UNIVERSITY OF CAPE COAST

RELATIONSHIP BETWEEN MATHEMATICS TEACHERS' BELIEFS AND INSTRUCTIONAL PRACTICES IN SELECTED SENIOR HIGH SCHOOLS IN WESTERN REGION

BY

JOSEPH OKINE ADU

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Thesis submitted to the Department of Mathematics and ICT Education of the Faculty of Science and Technology Education, College of Education Studies, University of Cape Coast, in partial fulfilment of the requirements for the award of Master of Philosophy degree in Mathematics Education

AUGUST 2024

DECLARATION

Candidate's Declaration

I hereby declare that this thesis is the result of my own original research and that no part of it has been presented for another degree at this university or elsewhere.

Candidate's Signature……..…… Date……

Name: Joseph Okine Adu

Supervisors' Declaration

I hereby declare that the preparation and presentation of the thesis were supervised in accordance with the guidelines on supervision of thesis laid down by the University of Cape Coast.

Supervisor's Signature ……..… Date ……

Name: Prof. Ernest Kofi Davis

ABSTRACT

This study explored mathematics teachers' beliefs and instructional practices in selected senior high schools in the Western Region. A quantitative research method embedded with a descriptive survey design was used. The primary methods of information gathering involved the use of a modified questionnaire and an observation guide. One hundred and twenty-two teachers from 10 senior high schools were recruited for this project. Pearson Product Moment Correlation, independent sample t-test, mean, and standard deviations were used to analyse the data. The findings of the study revealed that there was a significant relationship between senior high school mathematics teachers' beliefs about mathematics and their instructional practices. Furthermore, there was no significant difference in mathematics teachers' beliefs about mathematics based on gender. The study also found that SHS mathematics teachers held constructivist beliefs about the subject. There was no significant correlation between teachers' years of experience and their instructional practices of teachers. Based on the findings, it was recommended that teachers' positive beliefs about mathematics should be leveraged on to encourage them to employ the constructivist approach in their mathematics teaching.

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DEDICATION

To my lovely wife, Mrs. Gloria Prosper Okine, and my dearest daughters,

Ashia Betty Okine, Nhyiraba Okine Tawiah, and Afua Poti-Asor Okine.

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CHAPTER ONE

INTRODUCTION

Teachers' beliefs have the propensity to influence their choice of teaching strategies. Whiles findings on these constructs have been inconclusive, major studies have only focused on the basic school level. This study sought to determine the relationship between SHS mathematics teachers' beliefs and instructional practices. This chapter elaborates on the issues that necessitated this study. The chapter presented the background to the study, statement of the problem, the purpose of the study, research objectives and questions, the significance of the study, delimitation, and limitation of the study, and organization of the study

Background to the Study

Beliefs form an integral part of a person's life. It forms the basis on which a person operates and makes vital decisions. In the words of Bishop (2008), beliefs are the support or justification for one's choices. Hence, the choices or decisions individuals make are informed by their beliefs. That is why others think that man is what he believes to be. According to Beswick (2006), belief systems cannot be viewed in isolation but are interconnected in a complex manner. Based on the classification of Buehl and Beck (2015), beliefs can be categorised into three dimensions.

In the first dimension, beliefs are classified based on their premises and conclusions. The organization of these beliefs appears logical to the individual and constitutes the basis for its formation. The psychological intensity of the belief constitutes the second dimension. The terminologies core (central held) and peripheral beliefs have been used to refer to high and less intensified beliefs,

respectively. Due to the strength of the formation, core beliefs are more difficult to change than peripheral beliefs (Brownlee, Boulton-Lewis & Purdie, 2002). The third dimension describes beliefs based on clustering and segregation of experiences. Last but not least, this set of beliefs is held in silos, apart from other beliefs, even if the individual is unaware that the two sets of views conflict. However, beliefs based on evidence can be changed if the evidence is provided to contradict the already existing belief.

An instance of centrally held (core) beliefs is a situation where a teacher believes in using constructivist teaching approaches. One of the consequences of this teaching approach is allowing students to justify and explain their solutions to problems. Hence the teacher believes in students owning and defending their work because of the constructive beliefs that the teacher possesses. Regarding clustering, a teacher may believe that students should be at the centre of teaching and learning during lessons; however, he still believes the teacher should play an active role in teaching and learning.

Also, old beliefs that have been accepted and serve as a guide to one's life may be difficult to unlearn compared to learning new beliefs (Decker & Rimm-Kaufman, 2008). In this view, some people hold beliefs quite contradictory to real-life situations and may contribute little to progress, but they cannot modify or unlearn such old beliefs to match current situations. Teachers' beliefs cannot be overlooked in teaching, as their beliefs inform lesson delivery. This was thus emphasized by Decker and Rimm-Kaufman (2008), who stated that teaching involves making many decisions related to using materials and pedagogy in instruction. These decisions are, however, informed by teachers' beliefs about what would work best or not based on experiences and information they have obtained in the past. When teachers encounter problems in teaching,

they tend to develop their remedies based on a personal understanding of the situation, which is informed by their beliefs. Hence, teachers' beliefs and philosophies are not taken for granted in countries or areas where the quality of teaching is a priority.

Beliefs may vary based on the aspect of mathematics under consideration. Teachers hold beliefs about the nature of mathematics, the teaching, and the learning of mathematics (Beswick, 2011). Thompson and Raymond (1997) described teachers' beliefs about the nature of mathematics as the teachers' conscious or subconscious beliefs, concepts, rules, meanings, preferences, and mental images that they hold in relation to mathematics as a discipline.

Purnomo, Suryadi, and Darwish (2017) pointed out that beliefs regarding how students learn mathematics shape teachers' instructional beliefs. In mathematics, there are two types of beliefs. The first is the widely held belief that training and memorization are the keys to achieving excellence in mathematics education. The second relates to one's fundamental beliefs, particularly those that stress comprehension and insight. The concept-focused math teacher disagrees with the memory-based teacher, who believes that students learn mathematics in the same way they are taught and that, as a result, it is vital to teaching students mathematical concepts. As a result, this type of instruction is shallow since the teachers are more concerned with training and maintaining the steps to master a skill than with the mistakes or ways in which the pupils think. The teacher who beliefs their pupils' understanding of arithmetic concepts and knowledge, on the other hand, believes that it is not sufficient to limit learning to the cognitive level. The previous knowledge must be connected to the new concepts by allowing the children to practice

independently. The teacher challenges the students to practice skills, use them in their daily lives, and concentrate on conceptual and procedural understanding.

With respect to the instructional practices of teachers, Wilkins (2008) asserted that understanding teachers' beliefs are a major stepping stone to understanding their instructional practices. This is because the teachers' beliefs reflect the philosophies, principles, and theories they possess about the nature of mathematics, teaching, and learning of mathematics (Pajares, 1992). Hence what teachers do in the classroom is a product of their beliefs (Cooney, 2001), and if there has been any change in teachers' practices, their beliefs might have been modified as well.

Teachers' beliefs and practices are also closely linked to the strategies they use in the classroom, shaping students' learning environments, which influences students' motivation. When students are motivated, it influences performance (Klieme & Vieluf, 2009); effective teaching does not depend solely on teachers' beliefs and practices but may include social, classroom, and student factors. However, whether beliefs influence practices or rather influence beliefs remains debatable. Despite this, Cobb, Wood, and Yackel (1990) proposed that beliefs and practices influence one another and develop together. Research conducted by Beswick (2003) explained why there had been inconsistencies in whether beliefs influence practices or vice versa. His argument was since the contexts in which different teachers' practices were observed differed.

Studies support this by Klieme and Vieluf (2009), which show that teachers' beliefs can be influenced by various circumstances, including their education level, the content they teach, and their employment status. According to Parajes (1992), teachers' beliefs are reflected in the instructional practices and decisions they make, which are informed by the instructors' views about

mathematics as a topic and the teaching and learning of mathematics. According to Beswick (2007), three facets of mathematics teachers' worldviews characterise their capacity to cultivate an engaging and supportive learning environment in the classroom (Evans, 2003). Teachers' perspectives on mathematics, mathematics education, and mathematics learning and teaching all fall under this category.

Studies such as Richardson (2003) and Negreiros (2017) are of the view that the beliefs that teacher possess on the nature of mathematics, as well as teaching and learning of mathematics, has a vital role to play when it comes to the effectiveness of the teacher in the classroom with regards to the decisions that the teacher makes and practices in the learning environment. Also, in the perspective of teachers' practices, Wilkins (2008) iterated that understanding teachers instructional practices all boils down to understanding their beliefs first. However, some researchers contrast this statement as their findings revealed that teachers' instructional practices are a function of several factors, of which beliefs are just one of them (Bolden & Newton, 2008).

In the African context, Ramnarain and Hlatswayo (2018) researched South Africa to investigate teachers' beliefs on inquiry-based learning and classroom practices. It was discovered that teachers had a positive belief towards inquiry-based learning; however, they are not inclined to enact inquiry-based learning in their lessons. This depicts that they believe in using such approaches in teaching, but when it comes to practice, only a few teachers implement what they believe.

Another study in Kenya also stated that teachers are unaware of their beliefs. This is due to factors such as training and professional development, which teachers believe do not significantly contribute to their beliefs, which may

influence their instructional practices (Utami, 2016). Nevertheless, he emphasised that negative beliefs could be changed into positive ones through various activities such as workshops and seminars planned by teachers and the school to make teaching effective. Few studies have been conducted in the Ghanaian context pertaining to teachers' beliefs and practices in the learning environment. This includes that of Ampadu (2014) and Yarkwah (2020), whose studies were based in the Junior High school setting. Both studies revealed that, though teachers were conversant with the requirements in the national curriculum, which stated that constructivist approaches are to be used in teaching, teachers usually practice teacher-centred approaches though they believe in constructivist learning approaches. In this vein, the present study investigates teachers' beliefs and instructional practices in mathematics at the Senior High School level, specifically in the selected senior high school in the Western Region, to bring to light the beliefs and practices that Senior High School mathematics teachers hold.

Statement of the Problem

Governments and educational institutions worldwide are increasingly concerned about teacher quality (Australian Council of Deans of Education, 2012; Gonzalez & Kuenzi, 2012). Researchers in the West have shown that most teachers hold strict and limiting beliefs about mathematical education (Brinkmann, 2016; Allotey, 2019). Indeed, White et al. (2016) opined that negative beliefs might contribute to negative classroom teaching practices, which may contribute to poor student beliefs, attitudes, and performance outcomes. Teachers' beliefs about the subject matter act as a filter for what they learn about teaching mathematics, shaping the kinds of the professional growth they prioritise and, in turn, how they practice mathematics education in the

classroom (Rozelle & Wilson, 2012). Various educational reforms (MOE, 2012; NaCCA, 2019) have been influenced by some learning theories, including constructivism, while different scholars have advocated through several studies that it plays a key role in teaching mathematics that enhances students understanding (Lee & Hannafin, 2016; Yarkwah, 2020). Some studies (Ampadu & Danso, 2018) have been conducted in the country to enhance the teaching and learning of mathematics and how to increase students' performance in the subject but produced a minor effect. Anecdotal evidence from the researcher indicates that there is a paucity of studies examining mathematics teachers' beliefs and practices and their effects on students' performance at the junior high school level in various senior high schools in the Western Region.

Studies by Anokye-Poku and Ampadu (2020) paid attention to gender differences in attitude and achievement in mathematics among JHS students. Davis, Beccles, and Intsiful (2019) added an important contribution to knowledge by using a mixed-method approach to explore how primary and junior high school teachers place their students at the centre of the teaching and learning process. Their study's findings demonstrated that instruction was mostly teacher-centered. Anokye-Poku and Ampadu (2020) focused their study on gender differences among junior high school students, while Davis et al. (2019) also paid attention to junior high school teachers. There is a paucity of studies focusing on relationship between senior high school teachers' beliefs and practices for effective teaching and learning of mathematics.

Bimbola and Daniel (2010) indicated a great need to examine the teachers' beliefs and practices in developing countries, of which Ghana is no exception since various educational reforms have been influenced by some learning theories, including constructivism. Therefore, it is against this backdrop

identified in the literature that the study employed a quantitative research method embedded with a descriptive cross-sectional survey design to examine the relationship between mathematics teachers' beliefs and practices for effective teaching and learning of mathematics.

Purpose of the Study

The study aims to investigate the beliefs and instructional practices of mathematics teachers in selected senior high schools in the Western Region. The study determined whether there was a relationship between teachers' beliefs and practices and provided knowledge to teachers and stakeholders in education. This helped shape teachers' beliefs for effective teaching and learning practices.

Objectives of the Study

The following research objectives guided the study.

1. To ascertain senior high school mathematics teachers' beliefs about the nature of mathematics and the teaching and learning of mathematics.
2. To determine the instructional practices enacted by senior high school mathematics teachers.
3. To explore the relationship between teachers' beliefs and instructional practices.
4. To explore the relationship between teachers' years of teaching experiences and instructional practices.
5. To find out gender difference in teachers beliefs about teaching and learning of mathematics

Research Questions

To effectively address the main issue regarding the current study, the research was guided by the following research questions.

1. What beliefs are held by mathematics teachers in the selected senior high schools in Western Region?
2. What instructional practices are enacted by mathematics teachers in the selected senior high school?

Research Hypotheses

1. H_0: There is no statistically significant relationship between teacher's beliefs and instructional practices in selected senior high schools in Western Region
2. H_0: There is no statistically significant gender difference in teacher's beliefs about teaching and learning mathematics in selected senior high schools in Western Region
3. H_0: There is no statistically significant relationship in teachers' years of working experience and instructional practices in selected senior high schools in the Western Region

Significance of the Study

The findings of this study will go a long way to be important to different groups of people. Knowledge of the current research may inform stakeholders of how teachers' beliefs and practices affect students' performance in mathematics. Understanding senior high school mathematics teachers' beliefs and practices have implications for implementing the reforms of the senior high school mathematics curriculum. Understanding teachers' beliefs would also contribute to teacher preparation programmes and practice.

Delimitations of the Study

Teachers' beliefs would be limited to teachers' beliefs on the nature of mathematics and beliefs about the teaching and learning of mathematics. The study would be restricted to some selected schools in the Western Region, which

may affect the generalisation of the findings on the effect of teachers' beliefs and instructional practices in mathematics.

Organisation of the Study

The first chapter of the study comprised the study's background, the problem statement, and the purpose for which the study is being conducted. This work section also includes the research questions and hypotheses addressing the topic. The significance of the study and delimitations of the study and organisation concluded this chapter. The second chapter reviewed related literature and various themes derived from the research questions and hypotheses. The theoretical framework underpinning the study was elaborated in this section. Chapter two will also tackle other relevant issues that need to be reviewed. The study's methodology was explained in detail in chapter three. This will comprise the population, sampling, sample size, and research design. It also included the methods and tools used to acquire the data, ethical issues, and the processing and analysis of the data. The study's findings and results are also covered in Chapter 4. The study's summary, conclusions, and suggestions are presented in the last chapter.

Definition of terms

Beliefs: beliefs are what one thinks and knows from experiences that shape the way the person views and deals with his/her world (Mansour, 2008).

Practices: The various methods teachers employ in their classrooms to teach (Finkelstein, Sharma & Furlonger, 2021).

CHAPTER TWO

LITERATURE REVIEW

This chapter provides a comprehensive overview of the research on mathematics teachers' beliefs and instructional practices. The discussion would thus be based on the following themes; the concept of beliefs in mathematics, beliefs about the nature of mathematics, beliefs in teaching mathematics, beliefs in learning mathematics, the concept of instructional practice in mathematics, beliefs held by mathematics teachers, instructional practices enacted by teachers, factors influencing teachers' beliefs and practices. Also, the relationship between teachers' beliefs and practices, the relationship between gender and teachers' beliefs in mathematics, and the influence of age difference on teachers' teaching practice.

Theoretical Framework

The study examines the beliefs and instructional practices that Senior High School teachers employ in teaching and learning mathematics. Hence the main focus is on beliefs and teaching practices. Having looked at several existing theories that may serve as the backbone of this study, it was concluded that three learning theories might sit well with the study. These learning theories are the behaviourist, the constructivist and the instructional theories of learning. These theories were chosen because beliefs in teaching mathematics could be aligned with either behaviourist or constructivist perspectives. On the other hand, instructional practices that may inform a teacher's teaching may also be categorized under behaviourist or constructivist teaching practices. Each of these theories will be explained in the next paragraphs.

Instructional Theory

The component display theory is an instructional theory developed by Merrill (1987), which emphasizes the microelements of instruction or specific ideas and methods of instruction (Reigeluth, 1999). According to the theory, teachers with this theoretical viewpoint believe that learning is divided into two categories: content (concepts, facts, processes, principles, and procedures) and performance (memory and generalities). The four main types of presentations are rules, examples, recollection, and practice. Examples are expositive presentations of occasions and occurrences, whereas rules are expositive presentations of generality (Duncan & Goddard, 2011, p. 80). Recall, on the other hand, is inquisitive or questioning generality, whereas practice is probing instances. Secondary presentation forms, such as goals, mnemonics, preconditions, and feedback, are included in the Component Display Theory. Teachers in the instructional theories arena believe that instruction is only effective if it includes all necessary primary and secondary forms. As a result, a comprehensive instructional lesson would consist of a goal followed by a task-specific and appropriate combination of rules, examples, practice, mnemonics, recall, and feedback.

Additionally, teachers believe that a unique mixture of the many modes of presentation results in the most effective and successful learning experience for any given objective and learner. Furthermore, the Component Display Theory is based on a variety of assumptions. While memory comes in various forms, the theory maintains that algorithmic and associative memory structures are intrinsically linked to Finding/Use and remembering performance. While algorithmic memory comprises maps or rules, associative memory comprises successive layers of network structure.

The distinction between the Find, and Usage performance uses pre-existing rules to manage inputs and develops new rules through rule restructure. Teachers should encourage students to think critically and solve problems as they learn. There is mounting evidence linking the depth and breadth of a student's learning to their ability to comprehend new concepts in their heads. In any case, it is possible that enhanced mental processing and a hands-on approach can boost learning (Reigeluth, 2013). Educators that embrace these strategies typically use interactive computers, implementing students' active participation more simpler than other forms of instructional media.

At the very least, many instructional aspects affect student outcomes, such as course structure, instructional medium, student motivation, and instructional interaction management. One can further divide an instructional structure into two groups: those dealing with multiple themes and those focusing on just one. One of the limitations of the Component Display Theory is that it can only be used to analyse how lessons are presented for a single subject. The theory may only address one small part of education, but the careful steps it takes to get there might help classroom teachers provide effective lessons.

Behaviourism

Behaviourism is a theory in psychology and education that emphasises behaviour that can be observed and quantified. According to the behaviourist theory of learning, animals and humans should be evaluated solely based on their visible behaviours and not their cognitive processes. In the eyes of behaviourists, learning is defined as a shift in behaviour that lasts for an extended period. As a pedagogical approach, behaviourism assumes that students would respond indifferently to changes in their surroundings. According to the notion, only observed behaviour is significant. In other words,

covert behaviours such as emotions or thoughts are not relevant studies (Zhou & Brown, 2015). The theory also posits that all behaviours can be unlearned and replaced with new behaviours. Hence to discontinue unacceptable behaviour, punishment should be used to deter people or students from repeating such acts. However, reward systems should be introduced to encourage new and acceptable behaviours (Parkay & Hass, 2000).

Rewards and punishment have thus been used in our educational systems to bring about desirable changes in students' behaviour with regard to learning. John B. Watson and B. F. Skinner are two theorists who have backed this position. Their central argument was that we might learn more about how people grow as individuals by observing their overt behaviour than by theorising about their hidden motivations and mental processes (Shaffer, 2000).

Applying behaviourism in the classroom involves using punishment to discourage undesirable behaviour and using rewards through praise and positive comments to encourage good behaviour. This approach is used to enhance learning. Teachers in the classroom can also apply behaviourism to encourage their students to set goals for their learning and behaviour. It is also used in breaking learning tasks into objectives in which achieving a particular objective signifies that learning has taken place (Vannak, 2012). Regarding teachers' beliefs and practices, teachers with behaviourist beliefs communicate knowledge in a clear and structured way to students. This is where teachers demonstrate the correct way to solve problems to students (Büyüköztürk, Altun, & Deryakulu, 2017) to enhance students understanding of mathematics to improve their performance. Teachers also explain solutions and give students clear and resolvable problems. Teachers also believe a quiet environment is needed for effective learning (Peña-López, 2009).

They also think that prior information affects how much students learn. On the other hand, the methods involve spoon-feeding pupils all the information they need to know, presenting material in manageable chunks, and using incentives and sanctions as appropriate. Teachers that subscribe to the behaviourist school of thought lead by example when it comes to problem-solving (Büyüköztürk, Altun & Deryakulu, 2017). To be sure, pedagogical and human elements like gender and age, as well as external influences like prior experiences or knowledge and cultural traditions, all play a role in shaping practices and beliefs (Pena-López, 2009).

Constructivism

A second philosophy of learning that stands in opposition to behaviourism is constructivism. Jean Piaget's Cognitive Development Theory (Piaget, 1966) and Lev Vygotsky's Zone of Proximal Development (ZPD) are two of the most influential theories within the Constructivist school of cognitive psychology (Vygotsky, 1978). Their main views on teaching are that students should be at the centre of teaching and learning instead of passive recipients of the information. Constructivists define learning as a process in which students construct meaning based on their experiences and what they already know (Wang, 2006). Constructivists also believe that teachers' roles should be changed from the traditional knowledge transmitters into facilitators, organizers, guides, and counsellors, helping students construct and assimilate new information. This is where students construct their knowledge through teachers' guidance. The constructive teacher serves as a facilitator, organiser, guide, and counsellor, helping students construct and assimilate new information (Wang & Zhang, 2012).

They also argue that education is most effective when applied to real-world scenarios (Wu, 2006). As advocated by constructivism, students are more likely to be motivated and effective in knowledge and skill construction through problem-solving when presented with authentic scenarios and social-communicative activities. Furthermore, group study is crucial (He, 1997). Constructivists believe that each learner develops their understanding in their unique way and that different people have unique perspectives on the same subject. Therefore, group study aids in the acquisition of a rich, in-depth, and all-encompassing knowledge base. Students benefit from more opportunities for two-way communication with their teachers and with one another. Lastly, students need access to a wealth of materials so that they can build a broad and deep foundation of knowledge (Liu, 2003)

By contrast, the constructivist approach sees students as active agents in the learning process. Teachers who adopt this philosophy place a premium on student agency in the classroom, encouraging students to think critically and creatively about their learning and actively designing and implementing their lessons. More important than learning new facts is the cultivation of analytical skills in this context (Staub & Stern, 2002). The practical application of constructivism in the classroom is that teachers are to consider the cultural and social background of students while teaching. The teacher also ensures that students interact with others while learning is taking place peacefully and tolerably (Liu & Zhang, 2014).

Teachers who hold constructivist beliefs believe their role as teachers is to facilitate students' inquiry. They also believe students learn best by finding solutions to problems on their own hence, students should be allowed to think of solutions before their facilitator shows them how they are solved. The

teacher's objective in a constructivist classroom is to help students think and reason independently. Constructivist practices of teachers, on the other hand, include putting their beliefs into action, such as allowing students to construct their knowledge, giving room for peer learning and cooperative learning, and encouraging students to justify their responses (Büyüköztürk et al., 2017). Hence the teachers' beliefs and practices in the study would be guided by the behaviourist and constructivist beliefs and practices of teachers.

Concept of beliefs in mathematics

The concept of belief has been given less attention due to the assumption that whoever comes across the word already understands what it means (Bishop, 2008). However, there have been several definitions of beliefs that have resulted in varied understandings of the concept.

Beliefs can be defined from the individual perspective or the social perspective. Hence beliefs from the individual perspective are psychological and located in the individual, while beliefs from the social perspective are socially construed (Pehkonen & Pietilä, 2003). Individuals' beliefs comprise their feelings, perspectives, worldviews, and code of conduct. Socially created beliefs, on the other hand, are made up of universally shared sentiments, prevalent or accepted attitudes, and belief systems across cultural contexts. In Goldin's (2002) definition, beliefs are internally encoded cognitive or emotive configurations to which the possessor assigns truth value of some type. Mathematics beliefs are understood by some as implicit or explicit subjective concepts people regard to be true, which impact mathematical learning and problem-solving. According to Andrews and Hatch (2000), beliefs affect what is taught, how it is taught, and what the students eventually learn in the classroom. Beliefs also shape the thinking and feeling of teachers about

mathematics and how they teach it. On account of Österholm (2010), beliefs are related to uncertainty. In this view, Lerman (2002) proposed that to change the way teachers teach, they need to identify teachers' beliefs since these beliefs affect their practices in the classroom. However, there is the likelihood that old beliefs can either agree with or contradict new information. When new information fits into old beliefs, people tend to see it as a confirmation of what they already believe. On the other hand, when old belief is in contrast with new information, critical evaluation occurs to judge which one could be true, and this can lead to the new information being accepted or rejected.

Beliefs about the nature of mathematics

Beliefs about the nature of mathematics refer to the kind of conception or meaning held about mathematics. Raymond (1997) explained the nature of mathematics as the development of mathematical knowledge, its usefulness, how mathematics should be learnt and taught, and who should learn mathematics. Thompson and Raymond (1997) thus explained teachers beliefs about the nature of mathematics to be the teacher's conscious or subconscious beliefs, concepts, rules, meanings, preferences, and mental images that they hold in relation to mathematics as a discipline.

According to Ernest (1989), there are three views about the teachers' beliefs about the nature of mathematics: the instrumentalist, the Platonist, and the constructivist. The instrumentalist view of mathematics perceives mathematical knowledge as a collection of facts and following rules and procedures. Hence to understand mathematics, one must engage in rote learning (Heirbert & Leferve, 1986).

As the name suggests, the Platonist view of mathematics has its source in Plato. He believed that ideal entities are discovered and not created; hence

everything in the world was already existed but yet to be discovered (Hersh & Gray-Little, 1998). As a result, mathematics under the Platonist view is a static product that was discovered but not created. Lastly, the constructivist view of mathematics states that mathematics is socially constructed; hence it can be revised (Ernest, 1989). This view of mathematics is also called the problem-solving view. This view of belief also sees mathematical knowledge as a dynamic that is changing and developing through the testing of theories.

Additionally, Garegae (2016) suggested two factors for teachers' perceptions of the nature of mathematics. Though past experiences in teaching mathematics may have shaped teachers' opinions of the subject, the emphasis placed on mathematics in the curriculum and its foundations might provide information on the nature of mathematics. There are two philosophical perspectives on mathematical knowledge in relation to the roots of mathematics, as distinguished by Ernest (1991). These viewpoints are absolutist and prone to error. According to the Absolutist perspective on mathematics, it is a constant fact representing a particular field of knowledge. The knowledge of mathematics is, therefore, continuous and unchanging, and it is not susceptible to error. According to the fallibilist viewpoint, mathematics is a field that develops due to social processes. In light of this, mathematical notions and proofs are subject to change (Lakatos, 1976). Due to the quasi-empirical nature of mathematics, what has been confirmed at one point may be incorrect (Putman, 1998).

The curriculum emphasis could be on procedural or conceptual knowledge (Garegae, 2016). Procedural knowledge describes the steps taken to solve issues. With this kind of information, students can approach questions using dogmatic methods. Thus, procedural knowledge consists of being familiar

with the symbols used to describe mathematical concepts and the grammatical guidelines for writing those symbols (Hiebert & Leferve, 1986). Conversely, conceptual knowledge focuses on how various bits of information are related. In other words, it is knowing how things fit together and how things work, whether those rules are explicit or not.

The development of the two types of knowledge depends on one another. Sometimes, pupils learn to perform something correctly before grasping the concept. Additionally, there are situations when pupils must first acquire conceptual understanding before acquiring procedural comprehension (Rittle-Johnson & Alibali, 1999). In the study of mathematics, both procedural and conceptual knowledge are crucial; they reinforce one another. Connections between these two types of information might be considered the source of true mathematics comprehension. Students may have a strong intuitive grasp of mathematics but struggle to solve problems when concepts and techniques are not connected, or they may generate answers but not fully comprehend their actions (Hiebert & Leferve, 1986, p.9).

Beliefs in teaching mathematics

There has been a strong correlation between teachers' beliefs and practices in that a change in a teacher's practise results from a change in the teacher's views. Mathematics teaching in the classroom requires establishing opportunities for children to study mathematics (Jaworski, 1997). While some teachers' theories result in successful student achievement, others do not. When a teacher thinks that mathematics instruction should concentrate on practicing procedures and memorizing fundamental number combinations, Huinker (2018) gives examples of unproductive ideas that do not increase effective learning. Another instance is when instructors think their job is to lay out all the class

definitions, formulae, and rules and then show them how to apply that knowledge to mathematical problems. Students are viewed as "tabula rasa" under this type of educational thinking, which implies that they have no prior information for teachers to draw upon.

On the other hand, some educators may have a notion that pupils may build their knowledge in the classroom. As a result, problem-solving, logical thinking, and dialogue should all be emphasised when learning mathematics. Teachers may also think that part of their job is to get pupils actively involved in solving problems that need mathematics by utilising a variety of tactics and representations, defending answers, drawing on prior knowledge, and taking into account the reasoning of others (Huinker, 2018). Based on research, Golafshani (2013) set out to find out what teachers thought about using manipulatives in the classroom. Data on instructors' attitudes toward using manipulatives were gathered using teacher questionnaires, field notes, and observation. According to the study, teachers are enthusiastic about employing manipulatives in the classroom. Additionally, it was claimed that using educational materials helped weak students.

Beswick (2006) also identified some central beliefs related to the nature of mathematics, students and their capabilities, and the teachers' role in the classroom. Some of these beliefs were;

1. Mathematics is about connecting ideas and sense-making.
2. Mathematics is fun (in the sense of playful confidence with and enjoyment of mathematics).
3. Students' learning is unpredictable.
4. All students can learn mathematics.
5. The teacher is ultimately responsible for regulating classroom discussion.

6. A teacher's role is actively to support and direct pupils as they create their

7. The teacher is responsible for inducting students into widely accepted ways of thinking and communicating in mathematics.

8. The teacher has the final say on all matters of classroom standards of conduct.

9. Teachers have a professional responsibility to engage in ongoing learning.

Beswick (2006), however, argued that rather than classifying these sets of beliefs as teaching approaches, they should be categorised as constructivist beliefs because they relate to teachers' ability to create learning environments.

Additionally, Minarni, Retnawati, and Nugranheni (2018) investigated the impact of mathematics educators' personal beliefs on their classroom practices and students' learning outcomes. The knowledge and expertise of educators include the educators' convictions. Classroom behaviour is influenced by teachers' personal beliefs. Yet, there are times when educators fail to see the implications of their ideas on their classroom practice. This occurs for a number of reasons, including the views of society and educators. From 2013 to 2018, the Indonesian curriculum will emphasise student-centered instruction. Students are more likely to take an active role in their education when teaching tenets consistent with student-centered learning. Learning focused on the students' needs leads to gains in both knowledge and skill.

In contrast, student-centered instruction is hampered when teachers' theoretical frameworks and practical methods diverge. Therefore, it was found that mathematics educators' views help them choose effective methods of instruction. Also, students do better when learning is centred on them, and teachers whose pedagogical tenets and classroom practices are consistent with the student-centered learning model can help their students actively create mathematical knowledge and raise their mathematics learning outcomes.

Assuah, Yakubu, Asiedu-Addo, and Arthur (2016) conducted research in Ghana that inquired into the perspectives and practices of mathematics educators regarding constructivist approaches to education. The study involved 252 elementary school teachers from the Upper East area of Ghana. It was shown that students were more eager to adopt learner-centered instructional approaches and that constructivist instructional strategy aided in the construction of students' understanding.

Beliefs in learning mathematics

It would appear that mathematics is a focal point of the classroom experience, given that every educator values student achievement. Therefore, instructors have assumptions about how their pupils should approach mathematics. Thompson (1992) claims that most educators, particularly in the West, view mathematics as a set of immutable facts and principles that can be learned and applied mechanically. Therefore, proficiency in mathematics requires speedy manipulation of symbols without a need for conceptual knowledge of those symbols.

Pena-López (2009) states that there are two primary schools of thought regarding how people think people learn: those who believe that learning and instruction are best accomplished through direct transmission and those who believe that learning and instruction are best accomplished through active participation from the learner. Students are assumed to be passive in learning under the direct transmission theory. As a result, educators must impart information clearly, walking students through the correct responses and providing problem sets that can be tackled.

The constructivist view, however, opts for students to take an active stance in instruction. Hence students should be given a chance to construct their

knowledge, engage in peer-to-peer teaching and justify their solutions through lucid explanations. This would enhance students' creativity, thinking, and problem-solving skills (Peña-López, 2009). As von Glasersfeld (1990) argues, learning is contingent on prior information, which in turn was built from prior experience; hence, different people will form different sets of prior knowledge in reaction to the same event.

Concept of instructional practice in mathematics

Depending on their scope, instructional techniques can be considered broad or narrow methods of guiding student participation in class. The teacher's methods of instruction are like the means through which the students acquire the most knowledge. The 21st-century classroom teacher is expected to be proficient in a wide range of instructional practices, including but not limited to maintaining good communication skills; engaging students in class; using humour to alleviate stress and anxiety; allowing for and encouraging individualised learning; and providing clear, concise instructions and constructive criticism. Teachers' instructional strategies include involving students in making decisions and presenting material to capture students' interest.

Many authors have argued that a number of variables must be present for classroom teaching approaches to be successful. A strong teaching strategy is characterised by a number of features, including but not limited to: teacher clarity; class discussion; feedback; formative assessments; and metacognitive strategies, such as empowering students to plan, organise, and monitor their learning (Albert, 2015). However, a properly linked curriculum is essential to successful instruction and student development. Every curriculum should clearly outline the pedagogical methods, learning outcomes, assessment

procedures, and feedback that are to be used. As a result, the curriculum plays a role in informing instructors' pedagogical choices. Teachers' beliefs, experiences, and knowledge may also influence their methods of instruction (Peña-López, 2009).

Haynie (2010) found four consistent factors contributing to effective pedagogy. These include having high standards for all students academically, carefully managing time and resources, focusing on student development in the classroom, and being proactive in the lesson and unit design. Effective teaching and learning would be attained if these factors were well managed in the classroom, which may lead to strong performance on the part of students. Nonetheless, one of the countries with the worst results in international comparisons of teacher quality is Ghana (Buabeng, Owusu & Ntow, 2014). This was linked to teachers' lack of subject matter expertise and other factors (The International Association for the Evaluation of Educational Achievement [IEA], 2012). So it is important for teachers, particularly at the secondary school level, to look into how lessons are typically taught. Student's academic progress can be aided by this information.

Tchordie (2017) investigated the significance of educational resources in the Ho municipality in the Volta Region. The study included 500 students and 30 teachers as participants. Students' success in Agricultural science courses was significantly correlated with their access to and utilisation of relevant course materials. There was a strong evidence that students' academic performance improved when teachers routinely used instructional materials in their lessons.

Kabutey (2016) investigated the mathematics education resources available to teachers in senior high schools. A total of 86 mathematics teachers participated, and 10 were subsequently interviewed to provide more nuanced

responses. The research showed that only mathematics curricula, textbooks, mathematical sets, calculators, and whiteboard markers were available in the classroom. Despite the study's findings that resource use favours mathematics education, teachers' access to such resources remains limited. It was also shown that mathematics teachers rarely use supplementary materials, which could adversely affect their student's academic progress.

Teachers' pedagogical choices may also be influenced by the content of the curriculum, albeit there are instances in which instructors deviate from their stated goals. To evaluate their students, teachers in Awoniyi's (2016) school continued to employ continuous assessment even after removing it from the curriculum. The study of 110 mathematics instructors in the Cape Coast metropolitan area found that the vast majority still rely on the antiquated continuous assessment, suggesting that they are unfamiliar with the School-based assessment procedures.

Ghanaian mathematics teachers were interviewed by Ampadu and Danso (2018) to learn about their use of constructivism in the classroom. The research used questionnaires, observations, and interviews to compile its findings from 250 students and 41 mathematics teachers. The findings indicated that, despite widespread agreement amongst Ghanaian math educators and their students about the value of student engagement and collaboration, these strategies have yet to be completely conceptualised in the country's mathematics classrooms. The findings analysis revealed two significant cultural influences. When just the right answers are rewarded in the classroom, students lose faith in their abilities and become less engaged in mathematics class.

Further, most students in Ghanaian schools struggle to work in groups and accept and understand each other's perspectives, suggesting that the culture

of cooperation is not entirely accepted there. In every class, students' participation was dampened by the widespread practice of teasing those who got an answer wrong. Hence constructivism as a philosophy of teaching which underpins Ghana's educational curriculum is not fully incorporated into the learning environment.

Beliefs held by Mathematics Teachers

Teachers' worldviews may vary depending on their upbringing, educational background, and geographic or cultural background. Karatas, Guven, Yasin, Arslan, and Kadir (2016) investigated the perspectives of K-12 mathematics teachers in light of their backgrounds and training. The study's overarching goal was to investigate how basic school teachers' beliefs influence their mathematical instructional practices. This is related to the educational background of the instructors. Preschool educators' perspectives on and expectations for their students' mathematical development were investigated through a descriptive study. The attitudes of 139 Turkish preschool teachers about teaching mathematics to young children formed the basis of this study. Teachers in higher education were shown to have more optimistic views on mathematics. This study's findings suggest that professional development opportunities can influence teachers' mathematical beliefs.

In addition, Ramnarain and Hlatswayo (2018) found that teachers in South Africa had a favourable attitude toward enquiry-based learning in their study of this pedagogical approach. All attention was directed toward rural South African educational institutions. Eleven physical science instructors from the eighteen rural schools that were surveyed participated in the study. Lack of funding and excessive class numbers were just two of the challenges experienced by the schools chosen for this study. Despite these challenges,

every educator in the chosen schools had received training to understand, organise, and introduce a brand-new inquiry-based physical sciences curriculum. The results showed that educators value inquiry for its ability to improve students' motivation and comprehension of difficult scientific subjects.

According to Voss, Kleickmann, Kunter, and Hachfeld's (2013) analysis, there are various sources from which educators' views can emerge. Beliefs exist regarding teachers' competence, the teaching position's nature, and the classroom environment. In addition, they clarified that the assumptions about the classroom's immediate context in mathematics might be split in half. These are the theoretical positions concerning the nature of mathematical knowledge and its transmission to students. A person's epistemological beliefs must address questions about the origin and scope of knowledge. Beliefs regarding the nature of knowledge include the certainty and ease with which one can claim to have the knowledge (Hofer & Pintrich, 1997). To counter this, Schoenfeld (1992) examined what he called students' "mathematical world perspectives" to describe their assumptions about the foundations of knowledge. Törner and Grigutsch (1994) drew from Schoenfeld's perspective that pupils could think of mathematics as a static or dynamic activity.

Mathematics can be taught in various ways, depending on one's philosophy of education, including the learner-centered, content-focused, conceptual understanding, or performance-focused approaches. Teachers who adopt a learner-centered pedagogy put the students at the centre of the learning process, encouraging them to take an active role in their education. These educators foster a deep conceptual knowledge of mathematics by emphasising each learner's unique requirements and features. Teachers who subscribe to the content-emphasis approach to education think that their students' primary

learning objective should be acquiring and replicating knowledge. The success of their classes in fulfilling curriculum expectations and achieving good academic outcomes is of paramount importance to these educators (Voss et al., 2013).

Aside from the fact that most of these studies were conducted outside the country with different environmental features and training, Ramnarain and Hlatswayo's (2018) study was conducted in the field of science. The study, also done in Turkey by Karatas et al. (2016), involved a sample of preschool teachers. The findings made it clear that the higher the teachers' education level, the more positive their beliefs toward mathematics teaching. Yet, without a proper research study, we cannot generalise this to all teachers at the senior high school level. Teachers' epistemological and pedagogical beliefs on mathematics education will be the focus of this research. Reason: This study's theoretical framework is based on constructivist or behaviourist theories of learning (Voss et al., 2013).

Instructional practices enacted by teachers

One's beliefs may influence one's outlook and activity. What educators believe has a ripple effect on their interactions with students impacts their teaching practices and the student's academic performance. However, teachers' beliefs sometimes have no link with their practices in the classroom.

According to Assuah et al. (2016), teachers rarely include students in developing constructive evaluation methods. They hypothesised that teachers' lack of familiarity with constructivist methods of instruction was to blame for students' infrequent exposure to such methods. Teachers' lack of access to knowledgeable teachers who can introduce them to constructivist education methods was also cited as a contributing factor. The research also showed that

educators never provided students with useful feedback during assessment by failing to provide rationales for their answer choices. Thus, even while educators recognise the benefits of using constructivist learning theory, they are not doing so to their full potential in the classroom.

The implementation of problem-based learning (PBL) in Qatari primary government schools was studied by Al Said, Du, Alkhatib, Romanowski, and Barham (2019). Metaphors, lesson plans, and interviews with seventeen math educators all contributed as sources of qualitative data. Despite teachers' openness to and interest in trying innovative educational approaches, research suggests that doing so may be more work than initially anticipated. This means that problem-based learning is not being used to its full potential in classrooms. Teachers' insecurities and low self-esteem, barriers to student participation, structural limitations, increased workload, and a lack of institutional and social support are all cited as causes.

In addition, Umugiraneza, Bansilal, and North (2017) looked into KwaZulu-Natal classroom practices. Seventy-five KZN math educators were provided with a tool that included closed- and open-ended questions. According to the findings, teachers are less likely to report employing various tactics while educating on statistical ideas and more likely to do so when instructing on mathematical concepts. Teachers typically reported utilising a single strategy for evaluating students' progress. It was also discovered that in the classroom, the majority of time is spent on teacher-led activities and standardised tests.

The results also showed that teachers' demographic characteristics, including gender, age, teaching experience, and the taking of professional development courses and graduate studies, influence the methods of instruction and evaluation that they like. Yarkwah (2020) found the same when teachers

admitted to using behaviourist teaching methods despite their constructivist convictions.

Sofo, Ocansey, and Asola (2013) studied secondary-level physical education teachers in Ghana, who analysed how they used assessment in their classrooms. Sixty-three secondary physical education teachers from six different regions of Ghana took part in the research. Information was gathered using an open-ended survey, and content analysis was utilised to decipher the responses. According to the findings, most teachers incorporate numerous evaluation types while evaluating their students' progress. Therefore, they utilise quizzes, observations, essays, and more to evaluate their students' theoretical and practical knowledge and emotional and affective intelligence. A knowledge test, however, is the primary instrument of evaluation. This suggests that most tests are at the knowledge level, with relatively low stakes.

Oduro (2015) investigated how educators in Ghana's mathematics classrooms rated students' progress. In the Eastern part of the country, junior high schools were the subjects of the research. Educators were observed in the classroom, and interviews and document reviews were conducted using a qualitative research approach. Teachers were found to use both formal and informal assessment strategies, with formal assessment taking the lead. It was also shown that while teachers analyze students after learning, they rarely do so during a lesson. Teachers resorting to informal assessment frequently pose questions requiring memorised responses rather than critical thinking. In addition, the findings suggested that recollection was the primary evaluative factor.

Conclusions drawn from this research indicate that teachers believe in constructivist methods of education but are not always put to good use in the

classroom due to a lack of time and resources. However, there is surprisingly little research on how teachers in the United States approach teaching mathematics to their Senior High School students. This research aims to address that void by investigating classroom strategies utilised by high school teachers.

Factors influencing teachers' beliefs and practices

Saydee (2016) did a qualitative investigation on the influences on teachers' beliefs and practices. The participants were 25 language teachers and 241 students. Data were gathered through semi-structured interviews and free-form questionnaires. The study's findings suggest that teachers' attitudes and actions may be affected by the distinctiveness of the language they are teaching and the extent to which their students are prepared to deal with real-world circumstances. It is also shown that educators' personal biases shape how they teach their students. Teachers' beliefs and the methods they choose to use in the classroom are influenced by several external factors, including students' performance, feedback, and the teachers' training programmes.

Sawyer (2014) researched a related area, exploring the variables influencing elementary mathematics teachers' outlooks over time. According to Richardson's (1996) research, educators' beliefs can shift based on their own life experiences, students' learning experiences, and formal education and training. Sawyer (2014) also collected data from teachers using the Integrated Mathematics Pedagogy Belief Survey in addition to interviews and classroom observation and found similar results. According to the results, educators' perspectives are shaped by various factors, including their backgrounds and experiences in formal and informal education. However, teacher education programmes and professional development were the most influential variables

in shaping teachers' attitudes and behaviours. Teachers' pedagogical choices have been seen to reflect national economic conditions.

Personal circumstances outside of education were found to have a substantial effect on the opinions held by teachers in another study by Sawyer (2017) on factors influencing elementary teachers' beliefs in reform-based teaching. Teachers' views and actions are shaped by a number of factors, including classroom activities, teachers' personal and training experiences, and the students they teach. A study has not been conducted in Ghana to determine what influences educators hold and how such views are formed. Due to the unique circumstances in Ghana, the current research aims to explore this topic to shed light on these components.

Relationship between teachers' beliefs and practices

Lin, Chaung, and Hsu (2014) looked at elementary schools in Yulin County, Taiwan, to determine the connection between teachers' beliefs, student-centered practices, and inventive instructional strategies. The primary goal of the research was to look into the nexus between pedagogical tenets, student-centered practices, and novel pedagogical approaches. A survey was used to collect information from 600 educators at 35 different primary schools in the Yulin region of Taiwan. Multiple regression analysis in SPSS was used to analyse the gathered data. The study's findings suggest a beneficial connection between educators' core convictions and their adoption of innovative pedagogical practices in the classroom. The study results indicated that educators with a more student-centered stance would exhibit more creative approaches to teaching.

In addition, Kul and Celik (2017) conducted an exploratory study on the attitudes of preschool educators toward mathematical play in the classroom. The

study aimed to examine classroom teachers' mathematical attitudes and pedagogical approaches. A case study research strategy was implemented to better understand pre-service teachers' perspectives and methods. Nine future teachers from the University of Artvin Coruh's School of Education make up the study's sample. The study's findings show a steady link between educators' worldviews and their daily work.

Junior high school mathematics educators' attitudes and methods were also studied by Ampadu (2014). This study aimed to examine the attitudes of mathematics educators and the connection between those attitudes and pedagogical practices. The study's mixed-methods design reflected its exploratory nature. The researchers surveyed 42 middle school math instructors from around the Cape Coast Metropolis of Ghana. As the results reveal, mathematics educators' classroom theories and methods do not always align. It was also determined that there are issues with the new curriculum's implementation, despite the fact that instructors recognise the value of the constructivist approach to teaching and learning mathematics that is central to this transformation.

The impact of Cape Coast middle school mathematics teachers' perceptions on their students' performance was studied by Yarkwah (2020). The primary purpose of the research was to determine if and to what degree the attitudes and pedagogical strategies of middle school mathematics educators affected their student's performance in the subject. A descriptive survey was used to learn more about the perspectives of math educators. The study included 306 pupils and 31 maths educators. The study's most important conclusion was that many educators' theoretical understandings of constructivism were at odds with their actual pedagogical practices. Furthermore, it was found that the

mathematics teachers' instructional practices do not correlate with their student's achievement. Further investigation is required.

Researchers outside of Ghana have found a correlation between teachers' values and the methods they use in the classroom. Therefore, teachers who value their students as individuals will bring that value to their classrooms. Nonetheless, research conducted in Ghana by Ampadu (2014) and Yarkwah (2020) showed differently. Research conducted in Ghana revealed that teachers there hold constructivist views while employing behaviourist strategies in the classroom. Since both types of research involved middle-school students, their results may not be generalizable to Ghana's entire teaching force. In view of this, the current study would focus on the Senior High School to bring to light the situation at that level.

Gender difference in teachers' beliefs in mathematics

Throndsen and Turmo (2012) conducted research into the relationship between teachers' gender stereotypes and their students' mathematics achievement in primary school. The primary focus was on determining whether or not there is a gender gap in mathematics teachers' beliefs. A total of 521 teachers were included in the study, and responses from each were gathered using a questionnaire. Teachers' beliefs were examined to improve educators' pedagogical practices, professional competence, and students' learning outcomes. The results showed that female teachers emphasise student mastery and use a more mastery-based pedagogy in the classroom. Female teachers have greater confidence in their abilities than their male counterparts. So, it was concluded that math teachers' views on the subject varied by gender.

De-Kraker-Pauw et al. (2016) also investigated whether teachers' beliefs differ depending on their gender. A total of 107 Dutch educators and aspiring teachers participated in the survey. The study's findings made it abundantly evident that no correlation existed between teachers' demographic traits and their beliefs on gender. However, female teachers showed much lower gender-related views than their male counterparts regarding students' aptitude for science, even if they also had a STEM background. Teachers' implicit biases on gender can influence their pedagogy and the lessons they impart to their students. It was discovered that girls may have heard many stereotyped messages from their teachers, which may have led to the low enrolment of girls opting for STEM fields.

Comparable research on teachers' views on gender and mathematics was undertaken by Zhang, Wong, and Lam (2013). With the help of a questionnaire, we were able to learn what Chinese teachers think about the mathematical success of boys and girls. Teachers, regardless of their gender, were found to pay greater attention to male students than female students. The results also show that teachers have a range of stereotypes and assumptions regarding their female and male students. Teachers' beliefs and actions shape classroom dynamics, affecting students' attitudes and actions. The long-term effects on students' success are further compounded by the fact that teachers tend to call on more male students than female students to respond to classroom inquiries. The research was conducted in other countries; thus, their findings may not apply to the situation in Ghana. Therefore, it is important to research this area to ascertain whether or not there are disparities in the views of male and female high school mathematics teachers.

Influence of age difference on the teaching practices of teachers

Ismail, Arshad, and Abas (2018) found that teachers' age, experience, and effectiveness varied widely among their studies. The purpose of the research was to determine if the age and experience of teachers have any bearing on their performance in the classroom. A total of 410 school faculty members participated in the survey. However, a t-test and a one-way analysis of variance were used to examine the data. As a result, the data supported the idea that experienced teachers are superior to their younger counterparts. Those with more years of experience in the classroom are said to be more careful and mature while dealing with disciplinary issues among their students. It was also discovered that teachers with more experience in the classroom have better classroom management skills. Teachers with more years of experience tend to know more, have better connections with students, and make more sound decisions in the classroom than their younger counterparts.

As an alternative, Umugiraneza, Bansilal, and North (2017) investigated how mathematics and statistics were taught in South Africa. The study also aimed to compare and contrast teachers' demographic characteristics with their instructional and evaluative strategies preferences. To collect information for the study, 75 mathematics teachers were given open-ended questionnaires to fill out. According to the data, there is a clear generational divide in how teachers approach evaluation. Therefore, teachers under 40 were more likely to use multiple evaluation methods than their more senior counterparts. The teaching experience, as well as the tactics and strategies used in the classroom, varied greatly. Therefore, it was established that not all first-time teachers are ineffective. Furthermore, not all experienced teachers are better at their jobs.

When prospective educators are properly vetted and trained, it is possible to recruit and retain competent teachers.

Finally, Irvine (2019) examined how years of experience can improve a teacher's performance. Teacher effectiveness research on student outcomes was surveyed and analysed for this study. The results indicate that a teacher's level of success in the classroom is directly related to the number of years they have spent teaching. Therefore, teachers with more years of experience in the classroom have greater pedagogical abilities than those with less experience.

The studies in this domain focused on teacher effectiveness, including teachers' teaching practices. Some of the results revealed that very experienced teachers are effective teachers. However, results by Umugiraneza et al. (2017) proved otherwise. With that being said, there is a need to investigate this area to understand the situation in our country if age difference influences teachers' teaching practices at the Senior High School level.

Relationship between teachers' beliefs and practices

Lin, Chaung, and Hsu (2014) looked at elementary schools in Yulin County, Taiwan, to determine the connection between educators' views, student-centered education, and instructional innovation. The primary goal of the research was to look into the nexus between pedagogical tenets, student-centered practices, and novel pedagogical approaches. A survey was used to collect information from 600 teachers at 35 different primary schools in the Yulin region of Taiwan. Multiple regression analysis in SPSS was used to analyse the gathered data. The study's findings suggest a beneficial connection between teachers' core convictions and their adoption of innovative pedagogical practices in the classroom. The study results indicated that educators with a

more student-centered stance would exhibit more creative approaches to teaching.

In addition, Kul and Celik (2017) conducted an exploratory study on preschool teachers' beliefs toward mathematics instruction. The study aimed to examine classroom teachers' mathematical beliefs and pedagogical approaches. A case study research strategy was implemented to better understand pre-service educators' perspectives and methods. Nine future teachers from the University of Artvin Coruh's School of Education make up the study's sample. The study's findings show a steady link between teachers' beliefs and their daily work.

Ampadu (2014) looked into the beliefs and practices of middle school mathematics teachers. The purpose of this research was to look into the thoughts and beliefs of mathematics teachers and the connection between those thoughts and the curriculum used in classrooms. As exploratory research, this study used a hybrid approach. Researchers in Cape Coast interviewed 41 mathematics teachers from 22 public schools. According to the results, mathematics teachers' theories and methods in the classroom are at odds with one another. It was also determined that there are difficulties in implementing the new curriculum's constructivist approach to teaching and learning mathematics, although teachers acknowledge the relevance of this method.

Yarkwah (2020) investigated the influence of mathematics teachers' beliefs on their students' achievement in Cape Coast's junior high schools. The study's overall objective was to ascertain if and to what extent the attitudes and instructional practices of junior high school mathematics teachers influence their students' academic achievement. The research employed a descriptive survey design to investigate mathematics teachers worldviews. A total of 306 pupils and 31 mathematics teachers participated in the study. The study's

findings indicated that constructivist mathematics educators' beliefs and actions were at odds with one another. It was also determined that there is no statistically significant link between the mathematics teachers' pedagogical strategies and their student's success in the subject. This indicates that it is necessary to look into further factors.

Chapter Summary

The chapter presented and discussed literature that is relevant to the study. Instructional practices were anchored on the instructional theory, behaviourist, and constructivist theories of teaching and learning. Mathematics beliefs significantly influence teaching and learning, shaping how teachers approach the subject and how students engage with it. Teachers' beliefs about the nature of mathematics can be instrumentalist, Platonist, or constructivist, impacting their instructional methods (Ernerst, 1989). Studies showed that constructivist approaches, which emphasize active learning and problem-solving, lead to better student outcomes, but teachers' practices must align with their beliefs to be effective. The tension between traditional and constructivist views on learning underscores the importance of addressing teachers' beliefs to improve mathematics education.

Teachers' beliefs significantly impact their interactions with students and their instructional practices, which affect students' academic performance. However, there is often a disconnection between teachers' beliefs and their classroom practices. Studies, such as those by Al Said et al. (2019) and Umugiraneza et al. (2017), showed that innovative educational approaches like problem-based learning were underutilised due to teachers' insecurities, increased workload, and lack of support.

Again, research consistently showed a beneficial connection between educators' beliefs and the adoption of innovative pedagogical practices (Lin, Chaung, & Hsu, 2014; Kul & Celik, 2017). However, in Ghana, studies by Ampadu (2014) and Yarkwah (2020) reveal a misalignment between teachers' constructivist beliefs and their actual behaviourist classroom practices. Also, findings showed that gender and age significantly influenced teaching practices. Female teachers tend to use more mastery-based pedagogies and had greater confidence in their teaching abilities (Throndsen & Turmo, 2012). Similarly, Ismail et al. (2018) found that age and teaching experience also correlated with teaching effectiveness, with more experienced teachers demonstrating better classroom management and pedagogical skills (Ismail, Arshad, & Abas, 2018).

Despite the recognition of constructivist approaches in educational theories and policies, practical application in the classroom is often hindered by various factors, including lack of resources, training, and institutional support. For example, researchers outside of Ghana have found a correlation between teachers' beliefs and the methods they use in the classroom. Nonetheless, research conducted in Ghana by Ampadu (2014) and Yarkwah (2020) showed different findings. It was found that teachers in Ghana have constructivist views but employ behaviourist methods in the classroom. These findings may not hold for the general population of teachers in Ghana since the two studies were conducted at the Junior High school level. Given that prior studies have been inconclusive on the nature of teachers' beliefs about mathematics, there was a need for further research to explore these dynamics at different educational levels and within various cultural contexts. Hence this study sought to investigate SHS mathematics teachers' beliefs about the nature, teaching, and

learning of mathematics were investigated within a cultural setting where similar studies had not been undertaken.

CHAPTER THREE

RESEARCH METHODS

This study examined the relationship between mathematics teachers' beliefs and instructional practices in selected senior high schools in Western Region. This chapter describes the methodology that was used in the study. It presents the following: research design, study area, population, sample and sampling procedures, instrumentations, data collection, and data analysis procedures.

Research Design

The purpose of conducting quantitative research is to generate new data that will aid our comprehension of social phenomena. Numerous quantitative methods are used by social science researchers, especially those whose focus is on establishing connections. Quantitative research was the approach for this enquiry that will use numbers and statistics to answer questions about a population sample (Creswell, 2017). Insight into how teachers' own beliefs and instructional practices influence their classroom teaching at the high school level was obtained from this research. This study used a quantitative approach and a descriptive survey design. The questionnaire results were merged into a descriptive survey to determine and search for information about the issue. A descriptive cross-sectional survey is typically used to study the perspectives of a wide group of people on a certain situation or event (Wang & Cheng, 2020). It aids in the development of a comprehensive comprehension of the possible connections between the conditions measured, which are typically low-cost and simple to carry out **(**Ewart & Ames, 2020). The power of a descriptive survey design lies in its ability to explain educational phenomena in terms of pre-

existing conditions or relationships and the stakeholders' beliefs, including students, teachers, parents, and experts (Creswell, 2012).

Questionnaires administration is a popular data-gathering method, and data analysis requires quantification (Atmowardoyo, 2018). Another important factor for choosing this design is that it collects information that provides a descriptive account of the population, including its demographics, educational background, beliefs, and practices (Creswell, 2017). However, its also establishing cause-and-effect relationships between variables is limited, making it useful primarily for identifying patterns and relationships within a population.

Study Area

The study area is made up of five Districts in the Western Region. Namely, Districts A, B, C, D, and E. The five sampled Districts are part of fourteen Districts in the Western Region. They are adjoining Districts of one another and have a common language known as Wasa. They are the only Twi-speaking people in the Western Region. Ideally, these districts were selected for the study due to their proximity and closeness to each other. In the districts mentioned above, the main economic activities are farming, Trading, and mining, but they are predominantly farmers.

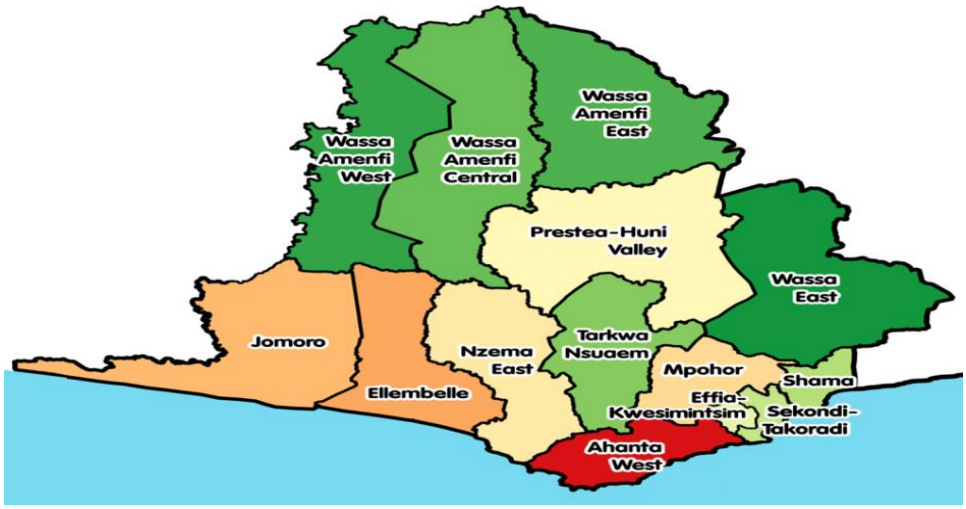

Figure 1: Map depicting the study area

Population

A population is defined by Enos, Yensu, and Obeng (2020) as a collection of elements or cases that meet a set of characteristics and are designed to generalise a finding from a study. All people eligible for sampling are part of the target population, while the subset of the target population to whom the researcher has access for the study is called the accessible population (Rita, Atindanbila, Portia & Abepuoring, 2013). All mathematics teachers at senior high schools in the Western Region were included in the study. The study's target population was all mathematics teachers in the selected senior high schools located in the five districts in the Western Region. The table below shows the names of schools and the number of mathematics teachers in the study location.

Table 1: Summary of the population for the study

S/N	Name of School	Number of Teachers (N)
1	School A	10
2	School B	15
3	School C	11
4	School C	13
5	School D	15
6	School E	14
7	School F	10
8	Schools G	13
9	School H	12
10	School I	9
11	**Total**	**122**

Sample and Sampling Procedure

The study's sample included 122 teachers from all the selected SHS in the Western Region of Ghana. To obtain this sample, a multistage sampling procedure was employed. First, the purposive sampling technique was used to select five districts from 15 districts in the Western Region of Ghana. The purposive sampling technique was deemed necessary because the selected districts shared common boundaries and language and were easily accessible to the researcher.

Further, all the mathematics teachers in the 10 senior high schools within the five selected districts were purposefully selected. In this case, because the total number of teachers in the selected districts appeared to be small, selecting some of them would further produce a small sample size. In addition, considering all the teachers from the selected SHS helped to provide a better picture and insight into the variables under study within that enclave. Hence all the mathematics teachers in the selected districts constituted the sample for the study.

Data Collection Instrument

The primary data collection instruments for the study were questionnaire and observation.

Questionnaire

Teachers at the secondary school level were surveyed with a questionnaire to learn more about how they view mathematics education and how they implement it in the classroom.

The questionnaire comprised Sections A, B, and C (Appendix A). In Section A, background information on the age, sex, attained educational level, and years of experience were solicited. Section B consisted of questions

designed to probe teachers on their beliefs about mathematics. In Section B, items on teacher beliefs adopted from Barkatsas (2003) and were organised into three subsets: Beliefs about the nature of Mathematics (BMN: 5 items), Beliefs about Mathematics teaching (BMT: 5 items), and Beliefs about Mathematics Learning (BML: 5 items). A Likert-type scoring format was used, and teachers were asked to indicate the extent to which they agreed (or disagreed) with each statement presented. A four-point scoring system as follows: *Strongly Disagree* =1, *Disagree* = 2, *Agree* = *3*, and *Strongly Agree* = 4 was used to code responses for further analysis.

Section C comprised 20 items that were adapted from the University of Cape Coast Teacher Professional Development (UCC-TPD) Teaching Practice Form A. These items sought to collect data on the instructional practices mathematics teachers undertook as part of teaching mathematics at the SHS. The mathematics teachers were required to indicate the frequency (Never, Rarely, Sometimes, Very often, Always) at which they undertook specific teaching and learning activities. This item response format was adopted from Vagias (2006). The responses constituted the teachers' self-reported instructional practice.

Observation

The actual instructional practices of mathematics teachers were observed using the UCC TPD Teaching Practice Form A. The observation was done by lecturers from Colleges of Education who were more experienced in assessing teaching practices using the indicated observational tool. Each teacher was scored according to the rubrics provided on the Form A. The Form A comprised 20 rubrics which assign scores based on the degree to which teachers performed some indicated or expected instructional practice. Each indicator was

scored from 1 to 5 where 5, 4, 3, 2, 1 implied Very Good, Good, Satisfactory, Unsatisfactory, and Poor respectively (see Appendix B).

Reliability and Validity of Instruments

In quantitative analysis, ensuring the instrument's reliability and validity is crucial to reduce the possibility of measurement error in the research sample. The term "reliability" describes the consistency and dependability of a measurement (Creswell, 2012). Cronbach's alpha was used to analyse the internal consistency reliability of the Likert-type scale's sub-dimensions. It helped establish how accurately various components in a measure capture the trait under investigation. The research provided insight into which items needed more precise wording or removal from the scale.

The reliability of a test is measured by how well its results hold up over time (Mohajan, 2017). Put another way; an instrument is considered dependable if it yields consistent results when used repeatedly on the same sample of respondents. Consistency throughout time and an accurate depiction of the entire population under investigation are further definitions of dependability. Cronbach's alpha was used to analyse the data and determine the reliability coefficient of the instrument; it was calculated to be $a = 0.887$. A dependable Cronbach's Alpha is defined as 0.70 or higher, as stated by Creswell (2012).

According to Chapelle, Cotos, and Lee (2021), validity refers to whether or not a test accurately assesses its target population. Mugenda and Mugenda (2003) define validity as "the extent to which an assessment instrument measures the constructs for which it was developed." According to Punch (2003), an instrument's validity can be judged by how well it elicits truthful and thoughtful responses from respondents, which in turn depends on the

respondents' disposition and mental state, as well as their capacity to answer the questions posed by the instrument.

Researchers have previously utilised the questionnaire employed here with positive results in assessing mathematics teachers' beliefs and instructional strategies. In other words, there tends to be scholarly consensus on the validity of questionnaire items that tap into distinct beliefs and instructional practices chosen and used in the mathematics classroom, relying on a wide range of studies into these topics. To guarantee that all beliefs and pedagogical approaches were captured in the customised questionnaire used in this study, its items and questions were subjected to thorough review.

Data Collection Procedures

The University of Cape Coast's Ethical Review Board approved the plan after it was successfully defended. The Board accepted a request for ethical clearance that was put forth. After that, a letter of introduction was obtained from the University of Cape Coast's Department of Mathematics Education and given to a number of senior high school heads to request their permission to distribute the questionnaire and carry out the observation. This was required to ensure that the teachers were aware of the data gathering beforehand. The participants were contacted again to set up a convenient time and day to collect the data. The questionnaires were delivered to the instructors with the heads of the individual schools' approval to get their opinions on their beliefs and methods of instruction.

The date range for data gathering was June 20, 2021, until August of the following year. Despite this, participants were assured that their participation in the study was voluntary (Neuman, 2014) and was urged to give their most truthful answers. All respondents knew that no psychological or physical abuse

occurred throughout the study (Neuman, 2014). Data collection was conducted in accordance with the COVID-19 guidelines.

Data Processing and Analysis

The data collected from the field was processed and analysed using SPSS (v.26) and Microsoft Excel. The data was divided into two sections. Section one contained the respondents' demographic data, and the second comprised the objectives' main data. The demographic data were analysed using frequency counts, means, and percentages. Furthermore, the Pearson Correlation coefficient (r) was used to test the relationship between the teachers' beliefs and their instructional practices at the 5% significance level. The Pearson Correlation coefficient (r) was again used to test the relationship between teachers' years of working experience and their instructional practices at the 5% significance level.

The independent samples t-test was used to determine whether there is or is no statistically significant gender difference in teachers' beliefs about teaching and learning mathematics. It was done at a significance level of 0.05. Ideally, the observation checklist reflected research question two to indicate whether the major response on teachers' beliefs reflects instructional practices. The observation checklist will be analysed using frequencies and percentage counts.

Ethical Considerations

Ethical research practices ensure that findings may be trusted (Kyngäs, Kääriäinen & Elo, 2020). Some challenges that can arise when conducting quantitative research include gaining approval, protecting the privacy of respondents, minimising disruptions at research sites, and defining the study's goals.

I began by visiting the schools to become acquainted with the atmosphere in which teachings were delivered. I explained the research goal to all individuals involved using the introductory letter. I met with the respondents and informed them of the study aim, meeting dates, and session times. They were required to sign a consent document. Finally, I assigned each participant a unique serial number. Thus, the study's data were coded to prevent them from being traced back to particular individuals.

CHAPTER FOUR

RESULTS AND DISCUSSIONS

The study investigated mathematics teachers' beliefs and instructional practices in selected senior high schools in the Western Region. This study opted for a quantitative methodology and a descriptive survey design. The information was gathered with the help of an adapted questionnaire and an observational checklist. The findings, based on the data collected and the discussions, are presented in this chapter. There are two main divisions in this chapter. Section A highlighted respondent demographics, while Section B Analysed the results in Section A using frequencies and percentages. The results of the demographics are presented in Tables 1, 2, and Figures 1, 2, respectively.

Background Information of Respondents

The responders' backgrounds are highlighted below. Information about the respondents' ages, genders, educational backgrounds, and years of experience in the classroom was also displayed. Table 2 displays the outcomes of the investigation.

Table 2: Background Information of the Respondents

Variables	Category	Frequency	Percent(%)
Age	20- 29	32	26.2
	30 – 39	59	48.4
	40+	3I	25.4
Gender	Male	111	91.0
	Female	11	9.0
Years of teaching experience	Less than 5years	43	35.2
	5 -9years	44	36.1
	Above 10 years	35	28.7
Academic Qualification	HND	3	2.5
	BSC	61	50.0
	B ED	48	39.3
	MSC	1	0.80
	M ED	9	7.4

Source: Okine (2022), Field Survey

Table 2 shows the teachers' age range. The findings show that most of the teachers (n=59, 48.4%) were between the ages of 30 and 39, followed by 32 teachers (26.0%), who were likewise between the ages of 20 and 29. Additionally, the results indicated that 31(25.4%) of the remaining teachers were aged 40 years and above. From these results, it can be inferred that most of the teachers who responded to the study were within the aged of 30-39years of age, who according to the World Health Classification of Youth shows that these, teachers are in their middle age, implying that there are a lot of youthful teachers in selected senior high schools.

Additionally, out of the 122 teachers who responded to the survey items on the questionnaire, it was revealed that 111(91%) of them were male teachers, whereas the remaining 11(9.0%) were female counterparts. This indicates that there were more male mathematics teachers than female teachers. This rather supports the assertion that mathematics is male-dominated.

Teachers' academic qualification was also attained; from Table 2, it was revealed that most of the teachers (n=61, 50.0%), in terms of their highest educational background, had obtained a bachelor's degree in science. More importantly, it was also revealed that aside from most of the teachers in selected schools having BSC, several numbers of them (n=48, 38.5%) have also obtained their bachelor's degree in education. Notwithstanding, 7.4% of the teachers have acquired a master's degree in education, while 2.5% of the remaining teachers have received the highest national diploma. These results depict that almost all the teachers who teach at the selected schools have obtained suitable professional qualifications.

Teachers' number of years in teaching was ascertained. It was noticed that most of the teachers (n=44, 36.2%) have teaching experience ranging from 5- 9 years, followed by (n=43, 35.2%) of the teachers with a teaching experience of less than 5 years. Moreover, the results revealed that the remaining (n= 35, 28.7%) teachers also have teaching experience ranging from 10 years and above. These results can be concluded that several teachers within the selected senior schools have teaching experience ranging from five to nine years. This number of years in teaching could significantly influence their instructional beliefs and practices, as Sawyer (2014) revealed that teachers' personal experiences, past schooling experiences, teaching experiences and teacher education experiences influence their beliefs and instructional practices.

Beliefs about Mathematics

In this section, the results on mathematics teachers' beliefs about mathematics were presented. The discussion was guided by the research question one stated as follows:

This research question aimed to discover the type of beliefs senior high school mathematics teachers held about the nature of mathematics teaching and learning. The statistical tools used to ascertain these teachers' beliefs were means and standard deviations. The four-point Likert-type scale responses were scored from 1 to 4. This ranged from strongly disagree (1) to strongly agree (4). The criterion means score for teachers' beliefs was 2.5. Therefore, any teacher's belief response with a mean score higher than the criterion determination means teachers agree to those beliefs; also, a mean score lower than the criterion cut-off point indicates that teachers disagree with those beliefs.

Table 3: Beliefs about the nature of mathematics

Item	Statement	SA %	A %	D %	SD %	**M**	**SD.**
5	Mathematics involves creativity and new ideas that can be tried independently	5.7	58.2	1.6	34.4	3.25	.64
6	Mathematics is given a body of knowledge and standard procedures	36.9	51.6	5.7	5.7	3.19	.79
7	Mathematics problems can be solved in many ways	61.5	32	3.3	3.3	3.51	.72
8	Mathematics is a way of thinking	54.1	42.6	1.6	1.6	3.49	.62
9	Mathematics involves problem-solving, figure out relationships and patterns.	67.2	28.7	3.3	.8	3.59	.68

Source: Okine (2022) Field Survey

Results from Table 3 showed that majority (58.2%) of the respondents agreed that the nature of mathematics involved creativity and application new ideas. Also, almost 90% of the respondents held the belief that mathematics is a body of knowledge and standard procedures. Similarly, more than 90% of the respondents believed mathematics problems could be solved in a variety of ways. More than 95% of the respondents viewed mathematics as problem solving and a way of thinking that involved building relationships and patterns. The high proportions and the item means implied that the SHS mathematics teaching held positive beliefs about the nature of mathematics. Also, the high standard deviations indicated high variability in responses to items.

Table 4: Beliefs about teaching mathematics.

Item	Statement	SA %	A %	D %	SD %	Mean	Std.
10	Students should be allowed to think independently about mathematics problems before the teacher shows them how to solve them.	41.8	46.7	6.6	4.9	3.23	.823
11	Mathematics is a creative subject in which the teacher should take a facilitating role allowing students to create their concepts and methods.	48.4	43.4	3.3	4.9	3.4	.729
12	Mathematics is an interconnected body of ideas that the teacher and the students create together through discussions	52.5	41.8	3.3	2.5	3.43	.704
13	Teachers' role is to guide students rather than telling students what they should do.	50	45.9	1.6	2.5	3.44	.630
14	Teachers provide manipulative materials for students to explore mathematical ideas and concepts themselves	41.8	50.8	3.3	4.1	3.31	.705

Source: Okine (2022) Field Survey

Table 4 is a continuity of beliefs held by mathematics teachers. These statements solicited their beliefs about the teaching of mathematics. Results in Table 4 indicated that mathematics teachers' beliefs about teaching mathematics are high. Most teachers 57 representing 46.7% agreed that "Students should be allowed to think independently about mathematics problems before the teacher shows how to solve them," while 51(41.8%) strongly supported the assertion given a mean of $(M = 3.25, SD = .823)$. It was further observed that in terms

of if "Teachers provide manipulative materials for students to explore mathematical ideas and concepts themselves." most 59(48.4%) of the respondents strongly agreed, with 53(43.4%) supporting the statement. Only 10(11.5%) did not agree with the assertion, given a $(M = 3.31, SD = .705)$. In addition, the respondent was asked if the "Teachers' role is to guide students rather than telling students what they should do." It was revealed that most 50% of the respondents strongly agreed, 56(45.9%) agreed, only 3(2.5%) strongly disagreed while the least 2(1.6%) disagreed given a $(M = 3.44, SD = .630)$. The last statement asked respondents if "Teachers provide manipulative materials for students to explore mathematical ideas and concepts themselves" it was indicated that 62(50.8%) agreed that "yes, they do," 51 respondents representing 41.8%, strongly agreed, while only 9 respondents disagreed given $(M = 3.31, SD = .705)$. As a result, it can be inferred that math teachers strongly believe in the subject since their answers reflect these beliefs.

Table 5: Beliefs about learning mathematics

Item	**STATEMENTS**	***N***	*M*	*SD*
15	Students learn by actively constructing their knowledge	122	3.22	.665
16	Students learn actively by finding solutions independently of mathematical problems provided by the teacher	122	3.16	.742
17	Every student can be successful at learning mathematics	122	3.03	.926
18	Learning is enhanced when students explain and demonstrate their solutions to others.	122	3.43	.629
19	Students learn best by discovering approaches for solving mathematical problems themselves	122	3.41	.702

Source: Okine (2022) Field Survey

Table 5 reveals mathematics teachers' beliefs regarding how mathematics is learned. It is clear from the statistics in Table 5 that teachers

have strong beliefs about how students should learn mathematics. For instance, several teachers (*M*=3.41, *SD*=.629) agree that "Learning is enhanced when students explain and demonstrate their solutions to others." This was followed by (*M*=3.41, *SD*=.702) of the teachers who also agreed with the assertion that "Students learn best by discovering approaches for solving mathematical problems themselves." Unarguably, teachers have high beliefs about mathematics teaching, as the results in Table 5 are true reflections of their beliefs.

Tables 3, 4, and 5 presented the various constructs about senior high school mathematics teachers' beliefs about the nature of mathematics, mathematics teaching, and mathematics learning, respectively. It can be inferred that teachers' beliefs about mathematics involve problem-solving and figuring out relationships and patterns; mathematics problems can be solved in many ways, pointing out teachers' beliefs about the nature of mathematics. Additionally, teachers' belief that their roles are to guilds students rather than tell them what to do. Teachers hold that mathematics is a body of concepts developed jointly by themselves and their students. Many teachers follow the constructivist ideology, which holds that students learn mathematics best when given responsibility for their education and opportunities to explore their ideas and methods.

Teachers that subscribe to the constructivist view of mathematics education believe that students learn best when they solve problems independently and then explain and demonstrate their methods to other pupils. As a result, the researcher of this study concludes that mathematics teachers at the high school level share the constructivist perspective on these issues. These current study findings align with the findings of (Peña-López, 2009), whose

research found that letting students work in collaborative groups, share their knowledge, and provide convincing justifications for their answers all linked to an increase in students' ability to generate novel approaches to familiar problems. The results are consistent with the research of Beswick (2006) which was cited by Yarkwah (2020), whose beliefs survey questionnaire on teachers' beliefs stipulated that mathematics is a way of thinking, mathematics involves problem-solving, and mathematics is constructivist mathematical beliefs when it comes to the nature of mathematics.

The findings also confirm Huinker (2018) statement that teaching mathematics should focus on developing an understanding of concepts and procedures through problem-solving, reasoning, and discourse, which are constructivist mathematical beliefs in classroom learning. These findings imply that senior high school mathematics teachers believe that students can construct their knowledge, and as a result, their role is to engage students in tasks that promote reasoning.

Instructional Practices

In this section, results on mathematics teachers' self-reported instructional practices and their observed practices were presented. The discussion was guided by the second research question.

The main aim of this research question was to ascertain the instructional practices enacted by senior high school mathematics teachers in their classrooms. To analyse the information on instructional practices, the mean and standard deviation were employed. The criterion means score (established mean cut-off point) for teachers' instructional practices was 3.0. To obtain the test value as a criterion measure, the response on the five-point Likert scale was scored from 1 to 5 (mean scores of any teacher instructional practice higher than

3.0) depict teachers making use of a constructivist approach to teaching and learning, and a mean score lower than 3.0 implies teachers use of constructivist teaching and learning approach. The researcher quantified the observational checklist to add value to the question under investigation.

Table 6: Instructional practice of teachers in the mathematics classroom

Item	**STATEMENTS**	N	M	SD
20	I state specific, measurable, achievable, and relevant lesson objectives.	122	4.2459	.81628
21	I summarise core points for all activities which relate to lesson objectives in my lesson notes preparations.	122	4.0984	.72054
22	I provide varied activities that are sequential and logical to direct students learning.	122	4.1230	.76685
23	I state appropriate TLAs and indicate when and how to use it.	122	3.9016	.95701
24	Indicate adequate subject knowledge linked to lesson objectives.	122	4.2869	.70978
25	I introduce a lessons in a way to stimulate students understanding	122	4.3934	.74476
26	I speak audible to the hearing of the class	122	4.5328	.71795
27	I distribute questions to students evenly in the lesson.	122	4.4098	.73579
28	I use chalkboard effectively	122	4.3279	.96589
29	I use teaching and learning resources to help facilitate learning	122	4.0820	.80894
30	I use appropriate language to communicate to students	122	4.3934	.72223
31	I encourage maximum student participation in the lesson.	122	4.3689	.76278
32	I exhibit command on the subject matter	122	4.3852	.79717
33	I use a lot of assessment techniques to assess students understanding	122	4.2459	.68407
34	I end the lesson by using questions and answers to clarify the main points in the lesson.	122	4.3033	.74843
35	I encourage cooperative learning	122	4.3115	.68130
36	I manage students conduct effectively during instructional periods	122	4.2705	.80327
37	I maintain students' attention throughout the lesson.	122	4.4590	.76220
38	I keep records about students for reference.	122	4.3770	.77489
Overall mean			4.543	.608

Source: Okine (2022), field data.

Table 6 shows the instructional practices enacted by Senior high school teachers in their mathematics classrooms. The results show that teachers had a mean score in their instructional practices. For instance, it was noticed that teachers state-specific, measurable, achievable, and relevant lesson objectives (*M*=4.2459, *SD*=.81628). Notwithstanding, it was also revealed that teachers summarize core points for all activities related to lesson objectives in my lesson notes preparations (*M*=4.0984, *SD*=72054) and end the lesson by using questions and answers to clarify the main points in the lesson (*M*=4.3033, *SD*=74843). Teachers that adhere to the content-focus philosophy think that their students should be able to replicate the information they have been taught. These educators place a premium on their students' successful completion of coursework and achievement of high test scores (Voss et al., 2013).

Besides, a low mean score was recorded in the statement; I state TLRs and indicate when to use it (M=3.9, SD=4.0). The results indicated that teachers encourage maximum student participation in the lesson, manage students conduct effectively during instructional periods, and encourage maximum student participation. These instructional practices teachers use in mathematics are deemed reflectively as a constructivist approach.

The researcher further observed the mathematics teachers to know whether their instructional practices reflected their beliefs about the learning and teaching nature of mathematics using the observation checklist, which was analysed quantitatively. It was revealed that teachers' belief about the learning and teaching of mathematics significantly influences their instructional practices, indicating that participants are clear about their instructional practices and teaching approaches regarding the connection between beliefs about the nature, teaching, and learning of mathematics. Most of the teachers observed

adopted the use of teaching-learning resources and invited questions and responses from the learners.

Table 7: Summary model of Teachers Instructional Practices

Observed items	M	SD
Record keeping and attitude to teaching	3.9669	.68232
Teacher behaviour	4.1405	.63647
Objectives /indicators	4.1967	.79917
Summaries/core points	3.9339	.77175
Subjective and pedagogies knowledge	4.1240	.69005
Introduction to the lesson	4.0909	.80623
Questions and feedback	4.0744	.73218
Use of chalkboard	4.0083	.72452
The use of teaching and learning resources (TLRs)	3.8099	.69898
Communication /use of language	4.0331	.65744
Students' participation	3.9752	.72414
Master of subject matter	4.2562	.70153
Assessment of students learning	3.8843	.64795
Closure	3.9256	.66037
Management of the learning /environment	4.0165	.64528

Source: Okine (2022), field data

The results indicated in Table 7 shows that teachers are subjective in their pedagogical knowledge, have mastery of the subject matter, and use the appropriate teaching and learning resources in teaching students. Teachers assess students learning and manage students learning. The observation result indicates that teachers' beliefs are linked with their instructional practices. The conviction is that teachers adopt the constructivist teaching approach in their

practices. The conviction is that teachers mostly use varied instructional methods and formal assessments in the learning environment. The findings contradict earlier results from Assuah et al. (2016), who indicate that teachers habitually do not involve their pupils during constructive assessment strategies. They proposed that the teachers' inability to frequently implement constructivist instructional strategies could be due to their inadequate pedagogical knowledge. They also stated that it could also be due to the teachers' inability to have expert and experienced teachers who would expose them to constructivist instructional strategies. They postulated that teachers never gave pupils appropriate feedback during an assessment because they did not explain why they selected some answer choices. This signifies that though teachers agree that constructivist learning theory effectively improves teaching and learning, teachers do not fully use it in teaching. Therefore, this study concludes that most senior High school teachers are not construed by a single method of teaching mathematics but several methods of teaching which truly reflect their beliefs about the teaching and learning of mathematics.

This implies that there are other factors that affect teachers' instructional practice. It can be inferred from the average mean of means scores (M = 4.5) obtained from instructional practice that teachers often use the constructivist teaching approach in their instructional practices. This is in line with Yarkwah (2020) findings, which state that teachers believe in a constructivist teaching and learning approach. However, they do not make optimal use of it, and there are limited resources to support this approach to teaching. Topping (2017) reported that factors such as discussion, feedback, formative assessment, and meta-cognition strategies, such as asking students to plan, organizing, and monitor their learning within the free environment, are key factors when it

comes to having effective teaching practice which conforms to findings of this present study. Hence teachers teaching practices are aligned with the constructivist teaching approach but cannot fully utilise them when it comes to its implementation. Werang, Leba and Pure's (2017) study revealed that inadequate teaching and learning resources are some of the factors affecting effective teaching and learning. Mirzajani, Mahmud, Fauzi Mohd Ayub and Wong (2016) stipulated that classrooms lacked adequate textbooks and teaching resources. The findings suggest that teachers persistently practice constructivist teaching and learning approaches in their instructional lessons that they could not make use of due to limited resources.

Relationship Between Beliefs and Instructional Practices

This section presents the results and discussion on the relationship between SHS mathematics teachers' beliefs about mathematics and their instructional practices. The discussion was guided by the first research hypothesis.

Hypothesis One sought to investigate the relationship between mathematics teachers' beliefs about mathematics (M = 3.26, SD = .46) and their self-reported instructional practice (M = 4.29, SD = .41). The Pearson product-moment correlation coefficient was used to assess the strength and direction of the relationship between the two variables. The results are summarised in Table 8.

Table 8: Relationship between teachers' beliefs about mathematics and their instructional practices

Variable	Mean	SD	1	2
1. Beliefs about mathematics	3.26	.46		.461**
2. Instructional practices	4.29	.41	.461**	

R^2 = .212 N = 122 **p < .01

Source: Okine (2022), field data

In Table 8, the results showed that the Pearson product-moment correlation coefficient between teachers' beliefs and their instructional practices in mathematics at the senior high school level was moderately positive and statistically significant (r = .461, p < .05). The coefficient of determination shows that the two variables shared about 21% of the variance. This means that their beliefs about mathematics can account for 21% of the variation in mathematics teachers' instructional practices. The findings in the current study contradict the findings of Ampadu (2014), who observed that mathematics teachers' beliefs and classroom practices are inconsistent with what they practice. In Ampadu's view, teachers attest to the importance of the constructivist approach to teaching and learning mathematics, which underpins the new curriculum, however, its implementation was problematic. The findings of this study aligned that of Kul and Celik (2017) who found that a consistent association between teachers' beliefs about learning mathematics and teaching practice.

Gender Difference in Teacher's Beliefs about Mathematics

This section presented the results of the hypothesis test on mean difference of mathematics teachers' beliefs about mathematics based on gender. It was guided by the second research hypothesis.

Research Hypothesis Two was formulated to ascertain whether gender difference was significant in mathematics teachers' beliefs about mathematics. The teachers' beliefs about mathematics were the dependent variable while gender was used as the grouping variable. Questionnaire responses on mathematics teachers' beliefs about the nature, teaching, and learning of mathematics were aggregated and used to determine the gender difference.

An independent sample t-test was conducted at 5% significance level. The result was presented in Table 9.

Table 9: Gender Difference in Teachers' Beliefs About Mathematics

Variable	Gender	N	M	SD	t	df	p
Beliefs about mathematics	Male	111	3.23	.46	1.527	14.8	.52
	Female	11	3.45	.31			

Source: Okine (2022), field data.

From the results in Table 9, it was observed that the beliefs held by female teachers (M = 3.45; SD = .31) were higher than that of the male teachers (M = 3.23, SD = .46). The results of the independent sample t-test produced a p-value of .52 hence I failed to reject the null hypothesis and concluded that the mean difference in male and female mathematics beliefs was not statistically significant.

The current study findings are compatible with the findings of de-Kraker-Pauw et al. (2016), whose study postulated that teacher characteristics of gender were not associated with gender-related beliefs of teachers. However, the findings contradict that of Throndsen and Turmo (2012) who found that beliefs regarding teaching mathematics differed among male and female teachers.

Relationship between Teaching Experience and Instructional Practices

In this section, the correlational statistics between the years of teaching experience and the instructional practices of SHS mathematics teachers were presented. This was based on the third research hypothesis.

This research hypothesis sought to test the significance of a possible relationship between the years of working experience and their instructional practices. The questionnaire results for teachers' self-reported instructional practices and years of teaching experience were correlated using Pearson product moment correlation (*r*). The correlational results were presented in Table 10.

Table 10: Relationship between teaching experience and instructional practices

Variable	Mean	SD	1	2
1. Years of working experience	1.93	.80		.103
2. Instructional practices	4.29	.41	.103	

R^2= .011 N=122 **p = .129

Source: Okine (2022), field data.

The Pearson product momentum correlation (*r*) results in Table 10 showed a positively weak correlation between teachers' years of teaching experience and instructional practice in teaching mathematics (r = .103, p > .05). The coefficient of determination (R^2 = .011) showed that only 1.1% variance was shared between the two variables. This means that senior high school mathematics teachers' years of teaching experience could explain only about 1.1% of the variance in their instructional practices. However, this relationship was statistically not significant at 5% alpha level.

Chapter Summary

In this study, mathematics teachers' beliefs about the nature, teaching, and learning of mathematics were positive. This means that the SHS mathematics teachers held positive beliefs that related to constructivists approaches in mathematics. Also, a statistically significant moderately positive relationship was found between teachers' beliefs about mathematics and their instructional practices. The research also found no statistically significant difference in the beliefs of male and female teachers toward mathematics instruction. Lastly, years of teaching experience and instructional practices were not significantly correlated. It was revealed that teachers' belief about the learning and teaching of mathematics significantly influences their instructional practices irrespective of their gender. These findings indicate that the mathematics teachers were clear about their instructional practices and teaching approaches regarding the connection between beliefs about the nature, teaching, and learning of mathematics. These findings further revealed that teachers embrace constructivist beliefs about teaching mathematics since they believe that mathematics is a creative topic, and the teacher should support students in generating their concepts and procedures.

CHAPTER FIVE

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

The focus of the study was to examine the beliefs and instructional practices of mathematics teachers in the selected senior high schools in the Western Region. The instructional practices enacted by senior high school mathematics and the relationship between teachers' beliefs and instructional practices were also explained. The research method adopted for the study was a quantitative research method embedded with a descriptive survey design. The sample comprised 122 mathematics teachers including 111 males and 11 female teachers from selected senior high schools in Western Region. A questionnaire and an observational checklist were used for data collection. Data gathered from the respondents were analysed using Pearson Correlation coefficient, means and percentages, and independent samples t-test. The results were presented with respect to the objectives of the study.

Summary of the Key Findings

1. The study revealed that SHS mathematics teachers associate themselves with constructivist beliefs about mathematics' nature, teaching, and learning.
2. The study also revealed that SHS mathematics teachers enacted constructivist teaching and learning approaches. These enacted instructional practices aligned with the requirements of the mathematics curriculum which emphasise the use of learner-centered pedagogy.
3. The findings of the study revealed that the correlation between the beliefs held by mathematics teachers and their enacted instructional practices was low positive but statistically significant.

4. The study found no statistically significant gender difference in teachers' beliefs about teaching and learning mathematics. That is, teacher characteristics of gender did not affect their beliefs about mathematics.
5. The study concludes that there is no statistically significant relationship in teachers' years of teaching experience and instructional practices.

Conclusions

The following conclusions were drawn from the findings of the study:

1. SHS mathematics teachers' beliefs about the nature, teaching, and learning of mathematics were positive. The teachers' beliefs aligned to the constructivists beliefs about the teaching and learning of mathematics. These are necessary to facilitate an engaging learning environment to enhance the teaching and learning of mathematics.
2. Also, the SHS mathematics teachers reported that they employed learner-centered pedagogies in their mathematics classes. These self-reported practices were conformed through the observation of all the mathematics teachers. The study has revealed that SHS mathematics teachers enact the constructivist teaching strategies that places the learners at the center of the learning process. The enacted strategies help to engage learners throughout mathematics lessons while giving them the independence to construct their knowledge through experience.
3. The study established that the beliefs SHS mathematics teachers held about the nature, teaching, and learning of mathematics aligned with the instructional practices they enacted in the classroom. The correlation between the two variables was significantly positive but

moderate. The shared variance between beliefs about mathematics and enacted instructional practices was about 21%.

4. Gender difference was not significant among mathematics teachers with respect to their beliefs about mathematics.
5. Lastly, correlation between SHS mathematics teachers' instructional practices and their years of teaching was positive and very weak. This relationship was found to be statistically insignificant.

Recommendations

Based on the findings that evolved from the study, the following recommendations were proposed to curriculum planners, head teachers, and mathematics teachers at the senior high schools.

1. Mathematics teachers should continue to hold more positive beliefs about mathematics' nature, teaching, and learning. They should engage in activities that seek to improve their insights about the nature, teaching, and learning of mathematics.
2. Teachers should be encouraged by head teachers to continuously employ constructivists teaching approaches in their mathematics classrooms. Also, workshops that seek to improve teachers' understanding and practice of constructivist teaching approaches should be organized to support teachers. The associated teaching and learning resources should be provided to enhance teachers' use of constructivists teaching methods.
3. Though the relationship between beliefs and instructional practices was significantly moderate, it being positive imply that an increase in one variable can increase the other. For this reason, it was recommended that teachers engage in workshops that can improve their beliefs about the

nature, teaching, and learning of mathematics as this can positively influence their use and practice of learner-centred instructional practices.

4. The findings of the study showed that gender difference was not apparent among mathematics teachers' beliefs about mathematics. Hence it is recommended that despite being the minority female mathematics teachers should be encouraged and guided to espouse positive beliefs and engage in constructivist instructional practices. This would promote gender equality in the teaching of mathematics.
5. Lastly, it was recommended that mathematics workshops organised by heads and the educational directorate should focus on all mathematics teachers irrespective of years of teaching experience. Given that no significant correlation existed between teachers' instructional practices and years of teaching, future workshops should be critical in supporting these diverse minds and experiences to appreciate the use of constructivist instructional approaches.

Suggestions for Further Research

Further studies can be carried out to:

1. Examine factors that influence mathematics teachers' beliefs and their instructional practices.
2. Examine the influence of teachers' instructional practices on their beliefs about learning and teaching of mathematics in other settings within Ghana.
3. Examine how demographic characteristics of teachers (gender, age, year of working experience) moderate the relationship between SHS mathematics teachers' beliefs and their instructional practices.

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APPENDICES

APPENDIX A

UNIVERSITY OF CAPE COAST

COLLEGE OF EDUCATION STUDIES

DEPARTMENT OF MATHEMATICS AND ICT EDUCATION

QUESTIONNAIRE

INTRODUCTION

My name is Joseph, Adu Okine, an Mhil. Mathematics Education student at the University of Cape Coast, Ghana. I am researching the topic: senior high school mathematics teachers' beliefs and instructional practices in five districts in the Western Region, which is the chosen area for the study. Your candid responses to this questionnaire are very valuable and will be appreciated.

Your response will be treated as confidential and used for research only. This study's findings will help improve senior high school mathematics teachers' beliefs and instructional practices. Thank you for taking the time to complete this questionnaire.

SECTION A

DEMOGRAPHICAL CHARACTERISTICS OF RESPONDENTS

Please put a tick (√) where suitable in the box corresponding to your choice for each of the items.

1. **Gender**
    a. Male [ ]
    b. Female [ ]
2. **AGE**
    a. 20- 29years [ ]
    b. 30-39years [ ]
    c. 40 years and above [ ]

3. **Years of teaching experiences**

   a. less than 5 years [ ]

   b. 5 – 9 years [ ]

   c. above 10 years [ ]

4. **Academic qualifications.**

   Diploma [ ] HND [ ] BSC [ ] B.ed [ ]

   MSC [ ] M.ed [ ] Phd [ ]

SECTION B: BELIEFS ABOUT MATHEMATICS

This section provides statements on beliefs about the nature, teaching, and learning of mathematics. Please indicate your opinion by ticking (√) the options as your level of agreement with the following statements.

1-Strongly disagree 2-Disagree 3-Agree 4-Strongly agree."

Beliefs about the nature of mathematics

N/S	STATEMENTS	1	2	3	4
5	"Mathematics involves creativity				
6	Mathematics is given a body of knowledge and standard procedures				
7	Mathematics problems can be solved in many ways				
8	Mathematics is a way of thinking				
9	Mathematics involves problem-solving".				

B. Beliefs about teaching mathematics.

S/N	STATEMENTS	1	2	3	4
10	Students should be allowed to think independently about mathematics problems before the teacher shows how to solve them				
11	Mathematics is a creative subject in which the teacher should take a facilitating role allowing students to create their concepts and methods.				
12	Mathematics is an interconnected body of ideas that the teacher and the students create together through discussions.				
13	Teacher's role is to guide students rather than telling students what they should do.				
14	Teacher's provide manipulative materials for students to explore mathematical ideas and concepts themselves				

C. Beliefs about learning mathematics

S/N	STATEMENTS	1	2	3	4
15	Students learn by actively constructing their knowledge				
16	Students learn actively through finding solutions independently of mathematical problems provided by the teacher				

17	Every student can be successful at learning mathematics				
18	Learning is enhanced when students explain and demonstrate their solutions to others.				
19	Students learn best by discovering approaches for solving mathematical problems themselves.				

SECTION C: INSTRUCTIONAL PRACTICES

This section elicits information about senior high school mathematics teachers' instructional practices enacted during instructional lessons.

Please tick (√) the appropriate box to indicate your options on these statements.

1-Never 3-Sometimes 5-Always

2-Rarely 4-Very often

S/N	STATEMENTS	1	2	3	4	5
20	I state-specific, measurable, achievable, and relevant lesson objectives					
21	I summarise core points for all activities which relate to lesson objectives					
22	I provide varied activities that are sequential and logical to direct students learning					
23	I state appropriate TLAs and indicate when and how to use them.					

24	Indicate adequate subject knowledge linked to lesson objectives.					
25	I introduce a lesson in a way to stimulate students understanding					
26	I speak clearly for the entire class to hear					
27	I distribute questions to students evenly in the lesson					
28	I use chalkboard effectively					
29	I use teaching and learning resource to help facilitate learning					
30	I use appropriate language to communicate to students					
31	I encourage maximum student participation in the lesson.					
32	I exhibit command on the subject matter					
33	I use a lot of assessment techniques to assess students understanding					
34	I end lesson by using questions and answers to clarify main points in the lesson.					
35	I encourage cooperative learning					

36	I encourage class in setting good behavior expectation					
37	I maintain students' attention throughout the lesson.					
38	I keep records about students for references.					

APPENDIX B

Observational checklist Adopted from the University of Cape Coast College of Education Studies Teaching Practice

Assessment Form A (2021)

ITEM		SCORES				
		LESSON PLAN				
		5= V. GOOD	4= GOOD	3=SATISFACTORY	2= UNSATISFACTORY	0/1= POOR
1. Objectives/ Indicators ☐		Teacher's state-specific, relevant, measurable and achievable objectives that are linked to classroom activities	Teachers state specific relevant, measurable, and achievable objectives but not linked to classroom activities	Teacher states specific relevant and measurable objectives but they are not achievable within the duration of the lesson.	Teacher states specific objectives that are relevant but not measurable or achievable.	Teacher states lesson objectives they are relevant but not specific measurable or achievable.
2. Summaries /core points ☐		Teachers state summaries -core points for all	Teacher state summaries / core points for	Teacher states summaries/ core point for all activities which	Teachers' states summaries / core points for some activities related	Teacher states summaries/ core points for

		activities which relate to lesson objectives and clarify main skills/ concepts	all objectives which are related to and clarify main skills and / or concept	which are related to main skills and concept without clarifying them	some of the main skills and concepts.	activities, but they are not related to main skills and / or concepts.
3. Teaching and learning activities ☐		Teachers provide varied teacher/learner activities that are logical, sequenced and direct student learning within that approximate time indicated.	Teacher/ learner activities are not varied but sequenced, logical and approximate time indicated	Teacher/ learner activities have approximate time indicated and are sequential but not logical.	Teacher/ learner activities have approximate time indicated but are not sequenced or logical.	Teacher/learner activities are not sequential or logical, and no time is indicated.

4. TLRs 		Teacher states appropriate and varied TLRs and indicate when and how they will be used in the lesson	Teacher states appropriate TLRs and indicates when and how they will be used in the lesson	Teachers states appropriate TLRs, and indicate when they will be used in the lesson	Teachers states TLRs and when they will be used in the lesson, but they are not appropriate	Teachers states TLRs which are not appropriate, and does not indicate when to and how they will be used in the lesson.
5. Subject and pedagogies knowledge 		Teacher's shows adequate and up to date subject knowledge linked to objective(s); provides subjects-specific –	Teachers shows adequate and up-to date subject knowledge linked to objectives, provides general techniques that	Teachers shows adequate knowledge, but does not provide appropriate techniques to facilitate students understanding.	Teacher shows adequate subject knowledge but indicate appropriate techniques to facilitate students, understanding.	Teachers shows inadequate and often outdated subject knowledge and does not indicate techniques that facilitate

		techniques that facilitate students' understanding.	facilitate students' understanding.			students understanding.
6. Introduction to the lesson		Teacher introduces the lesson, reviews students RPK, Link it up with topic and stimulates student's interest. teacher shares lesson objectives with students	Teachers introduces the lesson, reviews students RPK, link it up with topic are stimulated students interest; lesson objectives are not shared	Teachers introduce the lesson, review students RPK and link it up with topic	Teacher introduce the lesson and reviews students' RPK	Teacher merely introduces the lesson by stating the topic.

7. Presentation – teaching and learning activities 		Teacher organizers teaching are learning activities sequentially, logically, uses varied pedagogical skills, and maintains balance between teacher and students' activities.	Teaching and learning activities are organized, sequential and logical, Teacher uses varied pedagogical skills	Teaching and learning activities are organized sequential and logical.	Teaching and learning activities are organized and sequential	Teaching and learning activities are disorganized

8. Pace of lesson and Audibility of voice ☐		Pace is appropriate for the entire lesson and all students can hear the teacher clearly teacher dose not shout	Pace is appropriate most of the time and voice is audible from the back of the class. Teacher does not shout	Pace is appropriate some of the time and voice is audible from the back of the class throughout the lesson	Pace is appropriate some of the time but voice is not audible from the back of the class throughout the lesson	Pace of the lesson is not appropriate Teacher speaks too fast/ too slow/ too loud/ too low
9. Questions and feedback ☐		Teacher asked well balanced mixture of factual, probing, high order & divergent questions, distribute questions fairly	Teacher asks a mixture of factual probing high order and divergent questions, distributes question fairly, encourage	Teacher asks a mixture of factual and high order question distributes question fairly, but does not encourage students question and answers.	Teacher asks mostly factual questions; he/she is receptive to students question and answers and acknowledge students answers	Teachers asks only factual questions, he / she is not receptive to student questions and answers.

		always encourages students question and answers	students questions and answers most of the time.			
10. Use of chalkboard		Teacher manages board effectively; date, subjects and topic are written on the board; writing is legible gives students time to write down core points into the books,	Teacher manages board effectively; date, subject and topic are written on the board; all core points are systematically written on the board; writing legible, gives students time to	Teacher manages board effectively date, subject and topic are written on the board, core points are systematically written on the board writing is legible.	Teacher manages board effectively date, subject and topic are written on the board core points are systematically written on the board, writing is not legible	Teacher writes haphazardly on the board or hardly written anything on the board

		cleans board at the end of lesson	write down core points into their books			
11. Use of teaching and learning resources (TLRs)		Teacher uses appropriate TRLs, and links them to students previous knowledge and lesson objective (s) at key stage/s of the lesson	Teacher uses appropriate TLRs links them to students previous knowledge and lesson objective (s)	Teacher uses appropriate TLRs links them to students previous knowledge	Teachers uses appropriate TLRs but does not links them to students previous knowledge	Teacher does not have TLRs or does not use TLRs brought to the class
12. Communication / use of language		Teacher uses correct expressions, correct students language errors,	Teachers uses correct grammatical expression, corrects students	Teacher uses correct grammatical expressions, corrects students language errors: occasionally	Teachers uses correct grammatical expression but does not correct students grammatically incorrect expression	Teachers uses incorrect grammatical expression and often exhibits

		encourages to pay attention to their use of language, uses effective verbal & non-verbal communication avoids language mannerism	language errors, uses effective verbal & non-verbal communication, avoids language mannerism	exhibits language mannerism	exhibits some language mannerism	language mannerism
13. Student participation		Teachers engages all students in their lesson, facilitates problem solving among students encourages	Teachers engages all students in the lesson facilitate problem solving among students encourage cooperatives	Teacher engage all students in the lesson; facilitates problem solving among students, monitors progress and provide feedback	Teacher engages some students in the lesson; does not monitors progress effectively, feedback to students minimal	Students participation in the lesson is low; there is virtually no monitoring and feedback.

		cooperative peer-tutoring and reflective learning monitors progress and provide feedback.	learning monitors progress and provide feedback			
14. Masterly of subject matter 		Teacher exhibits command of subject matter, gives precise information; exudes confidence, cities lots of examples relates	Teachers has command of subject matter; gives precise information, exudes confidence; cities lots of examples relates	Teachers has command of subject matter; gives precise information; exudes confidence; cites lots of examples	Teacher has some command of subject matter gives relevant information; cites some examples	Teachers exhibits inaccurate subject matter knowledge and low level of confidence

		content to students experience fosters critical thinking	content to students experience			
15. Assessment of student learning		Teachers uses a variety of assessment techniques to determine understanding assessment are linked to objectives and timely he/she encourages students self-	Teacher uses a variety of assessment techniques to check understanding, encourages students' self-assessment of understanding and application of learning	Teacher uses a variety of assessment techniques to check understanding encourage student self-assessment of understanding	Teacher uses only one assessment method or tool (eg oral questioning, written exercise one-minute test etc) to check understanding. Assessment is linked to objective/ s	Teacher uses only one assessment method or tool (eg. oral questioning, written exercise, one-minute test etc) to check understanding. assessment is

		assessment and application of learning				not linked to objective(s)
16. Closure		Teacher draws attention to end of the lesson; uses question & answer, summary, practice to clarify main points along lesson objectives, gives & marks written exercise to evaluate learning	Teacher sues questions & answer, summary, practice to clarify main points along lesson objectives, gives & marks written exercise to evaluate learning	Teacher uses question and answer, summary and or practice to end the lesson objective(s)	Teacher uses questions and answer, summary and or practice to end the lesson	Teacher finishes lesson abruptly at the sound of the bell finishes lesson well ahead of times

		assign activity for next lesson				
17. Management of the learning /environment		Teacher establishes a purposeful learning environment; interacts with students; uses student ideas encourages cooperative learning and	Teacher establishes a purposeful learning environment, interacts with students uses student ideas and monitors student learning	Teacher establishes a learning environment that is purposeful and monitors student learning	Teacher establishes a learning environment and interaction with students are purposeful	Teacher establishes a learning environment but interaction with students are not direct towards learning

		monitors student learning activities				
18. management of students behaviour		Teacher establishes clear parameters for student conduct, develops appropriate strategies for preventing problems deals with misbehaviour promptly he/ She is fair, firm but friendly	Teacher establishes clear parameters for students conduct, develops appropriate strategies for preventing problems, deals with misbehaviour promptly	Teacher establishes clear parameters for studies conduct, develops appropriate strategies for preventing problems, is tardy in dealing with behaviour	Teacher establishes clear parameters for student clear parameter for students conduct and develops appropriate strategies for preventing problems	Teacher does not establish any clear parameter for student conduct.

PROFESSSIONAL COMMITMENT						
19. Teacher behavior 		Teacher shows enthusiasm in teaching maintains students attention throughout the lesson, is creative and innovative, exhibits decorum in speech and behaviour and is smartly dressed	Teacher shows enthusiasm in teaching maintains students attention in the lesson model polite classroom behavior and is creative and innovative	Teacher shows enthusiasm in teaching; focuses student's attention on the lesson and models polite classroom behavior.	Teacher shows evidence of enthusiasm in teaching and focused student attention on the lesson.	Teacher does no shows evidence of enthusiasm in teaching and is unconcerned about the direction of student attention

20. Record keeping and attitude to teaching ☐		Teacher keeps records or lessons in a bound notebook for reference, accepts constructive feedback to improve teaching, reflects on teaching, shows a positive attitude towards teaching	Teacher keeps records for lessons in a bound notebook for reference; accepts constructive feedback to improve teaching; reflects on teaching in REMARKS	Teacher keeps records of lessons in a bound notebook for reference and accepts constructive feedback to improve teaching	Teacher keeps records of a lesson on sheets of paper	Teacher has no record of the previous lesson; the current lesson plan is on some sheets of paper

APPENDIX C

IRB CLEARANCE LETTER

UNIVERSITY OF CAPE COAST
INSTITUTIONAL REVIEW BOARD SECRETARIAT
TEL: 0558093143 / 0508878309
E-MAIL: irb@ucc.edu.gh
OUR REF: UCC/IRB/A/2016/1503
YOUR REF:
OMB NO: 0990-0279
IORG #: IORG0009096

11TH OCTOBER, 2022

Mr. Joseph Adu Okine
Department of Mathematics and ICT Education
University of Cape Coast

Dear Mr. Okine,

ETHICAL CLEARANCE – ID (UCCIRB/CES/2022/29)

The University of Cape Coast Institutional Review Board (UCCIRB) has granted Provisional Approval for the implementation of your research **Relationship between Senior High School Mathematics Teachers' Beliefs and Instructional Practice in Selected Schools in Western Region.** This approval is valid from 11th October, 2022 to 10th October, 2023. You may apply for a renewal subject to submission of all the required documents that will be prescribed by the UCCIRB.

Please note that any modification to the project must be submitted to the UCCIRB for review and approval before its implementation. You are required to submit periodic review of the protocol to the Board and a final full review to the UCCIRB on completion of the research. The UCCIRB may observe or cause to be observed procedures and records of the research during and after implementation.

You are also required to report all serious adverse events related to this study to the UCCIRB within seven days verbally and fourteen days in writing.

Always quote the protocol identification number in all future correspondence with us in relation to this protocol.

Yours faithfully,

Kofi Fosu Amuquandoh
Ag. UCCIRB Administrator

ADMINISTRATOR
INSTITUTIONAL REVIEW BOARD
UNIVERSITY OF CAPE COAST