMs for teachers to use during lessons”. Additionally, 23.5% of the participants wrote lack of experience on the part of teachers to implement CIS as a challenge. For instance, one participant response was: “most teachers do not have the experience to use this approach effectively since it seems new”.

Moreover, Fifty-nine (17.8%) participants indicated large class size as another challenge, also, 34(10.3%) of the teachers believed limited time was a challenge, while the remaining 31 (9.4%) of the teachers indicated pupils inability to express themselves fluently in the English language as a challenge.

Generally, Table 4.15 seems to indicate that majority of the teachers’ envisaged lack of TLMs as a major hindrance to effective implementation of the constructivist approach to teaching.

A number of challenges were written on the questionnaire as shown above. To verify these responses, the eight teachers interviewed were asked to express their opinion about the challenges of teaching mathematics using the constructivist approach. Their responses are presented below:

T1: A male teacher with a class size of 33 “Sometimes there are some pupils hmmm their understanding is very difficult as compared to others. Some have hhhmmmm exceptional problems, no matter how you teach they still have problems concerning their understanding”

T2: A female teacher with a class size of 40 “TLMs are difficult to get; it is time consuming as I said. You don’t always get all the TLMs”

T5: A male teacher with a class size of 60 "Just like I said the time and some of them do feel shy in terms that when the make mistake their friends or colleagues will laugh at them, so sometimes it need courage and sometimes if you trying to motivate them and you don't take time the class will lead to noise or other things"

T7: A female teacher with a class size of 46 "Yea the number the number in the class is great, sometimes after teaching, image teaching this number of class, 46 pupil in class, teaching making sure that majority of pupils participate or talk, going around to make sure that individual understand I think is a challenge"

T8: A female teacher with a class size of 41 "Sometimes when I am to use TLMs that side that I always see that some of them are having problems, because you will say they should use the TLMs that they are touching to do this, somebody will be using different thing to do it"

The five different perceptions about the challenges of teaching mathematics using the constructivist approach are: Pupil's difficulties in understanding instructions and speaking the English language. Inadequate teaching and learning materials, limited time to use the approach and large class size.

4.6.2 Factors that Encourage the Teaching of Mathematics using the constructivist approach

As a follow up to questionnaire item 7 under section C, interviewees were asked to express their views about how teachers can be encouraged to teach mathematics using the constructivist approach. Below are some excerpts.

T2: "Actually some of the TLMs are expensive and even at times you will not get them, so I think if the TLMs are available they should buy them. It helps the teachers at times; you have to look for TLMs here and there and all that"

T3: "I think if eerr government is establishing this eerrrmm free education to check this our primary level, it has made parents to relax in contribution, if actually they want this free education to work well they should make sure that they try to provide TLMs to every topic in the books, so when you are treating a topic you know that you have the TLMs available. If not they give us a whole lot of stress, sometimes the TLM is expensive you have to buy, if you are to buy you can't ask the pupils to contribute money, because you know they say that you can't ask the pupils to contribute money, so the issue is it relies on you the teacher, the teacher to does not have money. You have to divert the topic or something, and though they are saying we should always improvise, even the improvisation sometimes you need to buy some of those thing to be able to improvise".

T4: "When workshops are organised for teachers and the TLMs are available for practice. If government can provide all the materials listed in the teacher's handbook and textbooks, I think it can improve the teaching of mathematics"

T5: "They need to be trained or need to inform or to show the importance of it as the see the importance and they go about it they will feel to like how it goes about because it helps pupils to interact and learn faster"

The results show that providing teaching and learning materials, and organising in-service training courses on constructivist approach could go a long way to encourage primary school mathematics teachers to use the constructivist approach in their classrooms.

4.6.3 Physical Environment Observed

The researcher observed and ticked any item that was present on the physical environment section of the observational checklist. The matrix of the physical environment of the classrooms observed is shown in Table 4.16 below.

Table 4.16: Matrix of the Physical Environment of the Classrooms Observed

Physical Environment	T1	T2	T3	T4	T5	T6	T7	T8
Presents an inviting, relaxed environment for learning	1	1	1	1	1	1	1	1
Adequate desks for pupils	0	0	0	1	1	1	1	1
Desks are arranged for easy grouping	0	0	0	0	0	0	0	0
Reflect current content through pupils displays	0	0	0	1	1	1	1	1

Footnotes: 1- means present and 0-means not present

T1= 1st teacher observed, T2= 2nd teacher observed

It was observed that the physical environment for all the eight schools were serene, neat and conducive enough for learning. The classrooms had dual-type desks, which are supposed to be used by two pupils.

However, in the classrooms of *T1*, *T2* and *T3* three pupils shared a desk. Due to the large class size, the desks in each of the classrooms observed were not arranged for easy grouping should a teacher decide to organise group activities. There were no charts displayed on the walls to reflect pupils' works in three of the classrooms (Table 4.16). When the teachers were asked why there were no displays of pupils' works they expressed:

T1: "There are no materials for pupils to work with"

T2: "You know that the time is very limited for me to teach at the same time monitor pupils to design works for display"

T3: "There is no money to buy card boards for such activities"

The results indicate that lack of materials and limited time were some of the reasons why pupils' works were not displayed in the classrooms.

4.6.4 Discussion of Results: *What factors impede primary school mathematics teachers' use of constructivist instruction?*

"There is little literature that probes, systematically or in depth, the full scope of challenges faced by teachers in creating constructivist classrooms" (Windschitl, 2002, p. 131). Teachers in this study mentioned numerous factors that impede effective implementation of constructivist instructional strategies in primary schools. These factors were categorised for easy discussion. These included: Teachers' inadequate content and pedagogical knowledge, lack of teaching resources, limited instructional period, large class size, and pupils' limited proficiency in the English language.

Schoenfeld (2002) explains that teaching for mathematics understanding is hard. It requires a deep understanding of the mathematics involved and of how to create instructional contexts that lead pupils to engage with mathematics in meaningful ways. The majority of primary school mathematics teachers learned their methods of instructions in the traditional way. Hence they neither have adequate content nor pedagogical knowledge in the strategies that would best facilitate their pupils' development of mathematical understanding.

Meyer (2004) indicates that although most teachers shifted from a behaviourist-based approach, only a few were able to adopt constructivist-based methods conceptually. Contrived curricula and teaching, in addition to limited experiences prevented most teachers from embracing the strategy that was strikingly different in conception from those with which they were familiar. Windschitl (2002) acknowledges this in his review of research on constructivist teaching practices; "the most profound challenges for teachers are not associated merely with acquiring new skills but with making personal sense of constructivism as a basis for instruction" (p. 131).

The results of the study identified lack of resources as a major challenge for the implementation of constructivist instructional strategies. When teachers have a lot of resources they are able to use "multiple representations to facilitate pupils' development of mathematical concepts" (Pape & Tchoshanov, 2001, p. 120).

Teaching and learning materials play a vital role in classroom instructions and form an integral part of the school curriculum. According to Reys, Reys and Chavez (2004), textbooks which forms part of the major resources, play a major role of improving pupils learning. Textbooks serve as a guide for teachers who might lack initiatives and innovations. Also, the teaching and learning materials allow connection to be made through different experiences (Drews, 2007). Additionally, symbolic representations help pupils condense information into a form that fits into a given attention span (Bruner, 1960).

Furthermore, inadequate desks posed a major hindrance for teachers. If these resources are not made available in our primary schools, it would have a negative effect on teachers' instructional practices.

On the contrary, Budge (2012) is of the view that one of the biggest challenges in adopting the learner-centred methods is getting past the emphasis on resources. She states that teachers simply do not need resources, what they need is an interactive approach to work with a child-centred frame of mind.

Teachers in this study indicated that teaching mathematics using the constructivist instructional strategies is time consuming. The time allocated for mathematics lessons in the primary school is insufficient for teachers to actively engage pupils in explorations, investigations and presentations. As Ward (2001) recognised, the primary concern of using the constructivist approach is the time required to conceive, design and carry out the activities.

Moreover, large class size was also indicated as another challenge of teaching mathematics using constructivist instructional strategies. Due to the high number of pupils in the classrooms, teachers are not able to effectively organise and manage classroom activities that promote constructivism. This finding contradicts that of Henry in 2003. He conducted a similar study and found that teachers with large class sizes of, 36 to 40 pupils, used constructivist teaching strategies more frequently than teachers with smaller classes. The differences in the findings may be due to the context in which the study was conducted.

Furthermore, the findings of the study revealed pupils' limited proficiency in the English language as a challenge to the implementation of constructivist instructional strategies. When pupils lack the ability to interpret mathematics concepts and express themselves, it serves as a hindrance to effective implementation of constructivist instructional strategies.

In order to increase pupils' achievement, the focus must be on the instructional strategies occurring in the classrooms. Instructional strategies that have been researched and proven to be effective must be expected in all of our classrooms. Consequently, accountability measures must be in place to ensure that all pupils do indeed show growth each year in school (Koeze, 2007).

Considering the benefits of adopting constructivist instructional strategies, it is imperative to assist teachers to implement the strategies effectively. Professional development programmes are essential for teachers, to keep them informed of modern trends in education. As such, the teachers suggest that organising in-service training on the technique of using constructivist instructional strategies will equip them to effectively implement the strategies.

They further suggested providing resources as a way of promoting the teaching of mathematics using the constructivist instructional strategies. Pupils who are given materials to manipulate struggle to make meaning of mathematics and could one imagine what happens to those who are taught mathematics without activities and resources (Drews, 2007).

In conclusion, mathematics is taught at the primary school in Ghana with the ultimate aim of assisting pupils to construct their own mathematical knowledge and apply it in real life situation (CRDD, 2012). Kwang (2002) views contemporary belief in mathematics education as learners becoming active rather than passive recipients of mathematical concepts. Also, constructivists of different points of view agree that the development of understanding requires active engagement on the part of the learner (Jenkins, 2000). Thus, reflects a movement away from behaviourism and towards constructivism with its emphasis on the pupils' active learning. To actively engage pupils in lessons, teachers are expected to do the following: Relate the new topic to what pupils already understand, engage pupils in meaning interactions, determine which group formation will ensure full participation of all pupils, represent the topic using concrete materials and in varied ways, as well as know when to intervene during discussions to minimise learners helplessness.

CHAPTER FIVE

SUMMARY OF FINDINGS, CONCLUSION AND RECOMMENDATIONS

5.0 Overview

These chapter summaries the study, and report major findings. It highlights the conclusion of the study and implications for practice. The implications were based on the major findings identified in the preceding chapter. It further outlines some recommendations and suggestions for future research.

5.1 Summary of Study

This study was conducted due to the need for teachers to assist pupils to construct their own understanding of concepts using their experiences. As emphasised by Fredua-Kwarteng (2005), mathematics teachers' methodology and pedagogy must change to give pupils opportunities for problem-solving, problem-posing, and active participation in mathematics learning in the Ghanaian classroom. This argument is in consonance with the assertion that pupils do not passively receive or copy input from teachers, but instead actively mediate it by trying to make sense of it and to relate it to what they already know (Kauchak et al., 1998).

For teachers to be able to support pupils to construct understanding that make sense to them, they need to have in-depth understanding of their pupils and mastery over prominent instructional strategies. Ward (2001), contends that constructivist approaches, have been found to assist pupils to construct knowledge; better grasp concepts and move from simply knowing the material to understanding it.

In order to understand what happens in the primary school mathematics classroom in Ghana, the following questions were considered:

1. What knowledge and perception do primary school mathematics teachers possess or hold about constructivist instructional strategies?
2. What levels of selected constructivist instructional strategies do primary school mathematics teachers use in their instructions?
3. What relationship exists between primary school mathematics teachers' perception of constructivist instructional strategies and their use of selected constructivist instructional strategies?
4. What factors impede primary school mathematics teachers' use of constructivist instruction?

Two hundred and five primary school mathematics teachers were involved in the survey. Through observations, interviews and analysis of records, data were collected from teachers' conceptions and practices of constructivist instructional strategies. These teachers were selected based on their responses on the questionnaire.

The results indicated that primary school mathematics teachers in the Upper East region of Ghana show positive perception towards constructivist instructional strategies *(M = 3.90, SD = .62)*. The findings further revealed that they practise traditional teaching strategies frequently than constructivist instructional strategies.

Although, the teachers expressed divergent views, with respect to their understanding of constructivist instructional strategies, majority of them (59.5%) perceived constructivist instructional strategies as assisting pupils to construct their own understanding of concepts. The teachers also demonstrated an awareness of some of the aspects and significance of constructivist instructional strategies to their pupils learning.

A sizeable number of them admitted that lack of resources, their inadequate content and pedagogical knowledge, and large class size were a major challenge for the implementation of constructivist instructional strategies. On the whole, the teachers perceived constructivist instructional strategies to be useful for teaching mathematics at the primary school.

The results of the different data sources: Questionnaires, interviews and observations were combined to answer the research questions. Particularly, each research question was looked at from all relevant data sources. In the case of contradiction between the data sources, the researcher gave more weight to the most objective data source. Finally, triangulation of the method of data collection was used as a check for validity of the findings.

5.2 Summary of Findings

The findings revealed that primary school mathematics teachers have positive perception towards constructivist instructional strategies *(M = 3.90, SD = .62)*. They also sometimes practised constructivist management strategies *(M = 3.71, SD = .51)*, and constructivist teaching and learning activities *(M = 3.32, SD = .41)*. While they rarely practiced constructivist assessment strategies *(M = 2.35, SD = .77)*. Also, the results of the interview showed that they practise certain aspects of constructivist instructional strategies, which were evident during the lessons observed.

It was also revealed that majority of the teachers (59.5%) perceived constructivist instructional strategies as learners constructing their own understanding. 2% of the teachers had no idea and 19.8 % of them linked constructivist instructional strategies to learner-centred method. The findings also indicated that teachers are aware of two aspects of constructivist instructional strategies; social interactions and authentic learning tasks.

The interview with the teachers also indicated that they believe constructivist instructional strategies promote understanding, interaction and socialisation among pupils. Additionally, it improves pupils' grammar and academic achievement.

The findings from the questionnaire showed a medium positive correlation between teachers' perception and that of constructivist management strategies (.319) and constructivist teaching and learning activities (.435), which was statistically significant at $p < .01$. Additionally, a small positive correlation existed between teachers' perception and constructivist assessment strategies (.060). As teachers' perception of constructivist instructional strategies increases, their frequency of use of selected constructivist instructional strategies increases. As a result, teachers should often be introduced to constructivist instructional strategies.

The challenges of teaching mathematics using constructivist instructional strategies were identified in this study to include:

1. Teachers' inadequate content and pedagogical knowledge
2. Lack of teaching resources
3. Limited instructional period
4. Large class size
5. Pupils' limited proficiency in the English language

The teachers in the study suggested that organising in-service training for teachers, providing teaching and learning materials for teachers will encourage them to teach mathematics using constructivist instructional strategies. There could be many explanations for the results of this study. Some of the reasons might include:

1. Teachers preferred to use teaching strategies that blended both old and new ideas.
2. Teachers were aware of the importance of using constructivist teaching strategies in the classroom due to their educational training or access to the internet.
3. Teachers might not have taken their time to read item 3 under section B of the questionnaire.
4. Teachers' believed given pupils the opportunity to be part of their own assessment will not reflect pupils' genuine academic results.
5. It was difficult to implement constructivist teaching strategies in large class size.
6. They may have over looked the impact of standardized assessment on instructional strategies.

5.3 Conclusion and Implications for Practice

Today's educational policy is heading towards a more active role of pupils in the whole educational system (Ball, 2008). According to Whitty and Wisby (2007) schools would benefit by giving a greater emphasis to pupils voice. That means giving them a more active role in their education and schooling along with teachers becoming more attentive to what pupils say about their learning experiences during their school life (Hargreaves, 2004).

Although, this study was conducted on a very small scale, it raises pertinent issues related to the quality of teaching mathematics in primary schools in Ghana. The study provides evidence to suggest that teachers' and pupils' performance in the classroom depends on several factors. These factors include:

1. Teachers' content and pedagogical knowledge
2. Teaching resources
3. Instructional period
4. Class size
5. Pupils' proficiency in the English language

The quality of lesson delivery is hampered by the manner in which pupils are assessed. In Ghana, classroom assessment comprises class test, exercises and home works. Pupils are not given the opportunity to assess their own learning. Encouraging the use of self-assessment strategies will go a long way to improve pupils' academic performance.

Teaching requires teachers who understand pupils' existing conceptions and can create learning experiences that will allow pupils to either accommodate or restructure their knowledge frameworks for new learning (Mayer, 2004). To ensure this, teachers' need an understanding of the constructivist model, which increases a teacher's knowledge about the learner-centred approach (Andrew, 2007). Acknowledging the existence of many flaws in constructing a constructivist instruction, the desirable way to teach mathematics is through constructivist paradigm (Golafshani, 2001).

5.4 Recommendations

Based on the findings, the researcher suggests that the stakeholders of education should organise in-service programmes on CIS. To increase teachers' knowledge of CIS within the primary schools, Ghana Education Service in collaboration with the Ministry of Education should conduct refresher course, short-term courses, workshops and seminars on CIS, so that teachers will be well equipped with new skills and knowledge needed to assist learners construct their own understanding of topics. Prospective teachers could also be given pre-service training on CIS as part of their induction process.

School administrators, government and professional bodies in the educational sector should conduct regular needs assessment of professional practices of teachers in order to design programmes to improve their knowledge, pedagogical skills and competence in various subjects, with a view to enhancing the quality of teaching and learning in primary schools.

Furthermore, the stakeholders should ensure that primary schools are well equipped with resources for teaching and learning. These resources should include desks, textbooks and teacher's handbooks with their accompanied teaching and learning materials, especially those that cannot be improvised. Provision of incentives and general improvement of condition of service of teachers will motivate teachers to do their best, since teaching mathematics using CIS has been identified as time consuming and as an approach demanding teacher resourcefulness.

Regular evaluation of the instructional process of teachers by supervisors so designated from within and outside the educational institution who are knowledgeable in CIS will ensure teachers' conformity to CIS in the school setting. Additionally teachers will be assisted appropriately and timely by these supervisors.

The teacher training Universities and Colleges of Educations in Ghana should embark on training of primary school mathematics teachers on how to teach mathematics using CIS, which should include authentic instructional approaches. The constructivist theory could be incorporated into the teacher training programmes at both the diploma and degree levels to sensitise teachers' awareness about contemporary instructional practices.

The Curriculum Research and Development Division of the Ghana Education Service should revise the syllabus to place related topics closer, which will provide teachers with the ample time to teach mathematics using CIS.

5.5 Suggestions for Further Research

The researcher suggests that future research study should be conducted in other regions of Ghana with a large sample size. This will give a clear picture of primary school teachers' instructional practices. Again a study could be conducted to investigate the relationship between teachers' and teacher educators' conceptions of CIS.

Also, a study of how information and communication technology can promote the teaching of mathematics using CIS is recommended for further study. Finally, the Ghana Education Service and other stakeholders of education should take upon themselves to investigate teachers' prior school experiences, their ongoing professional development, and their classroom practice.

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APPENDICES

Appendix A: Questionnaire for Primary School Mathematics Teachers

CONSTRUCTIVISM QUESTIONNAIRE FORM

I am a graduate student of the University of Education, Winneba who is conducting a study on constructivist instructional strategies among primary school mathematics teachers.

This questionnaire seeks your views on constructivist instructional strategies and the type of instructional approach that is pertinent in your classroom. All your responses will be handled with all the confidentiality it deserves.

SECTION A: PERSONAL DATA

Please tick (√), the appropriate response and provide comments where necessary.

1. Sex
   Male ……..
   Female ……..
2. Age
   18 – 23 years ………
   24 – 31 years ……...
   Above 31 years ………
3. Number of years teaching
   1 – 4 years ……….
   5 – 10 years ……...
   Above 10 years ……..
4. Grade level(s) you teach ………
5. Type of certificate you hold
   "O" level/S.S.S/WASSCE ……..
   Certificate "A" …………
   Diploma …………...
   Graduate (1st degree) ……….
   Post Graduate ……………..
   Other(s), specify ………
6. Number of pupils in your class …

SECTION B

Instruction

Circle the responses that most accurately reflect your perception and your classroom activities. (5 = Always, 4 = Frequently, 3 = Sometimes, 2 = Rarely, 1 = Never). Provide comments where necessary.

	Always	Frequently	Some-times	Rarely	Never
PERCEPTION ON CONSTRUCTIVISM:					
1) Constructivist approach improves pupils' academic performance	5	4	3	2	1
2) I teach mathematics using the constructivist approach	5	4	3	2	1
3) I effectively implement this approach in my classroom	5	4	3	2	1
4) It enables pupils' develop positive attitude towards Mathematics	5	4	3	2	1

	Always	Frequently	Some-times	Rarely	Never
CLASSROOM MANAGEMENT:					
5) Pupils work is always filed	5	4	3	2	1
6) Pupils raise hands always to talk in class	5	4	3	2	1
7) Pupils work in cooperative groups	5	4	3	2	1
8) I determine the physical arrangement of the classroom	5	4	3	2	1
9) Pupils use social negotiation to solve problems	5	4	3	2	1
10) The classroom activities demonstrate multicultural diversity	5	4	3	2	1
11) Class activities are learner-centred	5	4	3	2	1

	Always	Frequently	Some-times	Rarely	Never
TEACHING/LEARNING ACTIVITIES:					
12) Coverage of the curriculum is the primary influence on my lesson plans	5	4	3	2	1
13) I teach to multiple pupil's intelligence	5	4	3	2	1
14) I use whole class instruction	5	4	3	2	1
15) I ignore pupil's differences	5	4	3	2	1
16) I am located in front of the class	5	4	3	2	1
17) I teach to the intellectual level of the class	5	4	3	2	1
18) Hands-on learning activities are provided for the pupils	5	4	3	2	1
19) Pupils make interest-based learning choices	5	4	3	2	1
20) Pupils use drill and practice	5	4	3	2	1
21) Pupils choose from multi-option assignments	5	4	3	2	1
22) Pupils use critical thinking and problem-solving skills	5	4	3	2	1
23) The textbook is the primary reference	5	4	3	2	1

24) Pupils are tested for comprehension of information presented in class	5	4	3	2	1
25) Pupils investigate and solve real-world problems	5	4	3	2	1
26) Pupils select topics for independent study	5	4	3	2	1
27) Learning is active investigation	5	4	3	2	1
28) Pupils monitor their own learning	5	4	3	2	1
29) Parents are included in the learning activities	5	4	3	2	1
30) Pupils give single interpretations of ideas	5	4	3	2	1
31) Pupils produce video tape/role play/simulation	5	4	3	2	1
32) I wait for pupils responses to questions	5	4	3	2	1
33) Pupils use multiple resources in class	5	4	3	2	1

	Always	Frequently	Some-times	Rarely	Never
ASSESSMENT:					
34) Assessment is at end of learning	5	4	3	2	1
35) I determine the assessment tool for class activities	5	4	3	2	I
36) I monitor pupil's academic progress	5	4	3	2	1
37) Excellence is defined as percentage of Comprehension of material	5	4	3	2	1

38) I determine the grading criteria for learning activities	5	4	3	2	1
39) Standardized tests are used for assessment	5	4	3	2	1
40) Tests and final exams are used as primary grades	5	4	3	2	1
41) Pupils self-assess their learning activities	5	4	3	2	1
42) Pupils determine the assessment tool	5	4	3	2	1
43) Pupils monitor their academic progress	5	4	3	2	1
44) Pupils perform authentic tasks	5	4	3	2	1

SECTION C

Instruction

Please provide concise answers to the following; to the best of your understanding.

1. What teaching style do you use in your classroom?

   ……………………………………………………………………………………
   ……..

2. What factors hinder your teaching approach?

   ....
   ....
   ....
   ....

3. Have you been introduced to the constructivist approach to teaching? Will you be able to implement this approach effectively?

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

4. What is your understanding of constructivism?

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

5. What are some of the components of constructivism?

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

6. What aspects of constructivist instruction do you believe promote pupils' learning?

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

7. From your experiences what are the challenges of teaching mathematics using the constructivist approach?

   ……………………………………………………………………………………
   ……………………………………………………………………………………
   …………..

Thank you.

Appendix B: Separated Questionnaire

CLASSROOM MANAGEMENT:

Constructivist

7) Pupils work in cooperative groups

9) Pupils use social negotiation to solve problems

10) The classroom activities demonstrate multicultural diversity

11) Class activities are learner-centred

Traditional

5) Pupils work is always filed

6) Pupils raise hands always to talk in class

8) I determine the physical arrangement of the classroom

TEACHING/LEARNING ACTIVITIES:

Constructivist

13) I teach to multiple pupils' intelligence

18) Hands-on learning activities are provided for the pupils

19) Pupils make interest-based learning choices

22) Pupils use critical thinking and problem-solving skills

27) Learning is active investigation

29) Parents are included in the learning activities

21) Pupils choose from multi-option assignments

25) Pupils investigate and solve real-world problems

26) Pupils select topics for independent study

28) Pupils monitor their own learning

31) Pupils produce video tape/role play/simulation

32) I wait for pupils responses to questions

33) Pupils use multiple resources in class

Traditional

12) Coverage of the curriculum is the primary influence on my lesson plans

14) I use whole class instruction

15) I act upon pupil's differences

16) I am located in front of the class

17) I teach to the intellectual level of the class

20) Pupils use drill and practice

23) The textbook is the primary reference

24) Pupils are tested for comprehension of information presented in class

30) Pupils give single interpretations of ideas

ASSESSMENT:

Constructivist

41) Pupils self-assess their learning activities

42) Pupils determine the assessment tool

43) Pupils monitor their academic progress

44) Pupils perform authentic tasks

Traditional

34) Assessment is at end of learning

35) I determine the assessment tool for class activities

36) I monitor pupil's academic progress

37) Excellence is defined as percentage of comprehension of material

38) I determine the grading criteria for learning activities

39) Standardized tests are used for assessment

40) Tests and final exams are used as primary grades

Appendix C: Interview Guide Questions for Primary School Mathematics Teachers

This interview seeks to find out your perception on constructivist instructional strategies and other approaches to teaching. Your views will remain confidential and will be used only for this research purpose.

Personal data

Gender	Age (range)
Grade level(s) you teach	Type of certificate you hold
Number of years teaching	Number of pupils in your class

1. In your own opinion what do you think constructivist approach to teaching is all about?
2. Do you like teaching mathematics using the constructivist approach? Why?
3. Are you able to effectively implement this approach? If yes why? If no why?
4. What components of constructivism do you use in teaching?
5. Does constructivist-based instruction have any impact on pupils' performance? How?
6. What do you think are some of the challenges of teaching mathematics using the constructivist approach?
7. In your own opinion, how can teachers be encouraged to teach mathematics using the constructivist approach?

Thank you.

Appendix D: Observation Checklist for Teachers' Classroom Instructional Practices

Physical Environment

1. Presents an inviting, relaxed environment for learning ☐

2. Desks are arranged for easy grouping ☐

3. Adequate desks for pupils ☐

4. Reflect current content through pupils displays ☐

Instructional practices

5. Introduce the topic in relation to pupils' relevant previous knowledge ☐

6. Provide concrete material for pupils ☐

7. Provide opportunity for pupils to engage in authentic task ☐

8. Serve as a facilitator by allowing pupils to construct their own knowledge ☐

9. Pose challenging questions ☐

10. Provide hands-on learning activities ☐

11. Allow pupils to work in group ☐

12. Encourage healthy discourse in the classroom ☐

13. Pupils determine the assessment tool ☐

14. Assessment is on going ☐

15. Evidence of marking ☐

Pupils' performance

Scores of pupils in class assignment, homework, and class test.

Appendix E: Sample of Transcribed Interviews

Transcription of interviewee (*T1*)

Date: Monday, 13-04-2015

Personal data

Gender: Male

Age (range): 36

Grade level(s) you teach: Class 4

Type of certificate you hold: SSSCE

Number of years teaching: 10 years

Number of pupils in your class: 33

Q: In your own opinion what do you think constructivist approach to teaching is all about?

R: Is a method of teaching how to bring the pupils' understanding to the topic or subject you are taking them through.

Q: Do you like teaching mathematics using the constructivist approach?

R: Yes,

Q: Why do you use that approach?

R: Because it enables the pupils to understand the concept of the topic you are teaching.

Q: Are you able to effectively implement this approach?

R: Yes,

Q: How?

R: By using experiments and TLMs.

Q: What aspects of constructivism do you use in teaching?

R: I allow the pupils to demonstrate to stimulate their mind.

Q: Does constructivist-based instruction have any impact on pupils' academic performance?

R: Yes,

Q: How?

R: When I use the constructivist approach by the end of the term some pupils' score high marks.

Q: What do you think are some of the challenges of teaching mathematics using the constructivist approach?

R: Sometimes there are some pupils hmmm their understanding is very difficult as compared to others. Some have hhhmmmm exceptional problems, no matter how you teach they still have problems concerning their understanding.

Q: In your own opinion, how can teachers be encouraged to teach mathematics using the constructivist approach?

R: That is hmmm the school administration should take part of it by providing teaching and learning materials to help the teacher to deliver his or he lesson well.

Transcription of interviewee (*T2*)

Date: Monday, 13-04-2015

Personal data

Gender: Female **Age (range)**: 31

Grade level(s) you teach: Class 2 **Type of certificate you hold**: Diploma in Basic Ed.

Number of years teaching: 4 years **Number of pupils in your class**: 40

Q: In your own opinion what do you think constructivist approach to teaching is all about?

R: When the teacher allows the child to actively get involved in the learning process, like the child-centred method, which is by the use of what? Teaching learning materials.

Q: Do you like teaching mathematics using the constructivist approach?

R: Yes,

Q: Why do you use that approach?

R: Hmm mostly, I try to gather the TLMs first, and then hhhrr also prepare the lesson notes. That way when I come I allow the pupils to use the TLMs to do whiles eerrr hmmm in the process of the teaching. So with the use of the TLMs they are able to understand better.

Q: Are you able to effectively implement this approach?

R: Yes,

Q: How?

R: By using experiments and TLMs.

Q: What aspects of constructivism do you use in teaching?

R: Child-centred method, where pupils interact.

Q: Does constructivist-based instruction have any impact on pupils' academic performance?

R: Yes,

Q: How?

R: It impact because it allows the child to assess their own hhmm it's like their able to assess the activity themselves, the do the activity by themselves and the get the answers themselves, so that way they get a better understanding of the lesson.

Q: What do you think are some of the challenges of teaching mathematics using the constructivist approach?

R: TLMs, there are no TLMs.

Q: In your own opinion, how can teachers be encouraged to teach mathematics using the constructivist approach?

R: Actually some of the TLMs are expensive and even at times you will not get them, so I think if the TLMs are available they should buy them. It helps the teachers at times; you have to look for TLMs here and there and all that.

Transcription of interviewee (*T3*)

Date: Tuesday, 14-04-2015

Personal data

Gender: Female **Age (range)**: 28

Grade level(s) you teach: Class 3 **Type of certificate you hold**: Degree in Basic Edu.

Number of years teaching: 5 years **Number of pupils in your class**: 45

Q: In your own opinion what do you think constructivist approach to teaching is all about?

R: When the teacher actively engages the learners in the teaching and learning process.

Q: Do you like teaching mathematics using the constructivist approach?

R: Yes,

Q: Why do you use that approach?

R: I use it because it enables the pupils to understand concepts better.

Q: Are you able to effectively implement this approach?

R: Yes,

Q: How?

R: By using TLMs to engage the pupils.

Q: What aspects of constructivism do you use in teaching?

R: Assist pupils to interact with the TLMs.

Q: Does constructivist-based instruction have any impact on pupils' academic performance?

R: Yes, yes,

Q: How?

R: When I use the constructivist approach by the end of the term some pupils score high marks in the exams.

Q: What do you think are some of the challenges of teaching mathematics using the constructivist approach?

R: Inadequate teaching learning materials.

Q: In your own opinion, how can teachers be encouraged to teach mathematics using the constructivist approach?

R: I think if eerr government is establishing this eerrrmm free education to check this our primary level, it has made parents to relax in contribution, if actually they want this free education to work well they should make sure that they try to provide TLMs to every topic in the books, so when you are treating a topic you know that you have the TLMs available. If not they give us a whole lot of stress, sometimes the TTLM is expensive you have to buy, if you are to buy you can't ask the pupils to contribute money, because you know they say that you can't ask the pupils to contribute money so the issue is it relies on you the teacher, the teacher to does not have money. You have to divert the topic or something, and though they are saying we should always improvise, even the improvisation sometimes you need to buy some of those thing to be able to improvise.

Transcription of interviewee (*T4*)

Date: Tuesday, 14-04-2015

Personal data

Gender: Male **Age (range)**: 29

Grade level(s) you teach: Class 5 **Type of certificate you hold**: Diploma in Basic Ed.

Number of years teaching: 3 years **Number of pupils in your class**: 68

Q: In your own opinion what do you think constructivist approach to teaching is all about?

R: I think it is a method that tries to reveal that maths exist by using concrete materials in teaching or improvised material.

Q: Do you like teaching mathematics using the constructivist approach?

R: Yes,

Q: Why do you use that approach?

R: I think it improves the understanding of the pupils.

Q: Are you able to effectively implement this approach?

R: Not,

Q: why?

R: Sometimes hardly do you get the materials and it is time consuming too.

Q: What aspects of constructivism do you use in teaching?

R: Presentations by pupils.

Q: Does constructivist-based instruction have any impact on pupils' academic performance?

R: Yes,

Q: How?

R: It improves their learning situation by assisting pupils to understand concepts better.

Q: What do you think are some of the challenges of teaching mathematics using the constructivist approach?

R: TLMs are difficult to get, it is time consuming as I said. You don't always get all the TLMs.

Q: In your own opinion, how can teachers be encouraged to teach mathematics using the constructivist approach?

R: When workshops are organised for teachers and the TLMs are available for practice. If government can provide all the materials listed in the teacher's handbook and textbooks, I think it can improve the teaching of mathematics.

Transcription of interviewee (*T5*)

Date: Wednesday, 15-04-2015

Personal data

Gender: Male **Age (range)**: 28

Grade level(s) you teach: Class 6 **Type of certificate you hold**: Diploma in Basic Ed.

Number of years teaching: 3 years **Number of pupils in your class**: 60

Q: In your own opinion what do you think constructivist approach to teaching is all about?

R: It is the way and manner in which the teacher will help the pupils to construct meaning or understand the topic, approach or belief that you use in teaching.

Q: Do you like teaching mathematics using the constructivist approach?

R: Yes,

Q: Why do you use that approach?

R: I do because it helps the pupils to interact among themselves and also because it involvs practical activities.

Q: Are you able to effectively implement this approach?

R: Yes,

Q: How?

R: Yes, but it is difficult in some other things to get the materials and the time involved, but basically it is the time because by the time everybody will get involved in these activities before you now go to another activity.

Q: What aspects of constructivism do you use in teaching?

R: Pupil-centred, involving pupils in the lesson.

Q: Does constructivist-based instruction have any impact on pupils' academic performance?

R: It does.

Q: How?

R: Mostly, oral like this some of them cannot speak but through that one as they came out to present what they have generated among themselves it helps to improve their grammar and other things like socialisation and scores.

Q: What do you think are some of the challenges of teaching mathematics using the constructivist approach?

R: Just like I said the time and some of them do feel shy in terms that when the make mistake their friends or colleagues will laugh at them, so sometimes it need courage and sometimes if you trying to motivate them and you don't take time the class will lead to noise or other things.

Q: In your own opinion, how can teachers be encouraged to teach mathematics using the constructivist approach?

R: They need to be trained or need to inform or to show the importance of it as the see the importance and they go about it they will feel to like how it goes about because it helps pupils to interact and learn faster.

Transcription of interviewee (*T6*)

Date: Wednesday, 15-04-2015

Personal data

Gender: Male **Age (range)**: 35

Grade level(s) you teach: Class 4 **Type of certificate you hold**: Degree in Basic Edu.

Number of years teaching: 2 years **Number of pupils in your class**: 40

Q: In your own opinion what do you think constructivist approach to teaching is all about?

R: Learner-centred approach, I think is all about focusing on the way the delivery can actually go on or go down well with the pupils. Especially, involving them and allowing them to also bring out their views, their contributions. So in that view, I think it is something the pupils right in the classroom you will know that you are making an impact.

Q: Do you like teaching mathematics using the constructivist approach?

R: Yes,

Q: Why do you use that approach?

R: Hhmm mathematics is such that you don't have to talk too much. It is practical work, so once you use the constructivist approach you the pupils, so you are doing it with them and it is the assessment is faster than any other method.

Q: Are you able to effectively implement this approach?

R: Yes, I am on the way, there is room for improvement.

Q: why?

R: Hhmm it is something you are involving the pupils and then there are some many factors. Time factor, mathematics you need a lot of time but the period you get may by 45 minutes or less. So a lot of external factors come in.

Q: What aspects of constructivism do you use in teaching?

R: For example things like giving class work, a lot of class exercise to test understanding. May be the first 15 munites 10 minutes could be use for explaining and then if the lesson is 45 the rest could be use for exercise and then calling individuals to do some examples. Practical work on the board.

Q: Does constructivist-based instruction have any impact on pupils' academic performance?

R: Yes it has impact.

Q: How?

R: like I said earlier once you involve the pupils in the approaches child-centred and right from the classroom and the exercise they do and the contribution they make you know that actually they are getting it you are achieving your success.

Q: What do you think are some of the challenges of teaching mathematics using the constructivist approach?

R: The challenges I think is you need enough time, mean while you are teaching about seven subjects. So we can use too much time on just mathematics, this method needs enough time.

Q: In your own opinion, how can teachers be encouraged to teach mathematics using the constructivist approach?

R: If teachers are provided with more teaching and learning materialist for example will encourage them. I think particularly rural area like this, the pupils like speaking the local language and then since the like speaking the local language at time you have to bring them back to the English since the English is what we use in teaching.

Transcription of interviewee (*T7*)

Date: Thursday, 15-04-2015

Personal data

Gender: Female **Age (range)**: 26

Grade level(s) you teach: Class 1 **Type of certificate you hold**: Diploma in Basic Ed.

Number of years teaching: 3 years **Number of pupils in your class**: 46

Q: In your own opinion what do you think constructivist approach to teaching is all about?

R: Is an approach to teaching where teachers help pupils to construct understanding of the topic or subject you are taking them through.

Q: Do you like teaching mathematics using the constructivist approach?

R: Yes,

Q: Why do you use that approach?

R: Because it enables the pupils to understand the concept of the topic you are teaching.

Q: Are you able to effectively implement this approach?

R: No,

Q: why?

R: Lack of TLMs and time.

Q: What aspects of constructivism do you use in teaching?

R: I involve the pupils in discussions.

Q: Does constructivist-based instruction have any impact on pupils' academic performance?

R: Yes,

Q: How?

R: When I use the constructivist approach it helps the pupils to understand the topic I teach and they score high marks during exercises.

Q: What do you think are some of the challenges of teaching mathematics using the constructivist approach?

R: Yea the number the number in the class is great, sometimes after teaching, image teaching this number of class, 46 pupil in class, teaching making sure that majority of pupils participate or talk, going around to make sure that individual understand I think is a challenge.

Q: In your own opinion, how can teachers be encouraged to teach mathematics using the constructivist approach?

R: TLMS should be provided for teachers.

Transcription of interviewee (*T8*)

Date: Thursday, 15-04-2015

Personal data

Gender: Female **Age (range)**: 26

Grade level(s) you teach: Class 5 **Type of certificate you hold**: SSSCE

Number of years teaching: 4 years **Number of pupils in your class**: 41

Q: In your own opinion what do you think constructivist approach to teaching is all about?

R: That one you have to make sure that when you putting something on the board for them to understand just make sure that all those things you are giving one of them should come and do it themselves for you to know that what he or she is doing is the right thing. Especially after doing your own some of them their concentration will be on you but it is better for you to let them also demonstrate what you are doing there that you will know that they have understood or not.

Q: Do you like teaching mathematics using the constructivist approach?

R: Yes,

Q: Why do you use that approach?

R: They all need to come out and do something for you to understand that they have done those things for you. When you are teaching too you make sure that those who are in the class some of them whether they are concentrating or not because when you are having those pupils in your class you make sure that your mind will be on everybody before you end the lesson if not some of them their concentration will not be on you.

Q: Are you able to effectively implement this approach?

R: Yes,

Q: How?

R: After you end the lesson there that you will know that some of them have been achieve.

Q: What aspects of constructivism do you use in teaching?

R: As you start, just make sure that those who are in the class must know all what you are teaching by demonstrating.

Q: Does constructivist-based instruction have any impact on pupils' academic performance?

R: Yes,

Q: How?

R: Yes, it increase their performance.

Q: What do you think are some of the challenges of teaching mathematics using the constructivist approach?

R: Sometimes when I am to use TLMs that side that I always see that some of them are having problems, because you will say they should use the TLMs that they are touching to do this, somebody will be using different thing to do it.

Q: In your own opinion, how can teachers be encouraged to teach mathematics using the constructivist approach?

R: Motivate the teachers to use it. They should say that when you are teaching, you will say that when you are teaching you have to do this to help the pupils improve.

Appendix F: Introduction Letter from the Department

UNIVERSITY OF EDUCATION, WINNEBA

DEPARTMENT OF BASIC EDUCATION
P.O. BOX 25, Winneba Ghana Tel. {0432} 22036
E-Mail: Bastc@u0w.6du.gh

Date: February 11, 2015

Our. DBE/M.PHIL.67/VOL.2/6

***Your Ref*:**

The Director
Ghana Education Service
P. O. Box 1 1
Bolgatanga

Dear Sir/Madam,

LETTER OF INTRODUCTION

I introduce to you Ms. Wasila Yakubu, an M.Phil student of the Department of Basic Education of University of Education, Winneba.

She wishes to carry out her research survey in your outfit and would therefore need your assistance.

I would be grateful if she is given the needed assistance.

Thank you.

Yours faithfully,

ASONABA KOFI ADDISON (PhD)
(Ag. Head of Department)

Appendix G: Introduction Letter from the Regional Education Office

GHANA EDUCATION SERVICE

In case of reply, the number and of this letter should be quoted
OurRef. REO/19/Vol.l/21

REPUBLIC OF GHANA

REGIONAL EDUCATION OFFICE
P.O. BOX 110 BOLGATANGA-
U.E.R.

23rd March, 2015

RE - LETTER OF INTRODUCTION

An introductory letter from the University of Education, Winneba, indicates that Ms. Wasila Yakubu is an M. Phil student of the Department of Basic Education.

She intends to carry out her research work in Basic Schools in the Upper East Region. Her research topic is "Primary School Mathematics Teachers' Conceptions and Practices of Constructivist instructional strategies".

Given the importance of research work in the advancement of knowledge and practice, you are requested to provide her with all the necessary assistance she may need in collecting data from Basic Schools.

Thank you.

^S5^Si^^^^^^^^^^^^^^^^^^^^^^^S
AG. REGIONAL DIRECTOR OF EDUCATION (UER)

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cc:- The Ag. Head of Department
Department of Basic Education
University of Education, Winneba P. O. Box 25 Winneba.

Ms. Wasila Yakubu Department of Basic Education University of Education, Winneba P. O. Box 25
Winneba