UNIVERSITY OF EDUCATION, WINNEBA

USE OF DIFFERENTIATED INSTRUCTION AMONG CENTRAL REGION SENIOR HIGH SCHOOL MATHEMATICS TEACHERS

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A thesis in the Department of Mathematics Education, Faculty Science Education, submitted to the School of Graduate Studies, in partial fulfilment of the requirements for the award of the degree of Master of Philosophy (Mathematics Education) in the University of Education, Winneba

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DECLARATION

Student's Declaration

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

Signature: ……

Date: ……..…….…….

Supervisor's Declaration

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

Prof. Charles K. Assuah (Principal Supervisor)

Signature: ……

Date: ……..…….…….

DEDICATION

To my lovely wife Mrs Vida Animle and my children Prospera Animle, Prosperous Animle and Prosperity Animle , the last but not the least is my mother Miss Mercy Yaa Deku.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

DI	Differentiating Instruction
EFA	Education For All
FCUBE	Free Universal Basic Universal Education
GSFP	Ghana School Feeding Programme
MDGs	Millennium Development Goals
NALAP	National Literacy Accelerated Programme
RPK	Relevant Previous Knowledge
SHS	Senior High SChool
SPIPS	School Monitoring and Improvement Plans
SPSS	Statistical Package for Social Sciences

ABSTRACT

The study explored the extent to which Senior High School (SHS) mathematics teachers use Differentiated Instruction (DI). The study employed a mixed research methodology design that uses a explanatory sequential approach. 128 SHS mathematics teachers in the Central region of Ghana were selected for the study using a stratified sampling technique. In the qualitative phase of the study, a maximum variation sampling strategy was used to select eight mathematics teachers. After a careful review of appropriate literature, self-administered questionnaires were used as the instrument to collect data to answer the questions set for this study for the quantitative phase. At the qualitative stage of the study, the researcher conducted semi-structured interviews. The study's findings demonstrated that SHS mathematics teachers' knowledge of DI was high. The result of the study indicated that training in DI seems to be the best predictor of the use of DI compared to age, teaching experience, training in DI, the value of DI, administrative support, class size, workload, and planning. It was recommended to reduce the teacher-to-student ratios in schools to improve the SHS mathematics teachers ability to personalize instruction to meet the individual learning needs in the classroom.

KEYWORDS: Differentiated Instruction ,Mathematics, Senior High School, Teachers, Knowledge.

CHAPTER ONE

INTRODUCTION

1.0 Overview

The chapter discusses the background to the study, the statement of the problem, purpose of the study, objectives, research questions, limitations of the study, the operational difficulties and organization of the study.

1.1 Background to the Study

In the learning characteristics and behaviour, any group of students would likely show significant variation. Learning differences become even more pronounced when students with learning disabilities or other learning disorders are included. Teachers today must engage in a wide range of activities in their classes due to the various learning features demonstrated by students today. The study sought to explore how Differentiated Instruction (DI) is being used by Senior High School (SHS) mathematics teachers.

Students' learning must adapt to the most appropriate educational approach, curricula, and an enabling environment to exhibit knowledge gained through the instructional process (Shaffer & Thomas-Brown 2015). Differentiating Instruction (DI) means having multiple learning paths to access the most effective learning experiences commensurate with students learning ability Teachers must ensure that all students meet the demands for the objectives of education. Teachers can address the students' needs by using DI approaches to help them meet and fulfil their expectations (Taylor, 2015). The purpose is to choose appropriate teaching methods to meet each student's needs (Tam, 2015). Differentiation is a teaching method in which teachers adapt to the different needs of individual learners and small groups of learners,

adapting and changing their teaching methods to ensure analytical processes used in academic success and data-based decision-making to maximise student learning opportunities within the classroom (Mulder, 2014).

DI is ideal for any educational system and is particularly suitable for students with different learning abilities. Students can handle their needs, levels of education, styles of learning, and interests in a range of ways. DI allows students from different contexts, with different abilities, to show what they learn and understand each individual's importance and value (Lindsey & Nagel, 2015). Tomlinson (1999) invented DI based primarily on the concept of Howard Gardner in brain-compatible research of multiple intelligences and literature. Teachers have been encouraged to recognise and differentiate educational practices in specific student styles by distinguishing content, process, and product, thereby contributing to the different learning styles students enjoy.

DI provides strategies, materials, learning experiences, and student products to meet each students' and small groups' individual needs so that each student in a classroom can optimise their learning opportunities (Hillier, 2011). DI refers to a teaching philosophy and a constructive approach to teaching different students through funded and heterogeneous assessment environments (Tomlinson, 2014; Suprayogi, 2017). Each student's learning characteristics differ significantly. The standard educational classroom profile has significantly increased student capacity, motivation, race, socioeconomic status, and the diversity of languages (Farooq, Chaudhry, Shaexpfiq & Berhanu, 2011). All factors that generate classroom diversity and motivate all students to achieve excellence create an appropriate educational need for all learners.

Several researchers and professionals are urging the need to adapt classrooms to the differences between students. For example, Barkley and Major (2020) emphasised that schools adapt to students' needs and levels of development instead of expecting them to adapt to systems that do not meet their learning needs. Different schools of thought believe that in general education, the teacher must provide differentiated instruction. Regarding students with disabilities, Riley-Tillman, Burns, and Kilgus (2020), state that teaching that recognises the needs of learners with disabilities is good instruction for all. With academically talented students, Meyer and Cranmore (2020) states that: "Differentiating instruction in response to the need of the students is a more defensible method than marking and separating the 'talented' learners" (p6).

After realising the best learning for students, teachers should discern the following: product, process, content, and environment of learning (Tomlinson & Imbeau, 2010; Watts-Taffe, Laster, Broach, Marinak, McDonald Connor & Walker-Dalhouse, 2012; Tobin & Tippett, 2013; Tomlinson, 2015). The content is taught by teachers and students are expected to learn (Tomlinson, 2005; 2010). The process involves teachers teaching and students learning and understanding facts, concepts, or competencies (Tomlinson, 2015). Product means what students learn, understand, and do based on their research on particular subjects (Bender, 2012; Tomlinson, 2015). Finally, the learning environment-physical and psychological-emphasises how safe and stimulating the classroom feels and functions (Santangelo & Tomlinson, 2012).

Tomlinson and Imbeau (2010) assume that DI is based on the following assumptions: (a) students vary in their ability to learn, interest, study styles, and life experiences; (b) variations are significant enough to affect what students learn, how fast they learn and how helpful teachers are to students; (C) learning is best done

when students can link their curriculum with interests or lives. Teachers realise that students must learn from these requirements and respond proactively to them with the increasingly common guiding principles. Teachers, however, have a different understanding of the nature of DI, which consists of part of teaching and variations in learning (Tomlinson, 2015). Teachers' beliefs can also be linked to their instructional strategies (Watts-Taffe, Laster, Broach, Marinak, McDonald Connor & Walker-Dalhouse, 2012; Freedman, 2015). Effective differentiation is based on the concept of understanding and evaluation of the student's individual needs. They act primarily based on their conduct (Santangelo & Tomlinson, 2012). Training for teachers also influences their perspectives, behaviour and belief in DI (Wan, 2017).

It is not clear that DI is appropriately implemented in high schools (Darrow 2013). The problem could be that the traditional teachers' condition is continuity with many factors, which tend to maintain things the way they have always been done. Often there is little room for change, particularly if forced from the outside. This allows teachers to adapt as little as possible to the changes. According to Fullan (2007), local features and external factors influence the collective application of DI. A number of studies have found that not all teaching repertoire includes skills needed for differentiated learning (Deunk & Doolaard 2013; Doolaard & Harms 2013). While assessment data are common to schools, teachers do not yet know how to obtain and use data to monitor advancement and may be unable to distinguish among the curriculla (what to teach, for example, requires more advanced materials for highly skilled children) (Santangelo & Tomlinson 2012; Doolaard & Harms 2013). Consequently, in practice, the differentiated teaching skills of senior high school teachers must be improved.

Local features include the district, the community, teachers, and school administrators. Fullan and Stiegelbauer (1991) assert that "the network of local schools represents one great set of situational constraints or incentives for meaningful reform". One obstacle to adoption is that schools are keeping a 'cautionary mentality' (Le Fevre, 2014). For example, teachers may fear the loss of control, as with differing teaching, children can adopt a more in-depth approach in their learning activities. The perceived risk of uncertainty could give a conservative stimulus and a need to safeguard current phenomena. For teachers and the school level in general, there can also be solid convictions and can serve as obstacles for improvements in teacher instructional practices (Le Fevre, 2014). Teachers in Ghana sometimes resist changes in educational practices, for example (e.g Buabeng-Andoh & Totimeh 2012). It is assumed that the highly competent learners in the classroom are not challenged (Doolaard & Harms 2013). Therefore, local factors like school culture and teachers' expectations might hinder the application of DI. Also, the government and other departments are external considerations. There are also contradictory educational requirements for some external parties (Luttenberg, van Veen & Imants 2013). They are equalising children's needs-as in DI conflicts, focusing on existing curricula (Engel, Claessens & Finch 2013). Teachers have a sense of insecurity and perplexity when dealing with numerous competing objectives (Le Fevre, 2014).

While DI has a broad range of learning interests, most schools worldwide look the same as ten years ago, and many teachers worldwide do not feel adequately trained to meet the complex demands of students today (Schleicher 2016). Differentiation is crucial to the willingness of teachers as a method to satisfy the needs of all students (Maxey 2013). In contrast, in terms of teaching experience, Santangelo and Tomlinson (2012) suggest that the expectations of teachers and

learners are low. Other researchers (Tobin & Tippett, 2013; Chien 2015) have also pointed out that teachers from various countries face growing challenges in tackling the diverse needs of students in their classroom because teachers have no knowledge on DI or competency and do not understand the importance of this approach (Santangelo & Tomlinson, 2012).

The variations in DI on teacher perception could also be attributable to insufficient teacher training in universities and colleges and the lack of training on DI directing professional development for teachers already operating in the field (Merawi, 2018). This could lead to many schools having teachers' unprepared and less alert for such a diverse school body. The literature does not provide a guide to proving how teachers see differentiation based on professional education or experience (Watts-Taffe, Laster, Broach, Marinak, McDonald Connor & Dalhouse, 2012). How teachers view DI and what they make of that information is also unclear (Maddox, 2015). In addition, teachers lack a broad understanding of how DI myths in public school systems are consistently addressed and how diversity is addressed (Watts-Taffe, Laster, Broach, Marinak, McDonald Connor & Walker-Dalhouse, 2012). The same authors explain that the differentiation in the classroom is little known. Reseachers report differentiation in the teachers' knowledge and perceptions, but do not provide specific information on their performance (Maddox, 2015; Watts-Taffe, Laster, Broach, Marinak, McDonald Connor & Walker-Dalhouse, 2012).

Discussing the diversity of learners appears daunting with all of the above issues. Nonetheless, professional teachers who have the expertise and the vigour to practice DI are strongly requested to resolve the learners' learning differences. To this end, the importance of using effective instructional strategies for quality education has been emphasised by local researchers (Agbenyega & Klibthong, 2015; Abora, 2015;

Kuyini, Yeboah, Das, Alhassan & Mangope, 2016; Shareefa, 2020) and policy documents (Ministry of Education, 2015). Despite such political support, however, in many schools in Ghana, various students learn the same lesson using the 'one-size-fits-all' method, whereby the same educational material is applied to each student (Melesse, 2015).

According to Melesse (2015), there is little evidence of active student learning, research processes, creativity, and logical thinking. This could be because of Ghanaian teachers' insufficient understanding and skills in the course of their training (Agbenyega, 2015), or because of teachers' lack of commitment and interest in their profession (Shareefa 2020). Different research studies also concluded that the quality of the teachers, in particular at the primary level (both in terms of knowledge, attitude, and skill), must be reviewed and that reforms in existing elementary school teacher training programmes must be called for (Yalew, Getachew & Tadesse, 2014; Worknehmen & Tasew, 2013; Merawi, 2018).

Shareefa (2020) further observed that teachers' knowledge, involvement, and perception in the Ghanaian context has not been substantially investigated in addressing student learning diversity. As reported by Stewart (2016), teachers may have completely different expectations in the same educational circumstances and therefore have different reactions; in addition, during the workshops, teachers' understanding of DI and the need to address the differences between the students have been observed to be varying and frequently contradictory.

1.2 Statement of the Problem

A traditional Ghanaian Senior High School (SHS) classroom is often mixed ability educational set-up. Students consist of low, moderate, and advanced learners. To meet all these students' diverse needs, it is essential to make many adjustments to

promote the comprehension of everyone so as not to disadvantage any category of students. Different instructional approaches must be implemented to serve the needs of all abilities in the classroom. Teachers find it challenging to teach or change teaching approaches in a regular classroom to meet the various learners' needs (Kuyini, 2013; Agbenyega & Klibthong, 2015; Abora, 2015; Kuyini, Yeboah, Das, Alhassan & Mangope, 2016; Shareefa, 2020). This implies that a category of learners would probably be excluded from participating actively in the teaching and learning process.

Kuyini, Yeboah, Das, Alhassan, and Mangope (2016), reveal little or no educational adaptability in teachers' classrooms to help children with learning disabilities. Agbenyega (2011) further found that teachers are prescriptive, static, and mechanistic and do not respect different learning styles in a daily classroom in Ghana. Again, a study by Kuyini (2013) showed that most street kids in Accra drop out of school because their learning needs do not match the instructional strategies. Studies (Yeboah, Das, Alhassan & Mangope, 2016; Shareefa, 2020) have also demonstrated that teachers can not satisfy the varied educational requirements of students, which is why students suffer from achievement. Several researchers and professional organisations have advocated the need for classroom adaption to DI. The National Association for Young Children's Education (Pianta & LaParo, 2000) stressed, for example, that, rather than expecting students to adapt to a system that does not meet their needs, schools have a responsibility to adapt to their developmental needs and the level of the students they serve. The assumption from different contexts is that the mathematics teacher will have to use differentiated teaching.

All students are not the same. Consequently, not all students learn the same thing. By recognising that students have different background knowledge, learning

differences, and readiness to learn, the importance of knowing and understanding their interests and academic needs has been brought to light. These ideas motivated the researcher to explore the potential factors affecting the use of differentiated instruction by SHS mathematics teachers.

1.3 Purpose of the Study

The study aimed to explore the extent to which Senior High School (SHS) mathematics teachers use Differentiated Instruction (DI) and factors that influence it. This will help the Mathematics teacher prepare lessons tailoring to meet each student's individual interests, needs and strengths. Teaching this way gives students choice and flexibility in how they learn, and helps teachers personalize learning.

1.4 Research Objectives

The objectives of the study were to determine:

1. SHS mathematics teachers level of knowledge on differentiated instruction.
2. Factors influencing the use of differentiated instruction in the mathematics classroom.
3. The relationship between teacher characteristics and the use of differentiated instruction.
4. The relationship between institutional characteristics and the use of differentiated instruction.

1.5 Research Questions

The following research questions were answered in the study.

1. What is SHS mathematics teachers' level of knowledge on differentiated instruction?

2. What factors influence the use of differentiated instruction by mathematics teachers?
3. Does Teacher characteristics have influence the use of differentiated instruction
4. Does Institutional characteristics have influence on the use of differentiated instruction?

1.6 Research Hypothesis

The following hypothesis was based on research questions 1 and 2 were tested in the research.

1. $H_0 1$: There is no relationship between teacher characteristics and the use of differentiated instruction.
2. $H_0 2$: There is no relationship between institutional characteristics and the use of differentiated instruction.

1.7 Significance of the Study

The study would complement existing literature by examining the extent to which differentiated instruction occurs in secondary education, using a sample of Senior High School (SHS) mathematics teachers, and determining what factors increase the probability or hinder the utilisation of differentiated instructional strategies. Factors related to the use of DI would contribute to the effective implementation of educational practice at the SHS level. The study will provide information that would enhance how mathematics teachers are trained in differentiated instructional strategies and how school administration and educational stakeholders can support DI.

The study results would guide administrators and trainers of teachers to be more effective in implementing effective professional development that encourages the use of DI. With DI, it would clarify the perspectives of SHS mathematics teachers. A careful study and analysis of these variables could provide promising methods for teachers to improve the use of DI. The information can be used by training programs to prepare teachers for the effective utilisation of differentiation. Policymakers and school administration can use the information for more efficient educational practice.

1.8 Delimitations

The study was delimited to only the public SHS in the Central region, and the outcome might be different if private SHS were included. Moreover, the participants who took part in the study were teaching in SHS in the Central region of Ghana, and the outcome might be different from participants in SHS from a different region.

1.9 Limitations

The results of this study were expected not to be generalised to all SHS mathematics teachers in Ghana, as the respondents involved in the study were mathematics teachers in the Central region of Ghana. The population was selected base on easy accessibility due to time constraints and limited financial resources that the researcher anticipated. Respondents might have over estimated or under estimated their responses.

1.10 Definition of Terms

Differentiated Instruction: It provides a way to ensure that the extent, interests, and chosen mode of instruction are compatible with what a student learns, how they learn, and how they demonstrate what they learn.

Mixed Ability Class: It comprises students comprising regular, high and low achievers and learning difficulties.

Teaching Strategy: It is the way the content is presented to the students.

Senior High School: A school between junior high school and tertiary that usually offers general, technical, vocational curricula.

Public Schools: Schools that receive proper government support primarily recruit teachers and provide additional teaching and learning resources.

*Learning***:** It is the knowledge/skills acquired through experience, study, or being taught.

Rural areas : Rural areas are areas with population less than 2500 which are less developed in terms of infrastructures.

Rural areas :Urban areas are areas with population at least 50000 which are well developed in terms of infrastructures.

1.11 The Organisation of the Study

Five chapters were organised in the study. The first chapter deals with the study context, description of the issue, study goals, research problems, study significance, delimitations, interpretation of terms, and the structure of the study. The study reviews the existing literature in the second chapter. The review is mainly linked to the fundamental concept of the DI. The design and methodology of the study are outlined in Chapter three. Data analysis and discussion of results from data analysis was part of Chapter four. The summary, conclusion, and recommendations arising from the study were given in the fifth and final chapters.

CHAPTER TWO

LITERATURE REVIEW

2.0 Overview

A review of related literature was addressed in this chapter to help establish a focus and better direction for this research. In view of this, the researcher discussed teachers' knowledge of the use of Differentiated Instruction (DI) and factors that influence its use. The structure of the literature review is outlined as follows; Theoretical framework, Conceptual Framework, Provision of Quality Education in Ghana, Concept of Differentiated Instruction, Elements of Differentiated Instruction, Teachers Knowledge of Differentiated Instruction, Factors that influence Differentiated Instruction, Empirical Review, Philosophical Foundations of Differentiated Instruction and Summary.

2.1 Theoretical Framework

Several popular educational theories provide a basis for using DI. However, the major ones that support it most are Gardner's theory of Multiple Intelligences (MI) and Vygotsky's Zone of Proximal Development [ZPD] (Lounder, 2011).

The Theory of Multiple Intelligences

In 1983, Howard Gardner published Frames of Mind, introducing his Multiple Intelligences (M1) theory. Gardner argues that human cognitive competence is best defined as a collection of abilities, gifts, or mental skills, which he refers to as intelligence (Gardner, 2006). According to the MI theory, intelligence is viewed as a "pluralistic view of the mind", which buys from the idea that a learner's mind consists of several bits of intelligence (Gardner, 2006). These MIs, or pluralistic views of the

mind, account for the various ways in which people think, read, and act, and each is linked to a particular part of the brain (Gardner, 2003).

The MI theory projects that every learner is intelligent in one way or the other. It also confirms that each learner has different strengths and limitations in different areas of intelligence. Gardner defines intelligence as a person's ability to process and apply information to construct something or solve a problem. He projected the existence of seven different bits of intelligence when he first introduced the MI theory. Spatial intelligence, linguistic intelligence, logical-mathematical intelligence, bodily-kinesthetic intelligence, musical intelligence, intrapersonal intelligence, and interpersonal intelligence are all examples. He later added eighth and ninth intelligence, the natural and existential intelligence, respectively (Gardner, 2009). Gardner (2006) argues that everyone has and uses all nine bits of intelligence, and that they all function together in an average individual, even though one intelligence might be stronger than the other. Individuals' genetic and cultural origins, on the other hand, have an impact on how they use and grow intelligence preferences. According to Gangi (2011), using MI to teach students' strengths has many advantages, including meeting learners' learning needs and engaging them, leading to higher learner achievement. Gardner (2003; 2005; 2006; 2009) explains the various intelligence of his MI theory:

Linguistic Intelligence

Linguistic intelligence is the ability of a learner to understand spoken and written language. Linguistic intelligence learners value books and demonstrate their strengths through using words, reading, storytelling, tape recording, brainstorming, journal writing, debates, giving, and publishing.

Logical-mathematical Intelligence

The ability to grasp the logic and numeric operations is referred to as logical-mathematical knowledge. Learners with this intellect strength enjoy analytical analysis tasks, such as estimates, quantifications, and classifications.

Spatial Intelligence

The ability to imagine what is spoken, read, or written and manipulate such visualizations is spatial intelligence. Learners who have a high level of spatial intelligence learn better by creating a mental or physical image that helps them grasp new knowledge. Drawing, using maps, and solving puzzles are all activities that help these students show their abilities.

Bodily-Kinesthetic Intelligence

The capacity to learn by movement and solve problems with the entire or sections of the body is known as bodily-kinesthetic intelligence. Hand-eye coordination is outstanding in students with this intellect. Role-playing, building, playing games, sports, and other hands-on activities are among the activities in which these students excel.

Musical Intelligence

The ability to develop, perform, and appreciate music is known as musical intelligence. Learners with this intellectual ability have a firm grasp of musical principles and learn effectively through songs, rhythms, chants, and poetry.

Interpersonal Intelligence

Intelligent learners are known as interpersonal intelligence learners, and it means knowing people. Via peer sharing, cooperative groups, board games, and simulations, they have a good sense of community and function well with others.

Intrapersonal Intelligence

Learners with intrapersonal knowledge can comprehend themselves. This intellect ability is correlated with a good sense of self and a preference for working alone. By working alone, setting goals, meditating, and deciding which task to complete, they are in contact with their own emotions and are excellent at the reflection.

Naturalistic Intelligence

The ability to distinguish and sort out objects or phenomena in nature is known as naturalistic intelligence. This intellect strength's students enjoy being outside, exploring, and learning about plants and other natural phenomena.

Existential Intelligence

The ability to understand the larger picture and why things or individuals happen is known as existential intelligence. This intellect strength allows students to think about why and how things happen. They consider and discuss questions with no apparent answers, consider how variables interact, and assess how concepts are related to one another.

Gardner notes that employing MI in instruction requires developing several educational strategies based on how an individual thinks to ensure that every particular learner is offered the utmost opportunity to learn, grow and succeed.

The Theory of Zone of Proximal Development

According to Vygotsky, is the gap between learners' present actual development level, as defined by independent problem-solving, and their emerging or potential level of development (Beheshti, Bowler, Large & Nesset, 2000). It contrasts

what a learner can do after obtaining assistance and what he can do on his own (Rezaee & Azizi, 2012).

According to Schutz (2004), the ZPD is the difference between what a learner has already mastered, their current level of growth, and what they may do with encouragement or future development. The ZPD theory's primary purpose is to illustrate the discrepancy between a learner's ability to solve problems independently and the substantial importance of that ability when given the required assistance. The developmental stage refers to all of the tasks that a child will complete independently. What the child can do in partnership today will be able to do individually tomorrow, according to ZPD (Kozulin, Gindis, Ageyev, & Miller, 2003). Assessment, curriculum scaffolding, the learning process, flexible classification, and learner preference are essential concepts in the ZPD theory (Miller, 2002). In the ZPD theory, evaluation is crucial for assessing readiness and scaffolding content (Whipple, 2012). Teachers' knowledge of ZPD helps them assess their learners and provide content-rich instructions at each learner's level.

Collaboration in ZPD Assessment

Learners' ZPD is tested during training by contact or cooperation with them because it allows for imitation, which is the way of recognizing maturing psychological functions that are still insufficient for independent success (Shabani, Khatib & Ebadi, 2010). According to Vygotsky (1998), incorporating the concept of cooperation into the students aids the teacher in determining their mental maturation, which is crucial to their success.

Scaffolding in ZPD

In further development, the central concept underpinning Vygotsky's ZPD theory is 'scaffolding'. Studies (Daniels, 2001; Shabani et al., 2010) project that the

foundation of scaffolding is a socio-cultural theory of mind and the idea of ZPD. A scaffolding curriculum, which supports a learner needs to make progress, is also a crucial aspect of Vygotsky's theory of ZPD (Whipple, 2012). It is a method in which students deal with learning tasks with the assistance of a teacher, a parent, a caretaker, a language tutor, a peer, or someone else who has already mastered that role (Rezaee & Azizi, 2012). Any person who possesses the capability of scaffolding a learner can be termed as a 'Significant Other' or a More Knowledgeable Other'. According to Rezaee and Azizi (2012), the assistance of others in the scaffolding process is significant and relevant for a child's growth in the ZPD. Vygotsky claims that if a more experienced person collaborates with a child, the child will continue to learn and develop dramatically (Whipple, 2012). In my view, scaffolding is more like supporting concrete with wooden boards (as in building) and leaving it to dry into one solid mass that can stand firmly on its own before the wooden boards are entirely removed. In this sense, scaffolding entails a more knowledgeable other giving gradual support to a learner and redrawing gradually and totally at last as the learner becomes capable of dealing with the task at hand. In scaffolding, the learning environment and tasks should be aptly challenging, and levels of teacher intervention should be adjusted in response to learner needs (Whipple, 2012). According to Whipple, essential aspects of ZPD include the teacher's flexibility, presenting options, and allowing for imagination. All these are the very basis upon which DI is also built.

Differentiated Instruction in MI and ZPD

The MI and ZPD theories have several similar ideologies and assertions that are tantamount to differentiation principles and practices. First of all, individual learner variance, diversity, difference and uniqueness that are the very basis upon which the DI concept is built are also projected by the MI and the ZPD theories. Both

theories propound that individual learner in the same classroom are different and, as such, should not be expected to learn in the same way. For instance, Gardner (2006) argues that human cognitive competence is best defined as a collection of abilities, gifts, or mental skills, which he refers to as intelligence. In the same vein, Vygotsky (1998) recognizes this individuality of learners and asserts that each learner might have their instructional levels, readiness levels for learning, and developmental levels. All these are supported by Tomlinson's (2001) view that DI is a powerful tool for addressing learner variability, differences, diversity and uniqueness. Several DI studies (Marzano, 1992; Tomlinson, 2000; Marzano, Pickering, & Pollock, 2001) even reveal that educational approaches that ignore learner diversities, differences and Variation among students is likely to hinder students from achieving their full potential.

In another development, the theories of MI and ZPD frown on the use of 'teach to the middle' approaches to instruction and advocate for giving appropriate individualised support to learners per their learning needs. As the ZPD suggests flexibility, variation, creativity and consideration of learner choices in instruction (Whipple, 2012), the MI theory suggests using 'multiple entry points' in presenting each topic or concept during teaching and learning (Gardner, 2006). With this, any subject or idea can be taught in at least seven different ways, each of which corresponds to one of the seven bits of intelligence (Gardner, 2006). To Gardner, when a teacher approaches a lesson differently, learners will be more exposed to the lesson, positively impacting their learning. Similarly, Vygotsky claims that scaffolding being a major teaching and learning strategy of the ZPD theory, should be employed differently or variably depending on the learning needs of the learners (Whipple, 2012). Invariably, what Gardner terms as "multiple representations" which

learners acquire through the process of "multiple entry points" is equivalent to the processes Vygotsky claims awakens a variety of "internal development". In effect, these ideological claims are termed as multiple routes to different learning in DI. Furthermore, DI provides an efficient way to counter learner variation (Tomlinson, 2001), avoids the drawbacks of one-size-fits-all instruction and instructional methods (McBride, 2004), integrates existing research (Tomlinson, 2003), and accommodates a variety of learning styles (Lawrence-Brown, 2004).

As a dynamic instructional tool, DI requires modifying the content, process, product and environment of instruction for learners based on their unique, diverse and differing characteristics (Tomlinson, 1995). This includes providing learners with varying levels of support (Tomlinson & Allan, 2000). The theories of MI and ZPD go side by side with the concept of modifying content, product and process, which is advocated by DI (Renzulli & Renzulli, 2010). Relevant concepts, per the assertions of Miller (2002), which are the basic foundations for the theory of ZPD, are a variety of assessments, a scaffolding of curriculum or content, the process of learning (comprising approaches, methods, techniques and strategies) flexible grouping and learner choice. Asking the right question, the effects on curriculum, teaching, evaluation and the school environment are all suggested effects that can be used using Gardner's multiple entries, multiple representations, and multiple associations (which are the basic concepts of MI) (Williams, 2002).

Another important idea that DI puts across is that learners should be taught through the different instructional processes due to individual differences. Although DI seeks to employ various instructional strategies to teaching, these strategies can be classified under independent and interactive learning. The interactive learning practices, which can involve a learner and their colleagues, a teacher or learning

material, are the basis for building several DI practices. According to Chaiklin (2003), Vygotsky's first concern was establishing a theoretical framework for practical pedagogical approaches, principles for future instructional grouping of learners, and identifying unique interventions for individual learners. Although Vygotsky projects these instruction interventions on diagnostic procedures by considering the learner's current state of development (Shabani et al., 2010), the emphasis is on social interactions and the cooperation of the learner (Miller, 2002). MI researches moreover advocate teaching to learners' strengths using intrapersonal (individualised) as well cooperative (interactive) approaches to instruction (Gardner, 2009). All these points to the direction that the DI concepts of individualised and interactive learning are rooted in the theories of MI and ZPD. Several DI types of research (Callahan, 2001; Heacox, 2002; Powers, 2008; Renzulli & Renzulli, 2010) project the use of independent learning and the need for challenging materials and cooperative practices.

Differentiation of instruction with the modification of its assessment, products or the outcome is grounded in Vygotsky's theory of ZPD and Gardner's MI theory. One of the relevant concepts to the theory of ZPD is assessment (Miller, 2002). In the theory of ZPD, evaluation plays a significant role in determining readiness and scaffolding, according to Whipple (2012). According to Vygotsky's theory, teachers with knowledge of ZPD and assessing learners' readiness level can provide instructions relevant to their learners' progress (Miller, 2002). According to Gangi (2011), learners' intelligence strengths must be assessed and determined in the MI theory through several ways: several inventories, questionnaires, tests, and observation. Williams (2002) claims that Gardner's MI theory on evaluation is justified in that when a lesson is taught using multiple approaches to teaching, it should be evaluated using multiple methods. Variations in DI evaluation, which seeks

to quantify what each learner generates as proof of their learning (Gangi, 2011), demonstrate the learners' ability to bring what they've learned into effect (Tomlinson & Allan, 2000; Heacox, 2002; Levy, 2008). Teachers use the items to determine whether or not students have understood and comprehended the content (Wormeli, 2007). Assessments choices should be given to learners formatively and summatively to show that learning has occurred (Heacox, 2002).

Building upon the theories of ZPD and MI, differentiation of instruction advocates for learning environments that provide optimum conditions for children's learning. This involves several elements in the classroom environment such as rules, procedures, furniture, resources, materials and atmosphere (Tomlinson, 2000). For instance, Williams (2002) asserts that one of the significant aspects of using MI is the school environment. Thus, the MI theory requires the teacher to provide inviting atmospheres that correspond to the multiple intelligences for successful application. Meanwhile, an inviting learning environment such as the quality of teacher-learner interaction is perceived to be very crucial when scaffolding learners in Vygotsky's ZPD theory (Shabani et al., 2010). In Vygotsky's ZPD, being versatile, offering choices, and allowing for innovation are important ways to create an attractive learning atmosphere (Whipple, 2012). In differentiation, the learning environment comprises the physical space and its arrangement (Wormeli, 2007). According to (Gangi 2011), differentiating the classroom environment should provide learners with an inviting atmosphere to learn.

Vygotsky's ZPD learning theory is at the heart of DI's principle of preparation (Hall, 2002). As a result, the idea is that material complexity should be above a learner's current level of mastery to test them (Durrett, 2010).

2.2 Conceptual Framework

According to Ogula (1998), the conceptual framework summarises the study's critical independent and dependent variables and their relationships. The variables used in the objectives were used to conceptualize the analysis. The conceptual framework in Figure 1 shows how mathematics teachers' knowledge of DI, teacher characteristics, institutional characteristics and other factors influence differentiated instruction in the mathematics classroom.

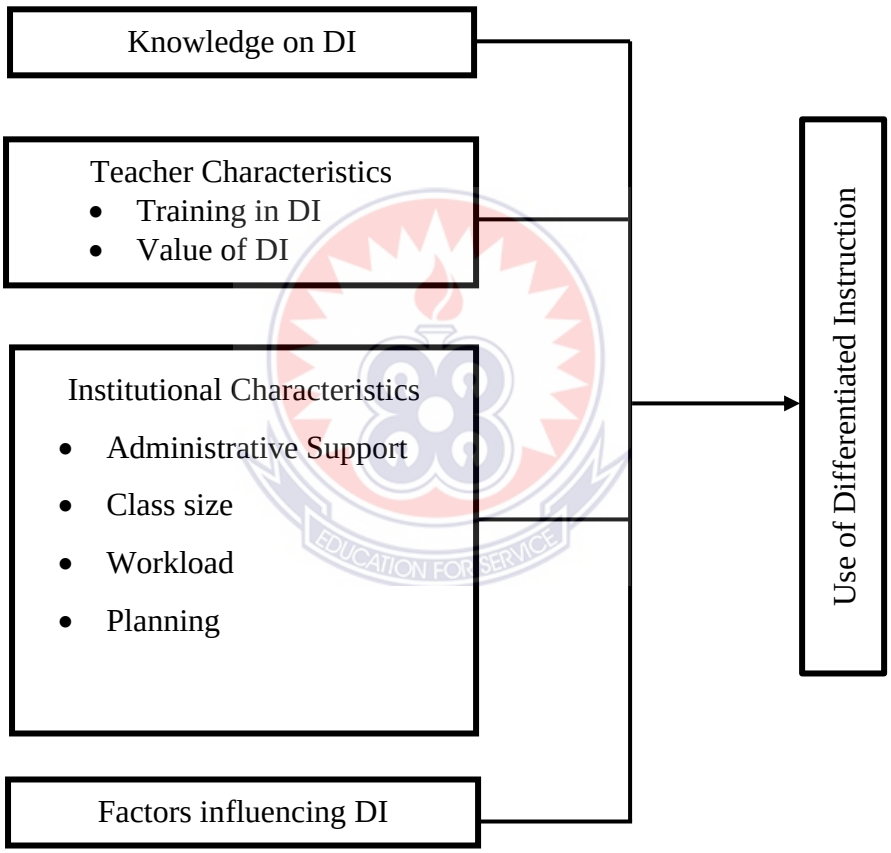

Figure 1: A conceptual framework of the study

Figure 1 shows a conceptual structure for guiding the study process and interpreting data from a theoretical perspective. The conceptual framework indicates the interaction between the dependent and independent variables.

In general, when it comes to the teacher's role in the teaching and learning process, it can be stated that they are the pivots in all educational or academic endeavours of a child's learning. Kauchak and Eggen (2003) report that; teachers are the most critical influence on school learning apart from children themselves. Teachers are probably the most influential facilitators in the teaching/learning process in a regular educational setting. Researches maintain that teachers are professionals searching for knowledge that could inform classroom practice (Kauchak & Eggen, 2003). This pertains that the knowledge a teacher possesses on a professional concept such as DI consequently affects their practices positively or negatively.

Having the requisite knowledge of DI is the first and most crucial step a teacher would need to implement differentiation effectively. Although teachers can employ some ingredients of differentiation in their instructional practices without possessing any aorta of knowledge, those practices may not be as regular and as effective as those who know about it. According to Tomlinson (2010), teachers who are in the best position to differentiate instruction have a strong knowledge of the bases and philosophies of DI.

Since DI is considered the total way teachers think and deal with their learners, the thinking and dealings should be borne of a strong knowledge of DI practices. DI implementation necessitates a thorough understanding of the process, theoretical framework, and methods for putting the theory into practice (Franz, 2009). To not corrupt their learners, teachers might not want to employ practices that they are not conversant with, no matter how beneficial they might think it is to the learners. George (2005) testifies that it deters teachers from using DI if they lack knowledge and inadequate expertise in its use. Moreover, the extent to which teachers know or understand DI is consequential to its implementation, according to Whipple (2012).

This teacher's knowledge factor inevitably influences the learning atmosphere created for student learning institutional characteristics.

2.3 Provision of Quality Education in Ghana

The critical importance of individual education and its importance for national and international development has required agitations for more functional and quality education throughout the world (Ampiah, 2008; Anamuah-Mensah & Ankomah 2010; Adu-Agyem & Osei-Poku, 2012; Opoku-Asare & Siaw, 2015; Amakyi & Ampah-Mensah, 2016; Donkoh, 2016; Pepra-Mensah, 2018; Ankoma-Sey, Nsoh & Quansah, 2019; Demuyakor, 2020). Education in Ghana as a constitutional provision and mandate, according to its global status. On many fronts, the Ghanaian government has led Africa to achieve the Millennium Development Goals (MDGs) in education, particularly improving universal access and equality between the sexes (Casely-Hayford, Seidu, Campbell, Quansah, Gyabaah & Rukayatu, 2013). Over the years, every political leadership in Ghana has continuously prioritised education as a central pillar of social and political life (Casely-Hayford, Quansah, Tetteh, Adams, & Adams, 2011). Therefore, the Ghanaian government was committed to subscribing to and implementing Education for All (EFA) values, particularly Universal Primary Completion, by 2015. Chapter 6 Section 38 Subsection 2 of the Constitution of the Republic of Ghana provides Free Universal Basic Universal Education (FCUBE) for all school children to be enforced by introducing the FCUBE programme (Constitution of the Republic of Ghana, 1992). The key policy goal of the FCUBE programme is to provide free quality education for every child in Ghana (MoE, 1999). In that context, the MoE identified three core goals for the FCUBE curriculum: improving teaching and learning quality, improving the efficiency of the education sector management, and improving access and participation in primary education.

The Government of Ghana in recent times implemented several learning programs and approaches in line with the MDG, as well as the EFA targets, which include; My First Day at School, National Literacy Accelerated Programme (NALAP), The School Monitoring and Improvement Plans (SPIPS), Capitation Grant, Ghana School Feeding Programme (GSFP), Free Senior High School among others. These projects were designed to increase enrolment, attendance and retention, and provide all school children with quality and inclusive fundamental education to comply with the constitutional mandate and international obligations regarding children's right to education. The initiatives also aimed to reduce inequalities in accessing good education, increase productivity in education and learning, increase the standard of education, and make education more critical to modern economic demands. Such kinds of educational initiatives are action frames to tackle and meet all children's different academic needs.

Despite significant efforts and investments for school children to have access to quality education for all, researchers have consistently shown that Ghanaian school children tend to have some of the worst schooling and learning results worldwide (Konadu-Agyemang, 2000; Owusu, Monney, Appiah, & Wilmot, 2010; Casely-Hayford, Quansah, Tetteh, Adams, & Adams, 2011; Chowa, Masa, & Tucker, 2013; Owusu-Acheaw & Larson, 2015). The alliance of NGOs and others interested in education have also expressed concern that, if immediate action is not taken to provide all children quality education (UNICEF Ghana 2013), Ghana is most likely not to meet the targets and objectives of the EFA and MDGs.

However, the emphasis on quality education is based on the fact that children learn essential competencies, particularly in literacy, measurement, and life skills (UNICEF 2010). Moreover, the number of children participating in the school system

and the number of years of schooling alone do not matter as much as the standard of their schooling (UNESCO 2005). The claim is that if children go to school but do not achieve better learning outcomes, especially in literacy, digitalisation and vital skills in life, they have no meaningful access to learning. Unfortunately, policymakers and governments have focused mainly on quantitative rather than the qualitative aspect of Ghanaian education (UNESCO, 2005).

According to UNICEF (2013) report, several others in the Ghanaian classrooms do not have access to education apart from the large number of children remaining outside the school in Ghana. That means that many Ghanaian students are not entitled to high-quality education and are poorly and not equitably handled with regard to their schooling (UNICEF Ghana, 2013). Dorleku (2013) further points to the failure to receive the full benefit of public education for specific groups of children in schools that have had difficulties attaining school achievement throughout the history of public education in Ghana. Shaw (2008) also found that many students with different learning needs are overlooked in a traditional Ghanaian classroom. Furthermore, curriculum inflexibility and emphasis on exams leave little space to address the diversity in learning among students. These confirm that it is essential to make education accessible, but the problem is free to access and meaningful access (Nudzor, 2013).

There is general agreement that good learning can be the only significant factor for enhancing or otherwise the success of learners (Dorleku, 2013). Dorleku reiterates that a child's failure to learn is primarily due to inadequate educational approaches, processes, techniques and strategies and that educational approaches play a central role in or are otherwise significant factors in education reform, progress and effectiveness. Several other research (Palmer & Maag, 2010; Sakyi, 2014; Kumi-

Yeboah, 2020; Bentum, Abdullah, Amponsah & Cudjoe, 2020) affirm that the way children learn is more important to their success or otherwise. In addition, what teachers think, believe and do in the classroom eventually determines how students learn (UNICEF Ghana 2013). Several studies (Kuyini, 2013; Opoku-Asare, Agbenatoe & DeGraft-Johnson, 2014; Kuyini & Abosi, 2014; Yidana, 2018; Boahin, 2019) have shown that Ghanaian schools use one-size-fits solutions and teaching-centred teaching methods. It has also been found that evidence-based research results do not support many approaches to teaching in Ghanaian schools and that many teachers don't clearly understand why, how, where and when such methods are used (Anamuah-Mensah & Ankomah, 2010). Several studies (UNICEF Ghana, 2013; Sakyi 2014; Kumi-Yeboah, 2020; Bentum, Abdullah, Amponsah & Cudjoe, 2020) have shown that diverse students with diverse learning needs in specific classrooms in Ghana are not provided with high-quality instructional delivery and are not equitably regarded with respect in the classroom, as their learning needs are not met (UNICEF Ghana, 2013; Sakyi 2014; Kumi-Yeboah, 2020; Bentum, Abdullah, Amponsah & Cudjoe, 2020).

In reality, students are at risk of school failure due to their differences and diversities in contemporary classrooms (Anderson, 2009). Such classrooms have different groups of students, including disadvantaged, inexperienced, slow and gifted/talented learners with a wide variety of needs and experiences, all of which are to be taught (Anderson, 2009). Imran (2008) supports these factors and recommends that teachers use child-friendly vocabulary, adapt their schools to different learners' needs, and encourage more participatory children centred teacher approaches. Erickson (2006) believes the needs of the various students must be fulfilled. The teachers must implement new teaching strategies that do not teach the middle classes

but address each learner's needs (Franz, 2009). We, therefore, as a country, need to reform what and how children learn.

2.4 Concept of Differentiated Instruction

All suggested methods, activities, tactics, and teaching and learning techniques can be grouped into a single basket called Differentiated Instruction (DI). The DI model in many educational milieus worldwide involves a rethought of the curriculum, management and content, and allows students to engage in this process for the good of everyone (Palmer & Maag, 2010). DI offers a framework to adjust courses and teaching methods to improve each student's academic preparation, interest areas and learning profiles (Tomlinson & Eidson, 2003). According to Launder (2011), DI is the adaptation of a combination of content, process, and product to meet the needs of all students in a classroom, taking into account their interests and learning styles and ensuring their ability to succeed. Gangi (2011) says that DI is a teaching approach that considers the learners' various learning needs through variations of the approaches and materials to accommodate their differences and abilities. DI can also be defined as an approach teachers use to fulfil the academic and behavioural expectations of a diverse community of students in the same classroom environment (Edwards, Carr & Siegal 2006). Pettig (2000) also thinks DI is a realistic approach that challenges teachers to change their classroom practices to improve the education of all students. These DI definitions stress the relevance of equity and fairness in the classroom. This implies that to teach in the middle and wait for every student to understand means that a teacher is most unfair to his students. This reaffirms again the need to address the learner's needs and the need to assist each student in benefiting from learning rather than from teaching curricula and examination needs.

Wormeli (2007) sees DI in another growth in a broader and more assimilated manner. He defines DI as an educational philosophy that incorporates or integrates other strategies. This is supported by Franz (2009), who reiterates that DI incorporates a broad range of educational strategies and techniques used by educators to improve each student's capabilities and offer each student the opportunity to reach his utmost potential and achieve success. Liu, Jones and Sadera (2010) and McBride (2004) also recognise DI as a synthesis of different theories and activities that positively change students' performance. However, Tomlinson (2000) does not view DI as just a technique and method but as a way of thinking about students, teachers, and learning as a whole. The entire DI in this regard refers to the cycle of teachings that are currently employed to tackle the personality of the learners in the classroom (being techniques, processes, technologies and strategies). Following these definitions, the researcher believes it is not an approach, a method, a technique, a strategy or a philosophy that is most relevant in DI, but rather its ability, its intention to maximise the potential of every learner and its tendency to offer them the best learning opportunities.

Only if teachers figure out a way to deal with their students' diversity, equity, and social justice in education will be met (Valiande & Koutselini 2009). Launder (2011) says that diversities in the classrooms demonstrate that teaching practices must give every student a chance to learn. Valiande and Koutselini (2009) say that several investigators and researchers reveal that in contemporary classrooms, the theory and practice of DI is the only solution to the problem of the multiple cultures of learners. In view of the efforts of educational think-tankers in the quest for effective instructional practice that would help educate diverse Ghanaian students, it is perhaps possible that the differentiation of instruction is perhaps the solution.

Several research (Tomlinson, 2001; Anderson, 2007; Franz 2009; Gangi, 2011; Alhassan & Abosi, 2014; Abora, 2015; Nketsia, Saloviita & Gyimah 2016; Kuyini, Yeboah, Das, Alhassan & Mangope, 2016) studies have shown that the use of DI gives both learners and teachers different advantages. DI offers students greater access to the curriculum, more significant comprehension of the content they have been taught and a better learning experience (Franz, 2009). DI helps teachers respond to each learner's learning needs by providing a learning environment suitable to meet their learning styles and interests at their readiness levels (Gangi, 2011). Yet again, DI helps teachers handle learners who have mastered the material of the lesson and can be tested while assessing the readiness level of the learners. Through the DI tools, teachers can challenge the students to learn to their advantage in academic success (Levy, 2008).

DI's motivation-driven design is another significant benefit. Gangi (2011) notes again that DI motivates students to learn more when selecting their learning activities. This will inspire students to learn to the optimal level, according to Anderson (2007). To promote success for disabled students and to increase results for all students, a combination of a differentiated curriculum and student preferences is also desirable (Servilio, 2009). Regardless of how slowly a student learns, whether they can do a task by themselves, they will be naturally inspired and compelled to do more. When teachers use DI, every student with different ability levels improve their understanding of the teaching content and thus create a more productive learning experience (Franz, 2009). In addition, the choices made by students of learning processes that best demonstrate their skills when they participate in DI allow them to take responsibility for themselves. Painter (2009) confirms that learning is becoming more interesting, fun and relevant when students pick their learning activities through

DI. The student-centred nature of DI helps students to be confident and responsible students during their learning.

Teachers can also gain in another jurisdiction from the use of DI in the classroom (Franz, 2009). If DI works, students are autonomous, and teachers can build an exciting and active learning atmosphere and promote students learning, thus reducing the long-term workload of teachers (Franz, 2009). DI enables teachers to teach students how to learn in this regard. It will guide them during their learning activities and encourage them to learn for themselves. This is also consistent with the assertion that stresses the importance of "teaching people how to fish rather than fishing for them". When students have this education, they would not wait for guidance from their teachers before learning and would choose to start their learning and continue it as it was taught them to do so.

DI encourages educators to remediate the unique needs of students and gives them the right opportunity to challenge talented students (Mitchell & Sutherland, 2020). This allows no child to be left behind and prevents frustration in the learning experience (Duckworth, Quinn & Tsukayama, 2012). DI creates positive learning experiences and drastic shifts in the positions of learners and teachers. The role of the instructor shifts to a student's learning facilitator as the students become more autonomous (McCabe & O'Connor, 2014). The teacher who differentiates the teaching takes care of the students by providing an enabling atmosphere of learning and possibilities that do not exclude any child (Osler & Starkey, 2017). DI is chosen due to its efficiency by many countries to train every student in their schools (Kirschner & van Merriënboer, 2013).

In this context, DI includes information on constructivist theory, styles of learning and brain innovations and empirical research into the factors that affect

readiness, motivation, and intelligence to encourage, participate, and develop academically within the school system. (Tomlinson & Allan, 2000). Teachers who differentiate their instruction use best practices to push all their students towards the skills and abilities of the state and local expectations (Gentry, Sallie & Sanders, 2013). Differentiated curriculum is based on student's previous experience and skills and their personal preferences and learning styles (Chamberlin & Powers, 2010) and learning adjusted to their differences (Chapman & King, 2005). Clear learning goals, ongoing and diagnostic assessments which change the educational paradigm and challenging tasks for all students are important features of DI (Chamberlin & Powers, 2010). Changing teaching to rely on the students' desires would possibly lead to greater participation of the students, greater intrinsic motivation, and tremendous success for the students, greater freedom for the students, more outstanding achievement and an enhanced sense of self-competence (Cox, 2008).

2.5 Elements of Differentiated Instruction

In Tomlinson's (2000) report, DI consists of teachers' efforts to respond to differences between students by changing the level of training to meet different learning needs and differences. Tomlinson (2001) suggests that teachers are differentiating lessons when they change the way a lesson is delivered or adjusts the job of a single learner. It is possible to differentiate instruction using different methods, strategies, materials, and examples to re-learn the same lesson (Tomlinson 2001). In other words, any effort made by an instructor to differentiate the teaching to meet the students' learning needs necessitates changing the instruction or materials. A teacher must deal with three student features, which he identifies as readiness, interest, and learning profiles (Gangi, 2011). In addition, Gangi explained readiness to learn as how much context information a student has about a topic widely known as

the Relevant Previous Knowledge (RPK). Learners' interests are the topics the learner should learn and inspire them to participate in learning, while learning profiles consist of how the student learns.

In other instances, researchers and educators have four primary areas where teaching can be differentiated (Tomlinson, 2000; Heacox, 2002; Wormeli, 2007; Cox, 2008; Levy, 2008; Launder, 2011; Bender, 2012). The areas of differentiation include content, process, product and learning environment. Each student's readiness, interest, and learning profile should be indicated in each of these areas of DI (Levy, 2008). According to Cox (2008), the objective is to distinguish every learner in these areas by giving them exactly what they need to increase their academic potential. Although students have different skills, skills and talents in the same school, the objective of DI is to offer all students the opportunity to achieve similar mastery levels on a certain level of content (VanSciver, 2005). Five main components of the DI were given to include the contents, process, product, impact and learning environment (Rojo, 2013; Ogunkunle & Onwunedo, 2014)

Differentiating through Content

The contents are defined as the skills, information, actions, concepts, generalisation, values and attitudes students need to learn in their classroom. (Ogunkunle & Onwunedo, 2014). Gangi (2011) sees what students need to know as content. The material relates historically to the precise nature of the program and the essential elements of the program being communicated to students. In content, the concepts, principles and skills that students should learn are addressed and how they are submitted to the students (Ogunkunle & Onwunedo, 2014). The distinction in a particular classroom is how students access key learning with assignments and goals associated with learning objectives. Many scholars in this area have a sense of what

students are doing, describing goals as content (Tomlinson & Allan, 2000; Heacox, 2002; Wormeli, 2007).

The methods that the students use to access critical content are what teachers can differentiate in content. All students will focus on the same principles, but the degree of sophistication must be adapted to fit different students (Ogunkunle & Onwunedo, 2014). The teacher's content, according to Tomlinson (2001), is focused on learning characteristics. Additional methods for modifying content depend on the degree of willingness, interest and profile of learners (Gangi, 2011). In addition, a teacher can differentiate content in the classroom across a range of resources and texts (Tomlinson, 2001). Teachers may use this approach to scaffold content by providing prerequisite content to some students, allowing for future-oriented students to advance their classes, or even adjusting the quality of those students' educational programs based on their particular needs (Tomlinson & Imbeau, 2010).

Differentiating through Process

The process allows students to understand, apply, learn and make sense of the materials presented (Wormeli, 2007; Levy, 2008). Thus, the process is how students understand and assimilate facts, principles, skills, or even more content (Anderson, 2007). In the process of distinction, teachers focus on innovative sensory research to enable students to appreciate the content by helping them to see the significance and importance of information outside the classroom. The process of differentiating represents a critical stage in DI because students need to function at various levels, with varying assistance, in different classes and learning modes (Tomlinson & Imbeau, 2010). During this process, the teacher allows the students to group flexibly, with under average students using auxiliary material, and the teacher provides additional encouragement and incentive for the students based on their success during

the course. Several other researchers and educators have also echoed the need for practical education approaches and for the critical role of good education practice to help students learn effectively (Imran, 2008; Palmer & Maag, 2010; Sakyi, 2014; Abora 2015)

Differentiating through Products

The products or summative evaluations show what students have learnt. Products offer students opportunities to show what they know, understand, and do in the long run (Tomlinson & Imbeau 2010). To create a purposeful, adequate distinction, which provides the list of options for approaches, choices and frame ways for specific needs, skills and interests in classrooms for various students, pre-and ongoing student preparation and development is necessary (Gangi, 2011). Whilst formal or informal tests are possible, a well-built student product will show different approaches and provide various scoring levels to meet the needs of diverse learners.

Differentiating through Effect and Learning Environment

The learning environment relates to the arrangement of time, resources, space, and the sound of the classroom. Affect takes into account students' mental or affective needs. Another essential aspect of differentiated instruction is the influence of student emotions and feelings on their learning. Students' emotions and feelings are generated by past experiences and responses, self-concept, self-efficacy, desire to learn, and collaboration capacity (Tomlinson & Allan, 2000; Heacox, 2002; Levy, 2008). The disparity between students influences the changes in the learning environment to meet the students' emotional needs. When organising aspects of differentiated instruction, such as inclusive assignments and versatile grouping, teachers should discuss their affective needs.

A learning environment is also a place where DI can be adapted (Launder, 2011). Many elements that include rules, processes, decor, materials, and mood can be changed (Tomlinson, 2000). A differentiated classroom should inspire and encourage students to represent current content, skills and objects (Gangi, 2011). The learning environment refers to the physical space in relation to the structure, according to Wormeli (2007). Wormeli also describes the social and emotional factors affecting learning. Wormeli says that to distinguish between the fields of learning, teachers should tailor their instruction to the needs of a single student or group of students, handling them so that they feel safe, confident and willing in their learning to accept risks.

Various educational approaches can differentiate student preparation, interest and profile elements in the classroom. The following guiding principles for DI should be pursued by such techniques such as group work, tiered exercises, scaffolding and class instruction (Tomlinson, 2003): (1) students are appreciated for activities that focus on the critical material of the lesson; (2) scholastically, students are tested and provided with sufficient resources to enhance learning; (3) class time provides opportunities for flexible grouping, a group working and individual jobs; (4) Assessment are continuous so that differentiation is maintained and responsive to developmental changes; and (5) the curriculum is consistent, significant, encouraging and considerate.

Differentiated Assessment

Assessment is one of the critical components of DI in the classroom (Whipple, 2012). There are a variety of assessment factors that are important for DI directions (Tomlinson & Imbeau, 2010). They involve pre-reviewing the ability of students to change lessons before their schooling, determining learning styles formatively and

summarily, and reviewing them accordingly (Tomlinson & Mbeau, 2010). As teachers assess students in a class, it allows them to decide their ability to understand the content and the next step. This method of assessment of learning helps teachers' measure progress in learner comprehension during teaching so that they can change their pedagogical practices.

2.6 Teachers Knowledge of Differentiated Instruction

According to Tsadidey (2002), "Nothing comes out of a sack except what is in it". Tsadidey's argument is based on the fundamental premise that an instructor who does not understand something cannot, therefore, pass it on to their learners. This means that a teacher who has limited or inextricable knowledge of DI may not use it in his classroom. Teachers who are in the best position to differentiate instruction in their classrooms "operate on strong (and growing) bases of expertise embedded in the theory of what classrooms could be if each learner's skills were maximised" (Tomlinson & Mbeau, 2010). Tomlinson and Mbeau (2010) also see differentiation as not a collection of methods for such teachers but a demographically necessary way of thinking about their work, ethically based, pedagogical, and empirically tested. Teachers are much more likely to incorporate it into their classrooms with DI's proper awareness and effectiveness (Franz, 2009). However, Tomlinson (2005) warns that DI is not a formula to use. It needs a more profound understanding of its methods, theories and forms in which they are applied.

The lack of knowledge and inadequate DI expertise usually prevents teachers from applying DI as an instructional strategy (Franz, 2009). While many teachers regard DI as beneficial to learners, they also believe it is challenging to integrate it into their classrooms (Tomlinson, 2005). Moreover, those who have been sufficiently trained in it are discouraged from doing this. Apart from that, teachers usually do not

receive proper training (Tomlinson et al., 2003). Most teachers feel it takes great effort to introduce contemporary teaching methods, such as DI (Holloway, 2000). It should be remembered that the degree to which teachers understand DI is a consequence of their application and practice (Whipple, 2012). DI is a dynamic term for understanding and applying, as it is considered a philosophy; its application may not be consistent (Whipple, 2012). If it positively impacts student results, the disparity between instructor knowledge/understanding and DI activities must be bridged (Whipple, 2012).

Given the possible advantages of DI on student achievement and whether or not resolving personality differences is feasible in today's comprehensive learning environment, teachers use of approaches is less regular and incoherent (Nedellec, 2015). Teachers often misunderstand the aim of differentiated education, and teachers are reluctant to adopt the strategies. Although this lack of utilisation of DI may lead to many factors, the complexity of the strategies themselves is a significant determinant (Tomlinson, 1999). The diversity of student needs will be balanced by incorporating appropriate and differentiated learning approaches into the lesson while simultaneously meeting the requirements of required curriculum vacancies (Dixon, Yssel, McConnell & Hardin, 2014; Chien, 2015).

Notwithstanding teachers' knowledge of student diversity and their belief in less productive conventional 'one-size-fits-all' teaching approaches, differentiated instruction is not commonly used. Even teachers who differ in their teaching can't do it regularly, according to Nedellec (2015). The researcher claims that one significant factor in teachers' application of DI strategies is the lack of sufficient knowledge on strategies. Teachers must have a comprehensive understanding of how content, processes, items, and the learning environment can be changed to fit students'

learning profiles. This means that teachers must know the pedagogical material required to carry out the differentiated instruction effectively.

Current empirical results from studies examining the relationship between teacher expertise and implementation of specific teaching techniques, such as DI, support the claim. Earlier studies have directly studied how teacher experience and the application of DI are related (see McMillan 2011; Baxter 2013; Nedellec 2015; Chien 2015). Chien's (2015) qualitative research examined the understanding and awareness of DI by Taiwanese elementary school English teachers. The researcher concluded that the reticence of teachers to implement DI was due to the lack of knowledge of the strategies. Analysing the interview data from 20 primary school teachers showed a relationship between DI training for teachers and teaching implementation (Nedellec, 2015). Similarly, an in-depth case study of Abbati (2012) demonstrated good competencies and the ability to differentiate a low DI implementer from a high DI implementer in a variety of personal aspects.

McMillan (2011) examined the connection between teachers' participation in DI, their skills, and employing these techniques among the studies using quantitative analyses. The research showed the teachers' experience with DI (knowledge and comprehension) and positively related strategy use. Brentnall's (2016) correlational analysis revealed that Teachers' ability to distinguish instruction (in terms of knowledge) and the amount of choice they offer their students (in terms of teaching and learning variations) suggest a correlation between DI knowledge and implementation.

2.7 Factors that influence Differentiated Instruction

A number of factors have been identified in extant literature that may affect teachers' use of DI strategies, including teacher knowledge, perception, teacher's

sense of efficacy, certification, experience, attitudes and beliefs (Wertheim & Leyser, 2002; Johnson, 2010; Casey, 2011; McMillan, 2011; Clotfelter, Ladd & Vigdor, 2011; Baxter, 2013; Davis, 2013; Burkett, 2013; Usher, 2013; Holzberger, Philipp, & Kunter, 2014; Dixon, Yssel, McConnell & Hardin, 2014; Chien, 2015; Nedellec, 2015; De Neve, Devos, & Tuytens, 2015; Brentnall, 2016).

Teachers' Perception

One crucial factor, influence teacher's use of DI has been the perception the teachers hold. In the past two decades, analysis of teacher thought has been focused on the premise that teachers' beliefs, values, and attitudes are connected to their actions and behaviour (Hall, 2005). Studies on teacher perceptions of different teaching strategies and related relations with adopting these teaching strategies are abundant in this respect (see Usher, 2013; Burkett, 2013; Watkins, 2013; Davis, 2013; Maddox, 2015; Brentnall, 2016; Smeeton, 2016).

Researchers argue that the understanding of DI by teachers is fundamentally a matter of their core conviction that all students should succeed in a mixed atmosphere (Brentnall, 2016). According to Brentnall (2016), the more teachers appreciate their ability to distinguish teaching, the more DI they give to their students, suggesting that differentiation is more commonly applied. Similarly, the qualitative research conducted by Burkett (2013) found that when it comes to implementing DI strategies, it's common when teachers consider the difference in education in an efficient classroom as crucial. In contrast, some studies point out that having a good attitude about DI does not guarantee its use. Chen (2007) discovered that while study participants emphasised the importance of DI, the values were not applied in their everyday lives. It was because of the lack of competence in DI, as described by the researcher.

Many quantitative and correlational research, on the other hand, support the positive relationship between teacher perceptions and DI use. Davis (2013), for example, found a moderate to a strong positive relationship between teaching arrangements and differentiation of instruction between content, process, product, and environment as viewed by teachers. A strong positive correlation has also been identified between teacher requirements and process-product differentiation as educational leaders perceive in the research. Usher (2013) also reported that a teacher's experience of DI was an essential predictor of DI.

Teacher Certification

Previous studies found that the qualification status of teachers could influence learning at all levels of education in mathematics (Clotfelter, Ladd & Vigdor, 2007; Curran Neild, Nash Farley-Ripple & Byrnes, 2009). However, for primary schools, the proportion of qualified teachers is shown to be below that of high school (Curran Neild, Nash Farley-Ripple & Byrnes, 2009; Kumpulainen & Sefton-Green, 2014). Certification criteria vary from one country to another, such as the standard of education (e.g. Wang, Coleman, Coley, & Phelps, 2003; Ingersol, 2007; Sahlberg, 2011).

Previous studies have shown that mathematics teachers with high-school or high-school-graduation mathematical qualifications tend to be more optimistic with students' academic achievement than primary or middle school teachers with complementary certificates (Clotfelter, Ladd & Vigdor, 2007; Curran Neild, Nash Farley-Ripple & Byrnes, 2009; Hill, 2011). Furthermore, despite being eligible for secondary education, Bouck (2005) discovered that only a small percentage of secondary education teachers had sufficient pre-service education at that level.

Teacher Experience in Instruction

The teacher's experience is described in this study as the total number of years they have worked as a teacher. Several studies have shown that teachers' experience positively affects student achievement (Moyer-Packenham, Bolyard, Kitsantas & Oh, 2008; Clotfelter, Ladd & Vigdor 2007; Curran Neild, Nash Farley-Ripple & Byrnes, 2009; Harris & Sass, 2011). Studies have shown some positive improvements at the start of the teacher careers, but after 5 to 10 years, this appears to level off (Moyer-Packenham, Bolyard, Kitsantas & Oh, 2008; Feng & Sass, 2011). Furthermore, teacher experience has a more significant positive impact on student success at the middle and high school level than elementary school (Moyer-Packenham, Bolyard, Kitsantas & Oh, 2008). Teachers with more teaching experience outperformed new teachers in mathematics, according to a report by Hill (2007). Teachers in the middle class who had previously taught in a high school indicated having more mathematics teaching experience than teachers who had not (Hill, 2007). Teachers' attitudes and values are positively influenced by their input from individual students (Subban & Sharma, 2005). Teachers' experience with different students has also been shown to positively affect the attitude and conviction of teachers (Subban & Sharma 2005).

Self-Efficacy

Self-efficacy is a person's subjective view of their ability to achieve the desired outcome in a particular context, as defined by social cognitive theory (Bandura 1977). Experiments have formed self-efficacy, including what people consider their current skills to do instead of the basic skills (Bandura, 1977; Bong & Skaalvik, 2003). Mastery experience, physiological factors, vicarious experience, and social persuasion are the four fundamental forces that create confidence in one's efficacy (Bandura, 1998). Mastery experience is the most significant contributor to these factors: success increases self-efficacy, while failure decreases it. Bandura

(2010) discovered that self-efficacy is driven by emotions and mechanisms that control people's motivation and are skills, tasks or domain-specific. Moreover, people with strong convictions in their skills prefer to view problems as obstacles to resolve rather than as risks to escape. This powerful approach encourages profound involvement and participation in activities (Bandura, 1998).

Teacher Efficacy Beliefs

Teachers' efficacy beliefs are characterised as beliefs and expectations about students with different needs and qualifications to be taught by teachers (Tschannen-Moran, Hoy, & Hoy, 1998). The teachers are also concerned with their ability to involve the students and to achieve their desired learning results (Bandura, 1997). This means that teachers with high teacher efficacy beliefs are confident in their ability to teach students with particular needs, while teachers with low efficacy beliefs are uncertain of their ability to teach students with varying needs. Teacher efficacy beliefs have been linked to the ability of teachers to plan and carry out teaching tasks in a variety of circumstances, according to previous research (Skaalvik & Skaalvik 2007). According to research, teachers' efficacy beliefs tend to change over time in various ways (Tschannen-Moran et al., 1998). Pre-service teachers and inexperienced teachers from pre-service institutions build their teacher efficacy beliefs early in their careers, according to Bandura (1997). He also said it is challenging to alter teacher efficacy beliefs once formed.

Teachers' efficacy beliefs have been shown in the context of teaching strategies, instructions and motivations, and in connection with students' achievement (Thoonen, Sleegers, Peetsma & Oort, 2011; Austin, 2013; Holzberger, Philipp & Kunter, 2014). Holzberger, Philipp and Kunter (2014) asserted that highly productive teachers appear to provide more student-centred instruction and expend more time

introducing innovative teaching approaches, techniques and personalised support. They are also more flexible in engagement and the design of classrooms (Temiz & Topeu, 2013). Teachers who deal with low-level students benefit from high self-efficacy because it allows them to retain a high level of interest, encouragement, and confidence in their activities (King-Sears and Baker, 2015).

Mathematics Teaching Efficacy

The efficacy of mathematics teaching can be described as teachers' confidence in their capacity to effectively teach mathematics (Enochs, Smith, and Huinker, 2000). Several studies have shown that efficacy in mathematics teaching is a significant predictor of mathematics instructional approaches for teachers. Effectiveness in teaching mathematics is more efficient for teachers with high mathematics teaching efficacy (Swars, 2005; Gresham, 2008). Teachers' self-efficacy in mathematics and mathematics performance have also been strongly associated with teaching efficacy in mathematics (Bates, Latham & Kim, 2011; Newton, Evans, Leonard, & Eastburn, 2012). Furthermore, a teacher with high mathematics teaching efficacy is more likely to be enthusiastic about student instruction and classroom participation and implement new teaching strategies and techniques (Bates, Latham & Kim, 2011; Takahashi, 2011).

2.8 Empirical Review

Despite the benefits of employing DI, several studies (VanSciver, 2005; McTighe & Brown, 2005; Servilio, 2009; Franz, 2009; Schmoker, 2010) reveal its drawbacks and challenges. According to VanSciver (2005), the drawbacks to employing DI mainly impacts the teacher rather than learners. VanSciver (2005) categorises these drawbacks as time, resources and complexity. Several other

researchers (George, 2005; Servilio, 2009; Gangi, 2011) affirm that DI is time-consuming. These researchers consider the toils a teacher has to go through to determine learners' background, learning style, interests, and learning need vis a vis developing strategies to satisfy them. According to Gangi (2011), teachers must take time out of their already busy schedules to evaluate students' learning needs, review tests, decide their learning styles, diagnose suitable strategies, prepare lessons, and execute them to meet those needs. With respect to this, teachers must be willing to invest extra planning time and preparation to create different types of work to get learners to participate in the learning and the content to best their ability to satisfy their learning needs (Latz, Neumeister, employing DI lies in the fact that the teacher has to provide for the whole class as well as specific groups or individual learners (Gangi, 2011). Adams, & Pierce, 2009). Gangi (2011) also affirms that a lot of resources are required to implement DI effectively. Gangi reaffirms that a significant barrier that teachers often face when implementing DI is a scarcity of necessary materials. Also, the complexity of employing DI lies in the teacher's ability to provide for the whole class and specific groups or individual learners (Gangi, 2011).

According to Tomlinson (2000), a common obstacle to DI is the highly standardised curriculum, which puts teachers under a lot of pressure to teach to the curriculum rather than the needs of the students. Researchers (Volante, 2004; McTighe & Brown, 2005;) reveal the intricacies teachers go through to effectively plan and cater to their plentiful learners' diverse learning needs pari passu satisfying the requirements of preparing these learners for all sorts of examinations. As a result, teachers refuse to focus on DI or any other teaching method that does not teach learners to satisfy the various tests (Latz et al., 2009). Furthermore, many teachers

believe that they do not have enough time to discuss anything other than what is required by the curriculum (Tomlinson & Doubet, 2005).

According to Franz (2009), lack of appropriate training and teacher support is another challenge many educators encounter to implement DI. According to Tomlinson et al. (2003), pre-service teachers are not given adequate instruction on how to use DI, and there is a lack of focus on how to teach students with special needs. Franz further explains that few teachers receive appropriate training and education on DI, leading to its consistent practice. Furthermore, asking teachers to move from a one-size-fits-all classroom to a dynamic classroom activity like DI, which involves a paradigm shift and a significant change in teaching practices, is frightening to many teachers (Tomlinson, 1995). This is because many of them feel that introducing a new method of instruction necessitates a significant amount of effort (Holloway, 2000).

In a study of DI for students with disabilities in regular classrooms, Kuyini and Desai (2008) discovered that teachers distinguished instruction poorly in some cases and did not use DI at all in others. Agbenyega and Deku (2011) looked into existing Ghanaian teachers' pedagogical practices in public school classrooms. They found that current instructional practices in Ghanaian standard classrooms are mechanistic, prescriptive, and static and do not consider a range of learners' learning styles. Teachers' competence in differentiating (adapting) instructions to meet the learning needs of learners with learning disabilities in Ghanaian school classrooms was examined by Kuyini and Abosi (2014), who found that teachers have limited to moderate competence in this field. The study found that class size, instructor background, and teaching experience all varied substantially but had no effect on teachers' ability to distinguish instruction. However, large class size was found to

influence teachers' ability to differentiate instruction negatively. The large class size deterred teachers from differentiating instruction, effectively controlling their class, gaining and sustaining students' interests and attention, and efficiently tracking and assessing students' progress during instruction.

Another research by Kuyini and Abosi (2011) on the inclusion of street children in primary school classrooms in Accra found that most street children dropped out because teaching was not differentiated to their learning needs. The street kids said they were caned because they didn't understand the lessons. As a result of this procedure, some children have struggled in school and have been pushed out. They also claimed that differentiated teaching methods enhance the learning outcomes of street children and that they should be used with other groups of children.

Anderson (2009) reviewed several pieces of literature on DI and concluded that it is significant to ensure that every student learns and reaches their academic potentials. The literature affirmed Anderson's belief that a teacher's responsibility is to ensure that every learner in a particular classroom learns and reaches their academic potential. Inconsistent with Abbati (2012) findings, teachers were frustrated by the large class size and the confusing ways that student learning groups were composed at their schools; Andersen's study discovered that employing DI was difficult for the teachers due to the diversity in learners. It concluded that the use of DI impacted the learning of struggling and gifted learners positively. This contradicts the results of Scott's (2008) report, which concluded that DI did not have substantial overall effectiveness. According to Scott's results, students with the higher academic performance gained significantly from the opportunity to be vigorously challenged, while students with average ability did not.

Servilio (2009) studied students with physical disabilities in a fifth-grade classroom. The school was listed as being in a region with lower family incomes, just like most schools in Ghana. By introducing a seven-step program called "You Get to Choose," the researchers distinguished instruction in reading, comprehension, and personal relation. The teachers devised seven steps to follow: “(1) identifying student needs and learning styles within your classroom; (2) assess current student achievement; (3) select empirically based strategies for reading, comprehension, and personal connection; (4) differentiate the material for the students with special needs; (5) provide options for student choice; (6) conduct the assessment; (7) evaluate student performance” (p. 5).

Teachers were able to distinguish material, process, and products as a result of these steps. After completing the curriculum, it was discovered that the learners' morale increased, and 83.4% of them improved their overall grades.

Emily (2005) conducted a qualitative study to evaluate the experiences of a group of students and parents in classrooms where DI activities were used. According to student, parent, and teacher reviews, DI strategies introduced at charter schools positively affected student development.

Logan (2008) looked into DI based on teacher responses to a survey. The survey results provided to middle school teachers to ascertain their awareness about DI in the classroom backed up Haim Ginott's statement that teachers are in charge of creating the atmosphere in their classrooms. It also revealed that teachers can make a student's school life miserable or happy and that teachers should be part of a team that believes that all students can learn. Despite their knowledge of DI, 50% of teachers said they do not distinguish instruction based on preparation, interest, or learning profile because they do not see a need to do so, echoing Moon, Tomlinson, and

Callahan's statements (1995). Logan's research also showed that most general educators believe they are unprepared to teach DI to students with a range of learning needs due to its difficulty and complexity. However, most teachers (73.0%) disagreed that DI does not train students for real-world competition in standardisation, testing, and exams.

Whipple (2012) conducted a comprehensive survey to learn more about teachers' knowledge of DI and their expectations of their ability to incorporate DI in primary schools. Teachers' comprehension of DI and their ability to incorporate DI based on Learner Interest, Assessment, Lesson Planning, Content, Method, and Product were investigated in the survey. The participants had a general understanding of DI and how to put it into practice. There was, however, some variance among the six components. The three principles that seemed to be the least understood were interest, product, and process. Teachers' implementation was found to be lower than their comprehension of DI, according to the report. According to the findings, student interest, method, lesson planning, evaluation, and product all had lower levels of implementation. It was also discovered that teachers were having trouble integrating student participation into the DI process, varying lesson plans and scaffolding learning, evaluating students in the process, and encouraging students to use a range of items to illustrate what they had learned. The research also discovered that special education teachers were more educated about DI and used it more effectively than general education teachers. This supports Franz's (2009) findings that DI necessitates a thorough understanding of its theoretical framework, mechanism, and methods for putting theory into practice. It also demonstrates that teaching is a knowledge-based discipline that informs classroom practice (Kauchak & Eggen, 2003).

DI was introduced in three classrooms in a middle-class, suburban school district in northern Illinois by Baumgartner, Lipowski, and Rush (2003) to improve student's literacy skills who required remedial assistance and increased reading achievement. They targeted 25-second graders, 27 third graders, and 25 seventh graders from various ethnic backgrounds in their classrooms. To the learners, they differentiated the content, process, and goods. Students could choose books about a subject that interested them and suited their skill level, differentiating the material. The process was changed by encouraging students to work in various group environments and providing them with diverse materials to engage with. Students were divided into classes based on their academic needs, which were often updated as the needs of the students changed. Students were given the option of selecting which assignments and concrete learning results they wanted to complete. Baumgartner et al. also wanted to know what students thought about reading in general. Students were tested before, during, and after the 19-week differentiation study. The findings showed that by the end of the 19-week duration, students were using more reading techniques than they had previously. The San Diego Quick Assessment revealed improved reading levels in each of the selected classrooms. The students showed greater mastery of phonics skills. Furthermore, the survey results showed that students' attitudes toward reading had changed overall. The third-grade results showed a 13 per cent rise in students who felt reading was enjoyable, while the second and seventh-grade results showed an 8% and 16% increase, respectively.

Williams (2012) performed a quasi-experimental study to see whether implementing DI activities in the middle school classroom affects students' math results on standardized tests. Students who were taught using DI strategies performed better, substantiating the assertion of Tomlinson et al. (2003) that traditional

classroom approaches to teaching and learning such as one-size-fits-all have been proven to be an ineffective means of instruction.

All learning classes were included to assess whether interventions were adequate based on individual learning needs, including exceptional students, economically disadvantaged students, English language learners, and gifted students. However, the researcher found flaws in the successful implementation of DI techniques in the classroom, implying the need for ongoing, high-quality professional development and support for educators. This affirms the need to train and encourage teachers to adopt quality and evidence-based teaching practices that effectively maximise the learning needs of all learners (Ampiah, 2008).

Woods (2014) researched in the music classroom to see how DI affects student achievement. The analysis aimed to see if some aspects of DI had a more significant effect on student achievement than others. Following the introduction of DI, the results showed signs of student music proficiency development and achievement. According to the findings, some DI components have a more significant effect on student achievement than others. DI methods focused on pre-assessment and ongoing assessment of student's progress against main goals fell into this category. The results also showed that schools that use DI to meet students' various learning needs see a substantial increase in their academic achievement. In general, the study concluded that DI could be the key to encouraging all students to excel academically, regardless of their differences.

Hobson (2008) examined the differentiation strategies used by middle school teachers and the frequency with which they practised DI in their heterogeneously grouped classrooms. The study revealed two types of teachers; those who differentiate frequently and those with minor frequency. The disparities in the teachers' use of DI

strategies indicated different types of teaching and learning occurring in the same school under different teachers. The findings also revealed that several teachers were not following models of DI but were simply employing best pedagogical practices; confirming the findings of Koeze (2007) that teachers who did not have training on differentiation may have sporadically used the differentiation variables but unintentionally and those random uses of the strategies did not increase learner achievement. Teachers were highly knowledgeable of differentiated assessment but showcased the lowest rate of its practice/implementation, and the lowest area of their differentiation was the learning environment. The study again revealed that factors such as teachers' age and years of teaching had little impact on their practice of DI. This disagreed with Abbati's (2012) that high implementers of DI were influenced by background factors such as the long experience teaching the same class.

A research was conducted by Valiande and Koutselini (2009) to evaluate teachers' conception of DI and the effect of employing DI in mixed ability classrooms on academic primary school learners' attainment of students. The study's findings indicated that most of the teachers in the research reported having heard a lot about DI but did not know what it meant. According to their report, some of the teachers who claimed to have used differentiation in the past did not necessarily distinguish their training but had the misconception that they did so by using different teaching techniques, tools, and teaching/learning activities. This affirms that teachers who are in the best position to differentiate instruction in their classrooms operate from a strong and growing knowledge base (Tomlinson & Imbeau, 2010). Although differentiation is one of the critical teaching methods in the Cyprus curriculum, almost none of the teachers in their study used it in their classrooms, and none of them obtained extensive differentiation training. This affirms Brennan's (2008) view

that there is the need to put a thoughtful and comprehensive plan for the professional development of teachers on concepts like DI.

Koshy (2013) evaluated the benefits of using differentiated assessments to enhance students' learning experience and output. After employing multiple assessment approaches such as role-plays, videos, blogs, and games based on learners' preferences, their performance improved and average students reflected on their grades.

Howard Gardner's MI theory can be used to differentiate teaching, according to Gangi (2011). The study concluded that using multiple intelligences to differentiate instruction assisted teachers in creating classroom environments that accommodate the learning needs of all learners in primary schools and significantly increased their academic attainments. This agrees with Tomlinson (2000) position that differentiated classrooms should be conducive enough to support DI activity such as flexible grouping, individualised learning, and peer teaching.

2.9 Philosophical Foundations of Differentiated Instruction

DI is constructivism's philosophy. According to Durrett (2010), the philosophical foundation for differentiated teaching and the theoretical structure comes from constructivist theories and studies. Tomlinson and Allan (2000) also posit that constructivists such as Dewey, Piaget, and Bruner were precursors of DI, a model for teaching and learning that promotes an engaging, learner-centred, and meaning-making approach. Durrett (2010) further explains that DI evolved from Dewey, a constructivist who argued that teacher instruction should be tailored to students' needs. Piaget's work, an essential part of the DI's constructivism, also plays a role.

Constructivism, a recent movement in cognitive psychology, emphasizes the importance of learners in the creation of new knowledge (Kauchak & Eggen, 2003).

Constructivism is an eclectic approach to learning that emphasizes four main elements; “rather than being delivered or communicated to them, learners construct their understanding; new learning is dependent on prior understanding and knowledge; learning is strengthened by social interaction; and authentic learning tasks facilitate substantive learning” (Kauchak & Eggen, 2003 p. 3). This has fundamentally changed how teaching and learning are perceived; learners have become active meaning-makers who build upon current knowledge. Teachers who are now facilitators in this teaching and learning process to promote the said process must create realistic learning situations where learners can collaborate on significant learning tasks with others (Kauchak & Eggen, 2003).

Essentially, according to Piaget, constructivism proposes that information must be built inside the learner (cited in Durrett, 2010). This implies that knowledge creation is a complex process that necessitates active involvement on the part of the learner. Vygotsky often stresses the importance of social contact, vocabulary, and dialogue in creating comprehension for students to co-construct and scaffold each other's learning (Durrett, 2010). Despite their differences, Piaget's cognitive constructivism and Vygotsky's social constructivism emphasize peer participation, a common motivator for students (Durrett, 2010). Several studies (Vygotsky, 1998; Durrett, 2010) indicate that learners are more effective when taught cruel ways to their readiness levels, interests learning profiles and motivational catalysts. In retrospect, constructivism is a philosophy and a theory of teaching and learning that combines a number of teaching methods and practices, including inquiry-based learning, cooperative learning, project-based learning, and other child-centred approaches. Since it integrates all of these approaches, philosophies, and paradigms, DI is linked to constructivism.

Differentiated instruction is a method of teaching that allows students to get the most out of their time in class when they are supported to construct their knowledge for cognitive growth that will eventually improve all learners' academic outcomes and, as such, strengthen their explanatory ability (Valiande & Koutselini, 2009). According to Valiande and Koutselini (2009), differentiation of teaching should be viewed as a learning process that emphasizes the interaction of learners, skills, and teachers in a flexibly open learning environment. They say that differentiation of instruction within the constructivism framework is the solution to the issue of increasing learner diversity and school failure in mixed-ability classrooms. Construction of knowledge is a one-of-a-kind personal learning process that allows each learner to understand better and gain new information based on prior knowledge, personal values, and learning needs. Learner-centred instructional approaches in a constructivist learning process where DI is applied take every learner as a unique personality and not as children with similar characteristics (Valiande & Koutselini, 2009). Learners are given opportunities to bring theory into practice based on their previous experience by differentiated instruction in constructivism, which helps them explore the links between what they've learned and what they've learned in other subjects (Koutselini, 2006). The paradigm of social constructivism asserts that the environment in which the learning takes place is just as important and significant as the learning itself and that when learners are in a classroom that is not differentiated, they may become unruly and, as such lose moments that can contribute to a meaningful education (Greene, 2011).

To summarize, constructivism's fundamental implications in a DI classroom may include substantial use of interactive investigative activities, an enticing and demanding learning atmosphere that promotes active cognitive participation, and the

use of cooperative learning strategies. It also involves activities that motivate and challenge learners to learn more, appropriate corrective assessment practices, and other things that suit their prior knowledge, interests, background, abilities, learning styles, and level of intelligence. In another development, the pedagogical implications that underlie DI and constructivism propose that active learners construct their knowledge. With respect to this, the primary role of the classroom teacher, according to Crawford (2000), is to be a facilitator, a monitor, a diagnostician, a guide, an innovator, an experimenter, a researcher, a modeller, a mentor, a collaborator, a motivator and a co-learner. Teachers will help by providing a stimulating and motivating atmosphere and interactions that will question learners' preconceived notions and actively engage them in the teaching/learning process (Matthews, 2002). In all, constructivist perspectives on instruction serve as a basis for understanding teaching and learning and have widely been accepted by most educators worldwide.

2.10 Summary

Research findings prove that there is a quest for quality education throughout the world. Every particular nation prioritises educating its citizens and commits a lot of resources towards its attainment. This educational aspiration is seeking to be achieved through effective instructional practices and approaches. There have also been more extraordinary efforts by educationists worldwide, seeking instructional practices that can be used as a panacea to all kinds of educational failures. However, the best instructional practice that has been and commended is Differentiated Instruction.

Throughout the literature, there is has not been a specific definition for DI. Various researchers describe DI in various ways, such as being an approach, a concept, a strategy, a method, a practice, a process and a natural way of teaching and

so on. Literature also reveals numerous aspects, concepts, practices and generalisations of DI. However, while few literatures points out the setbacks in employing DI, several studies project the merits in its implementation despite its complex nature.

In another development, learners' diversity, difference, heterogeneity, and variance prove that learners are not homogeneously equal and should not be treated as such in instructional delivery. This has been the basis upon which current effective educational practices (such as DI) are built. Arguments in the literature suggest that each learner in a classroom is uniquely different from others, and as such, each of them has their background knowledge, readiness, interest, learning style and learning needs. It has thereby been affirmed that the best instructional practices consider all learners' learning differences and cater to them. All these are done so that every child can learn, which necessitates DI's use.

Moreover, literature on DI suggests that it can be employed in any classroom, at any grade, to any group of learners and in any subject of study. It has also been ascertained that teachers can differentiate their instructions mainly through planning, content, process, product and learning environment. DI comprises several concepts and generalisations as well as strategic activities that catalyst its effective implementation.

According to the literature, DI is a learner-centred approach to teaching/learning that places the learner at the centre of learning. It advocates catering for the learning needs of each learner in a classroom instead of teaching to satisfying curriculum or examination requirements. DI researchers argue that when the learning needs of learners are catered for, curriculum and examination satisfaction comes with it as an additional benefit or bonus.

CHAPTER THREE

RESEARCH METHODOLOGY

3.0 Overview

This chapter discusses the research methodology that was used to examine how SHS mathematics teachers use differentiated instruction and factors which influence its uses. It includes the research design, the study area, population and setting, sampling technique and sample, data collection iinstruments, data collected procedure, reliability and validity of instrument.

3.1 Research Approach

The current study adopted a mixed method approach. This is because the researcher sought to complement the quantitative data with the qualitative data to offer more in-depth meaning to the data collected. The mixed methods approach falls under the pragmatism paradigm (Gibson, 2017) which holds the view that knowledge is constructed based on the realities of our experience in the world as well as being socially constructed (Gibson, 2017). The core rationale of using mixed methods is that the combined use of both qualitative and quantitative methods can provide a better understanding of research issues than a single method (Creswell & Plano, 2018).

This study is underpinned by the pragmatism paradigm which refers to a worldview that emphases on “what works best” rather than what might be measured categorically and accurately “true”. Pragmatism accepts a flexible approach to solving research problems (Kaushik & Walsh, 2019). According to pragmatism there cannot be one way to solve a problem but a mix of approach can better help solve a problem and discovery the truth. Pragmatists believe that there cannot be a single realism but numerous realities (Collins, 2017). The pragmatism paradigm tracks both positivism

and interpretivism to pursue the responses to the problems. Therefore, this research paradigm would propose a mixed-method approach.

A mixed method approach means that such research will use both qualitative and quantitative methodology in a chronological way. This worldview is different from the positivists‟ who believe that knowledge is objective and outside the world of the researcher and also different from the interpretivists‟ who opine that knowledge is basically constructed. The pragmatic worldview takes a midway between the two extreme worldviews of quantitative and qualitative paradigms. Pragmatists believe that the duty of the researcher is to use whatever works (within the realms of academic rigor and appropriateness) to conduct their research (Creswell & Plano, 2018) which therefore presupposes that the researcher should look out for methods that will help them answer their research question(s) rather than being dogmatic (Gibson, 2017).

Research paradigm refer to the philosophical ground for the research work and constitutes researcher's worldview, abstract beliefs and principles that shape how the researcher sees the world, and how she or he interprets and acts within that world (Zukauskas, Vvinhardt, & Andriukaitiene, 2018). A paradigm can either be positivist, constructivist, interpretive, transformative or pragmatic. In a similar mood, Kivunja & Kuyini, (2017) mention that paradigms are thus important because they provide beliefs and dictates, which, for scholars in a particular discipline, influence what should be studied, how it should be studied, and how the results of the study should be interpreted. Therefore, before a researcher defines an appropriate research paradigm, it is important to study its philosophical assumptions and clarify that it is suitable for his/her research. The choice of paradigm is very important as it sets down the intent,

and provides a theoretical framework for the methodologies employed in research (Kivunja, & Kuyini, 2017).

3.2 Research Design

The study employed a explanatory sequential mixed-method approach. This is based on the knowledge that provides a general understanding of the research problem using quantitative data and its subsequent analysis (Creswell & Plano Clark 2007). Qualitative data and analysis refine and illustrate statistic findings (Creswell, 2013).

The priority is to focus more on (or both) quantitative data and qualitative data (Creswell, 2013). The quantitative approach takes priority in a explanatory sequential design, as quantitative data collection is a significant part of the study, while in the second phase, a smaller qualitative part follows (Ivankova et al., 2006). However, before data is collected, during data collection or data analysis, the priority phase of the project could change, depending on what the study aims and questions the research seeks to address (Morgan, 2008). The quantitative approach was given priority in the study. Implementation refers to how qualitative or quantitative data are collected first, second, or simultaneously (Creswell, 2013). A researcher collected quantitative data and then qualitative data for the second stage of the study to explain results from a quantitative stage.

In this study, the researcher linked the quantitative and qualitative phases in four stages. The first connection occurs when research questions are developed in the qualitative phase based on quantitative results during the design stage. The second link is established when the researcher selects participants who completed the survey instrument based on their numerical values for the qualitative phase. The third connection is the development of an interview protocol for collecting qualitative data based on the results of quantitative analysis. In answering the research questions

posed in the study, the fourth data connection was made.

3.3 Study Area

The study was conducted in the Central region of Ghana. The central region covers an area of 9,826 square kilometres, or 4.1% of the land area of Ghana, making it the third-smallest area after Greater Accra and the Upper East. It shares common boundaries with the Western region to the west, Ashanti and the Eastern region to the north, and the Greater Accra Region to the east. The 168-kilometre-long Atlantic Ocean (Gulf of Guinea) coastline is to the south. Following mining and fishing, services dominate the region's economy (Ghana Statistical Service, 2014). The figure below shows the area of study.

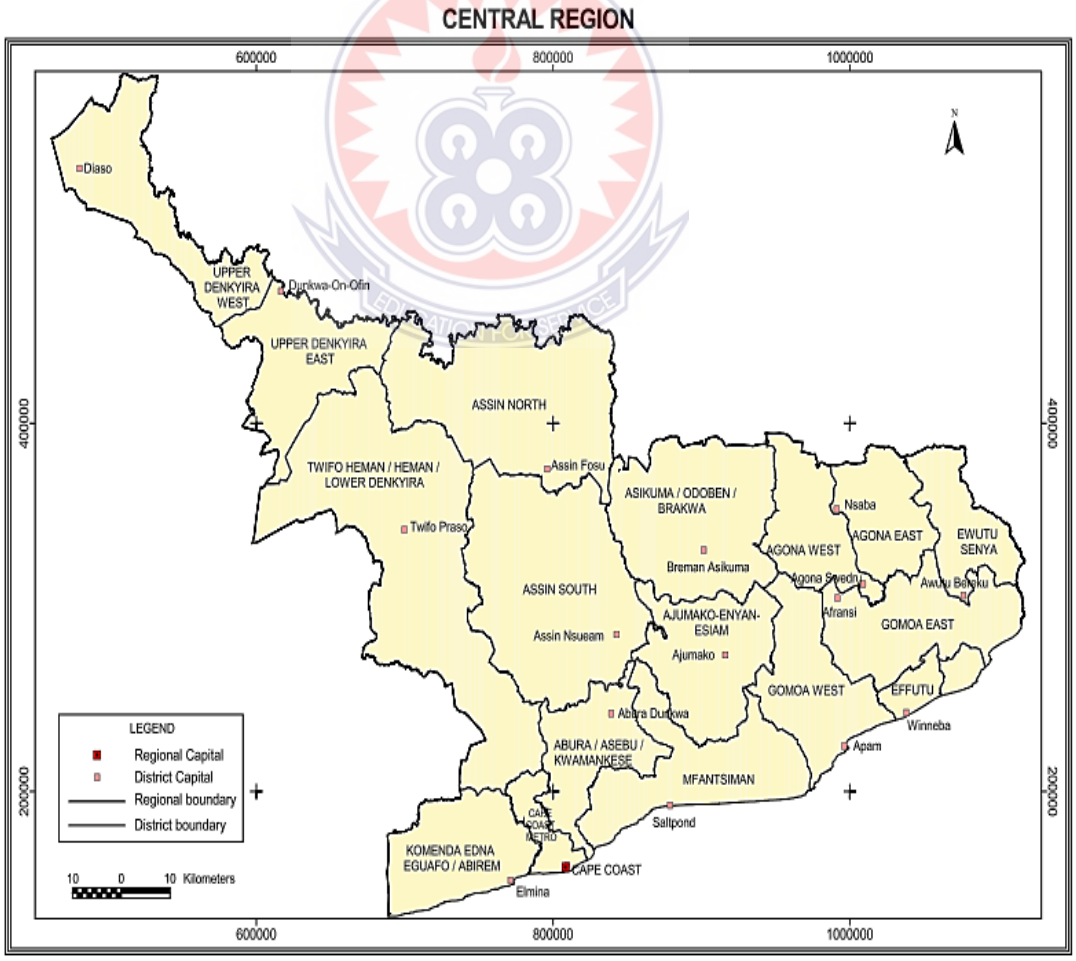

Figure 2: Map of Central Region

3.4 Population and Setting

The study population included all SHS mathematics teachers (both public and private) in the Central Region of Ghana. Central region was selected because the researcher has been teaching in the region for the past eight years and is familiar with the region's academic environment. In addition, the researcher has an indepth knowledge of the region's geographical area. The part of the general population left after its refinement is termed target population, which is defined as the group of individuals or participants with the specific attributes of interest and relevance (Creswell, 2018). The target population is more refined as compared to the general population on the basis of containing no attribute that controverts a research assumption, context or goal. As a results of that the target population included all the public SHS mathematics teachers in the 63 SHS in the Central Region of Ghana. In the study, mathematics teachers were used because, in particular, the mathematics curriculum emphasizes the use of different teaching strategies (Ministry of Education, 2010). The population distribution of SHS mathematics teachers in the 63 public SHS in central Ghana is shown in Table 1.

Since the researcher targated teachers with at least eight (8) years, the accessible population became the all the public S*HS mathematics teachers in the 63 SHS in the Central Region of Ghana who have been teaching in the region for the past eight years and their familiar with the region's academic environment. This is because the accessible population is reached after taking out all individuals of the target population who will or may not participate or who cannot be accessed at the study period (Cresswell, 2018). It is the final group of participants from which data is collected by surveying either all its members or a sample drawn from it. It represents the sampling frame (Cresswell, 2018), if the intention is to draw a sample from it.

With respect to the current study, teachers with at least eight years teaching experience became the accessible population for the study.

Table 1 - *Statistics of SHS Mathematics Teachers in the Central Region*

	Male	**Female**	**Total**
Teachers	431	262	693

Source: Regional Education Office, GES, 2020

3.4 Sampling Technique and Sample

One hundred and twenty-eight SHS mathematics teachers in the Central region of Ghana were selected for the study using a stratified sampling technique. The sample size is determined using Krejcie and Morgan (1970) table of sample size determination from a given population. This sample size is considered to be relatively large, reasonably suitable, and representative of the population. According to Mason, Lind, and Marchal (1999), the population is initially divided into subgroups, known as strata, with stratified random sampling. A sample of these subgroups was then be selected and the sample from the stratum selected. This study used the stratified sampling technique as most of the SHSs are located in rural and urban areas in the Central region of Ghana. Therefore, the stratified sampling technique was employed to obtain equal SHS representatives from rural and urban settings. The sampling method is stratified because the researcher is keen to emphasize specific characteristics of the subgroup in the population, which is rural and urban schools. Therefore, stratified sampling was used to ensure that each population subgroup was represented adequately inside the sample.

It is presumed that the population in each stratum is approximately the same, and therefore the sampling fraction was the same for each stratum. The researcher

divided the Central region into both urban (areas with population at least 50000 which are well developed in terms of infrastructures). As a results, there were seven (7) Urban places and sixteen (16) rural areas considered for the study and rural districts (areas with population less than 2500 which are less developed in terms of infrastructures). A simple random sampling technique was used select 16 SHS from urban districts and 16 SHS from rural districts. Four mathematics teachers were then be selected from each school selected in rural and urban districts, making 128 mathematics teachers. The sample's frequency distribution indicates a non-proportional distribution of the chosen mathematics teachers from rural and urban SHS. The distribution of the sampling procedure is presented in Table 2. In the qualitative Phase, In the qualitative phase of the study, a maximum variation sampling strategy was used to select eight mathematics teachers. Teachers were selected based on the number of expeience (at least eight years teaching experience) and have been adopting use of differentiated instruction during Mathematics instructions. The researcher selected 21 teachers because at that point data saturation was achieved.

Table 2 - *Stratified Sampling of Participants*

Strata	**Number of SHS**	**Number of Teachers**
Urban districts	16	64
Rural districts	16	64
Total	**32**	**128**

In the qualitative phase of this study, a maximal variation sampling strategy was be used to select eight mathematics teachers. The most efficient sampling process for selecting participants for this study is the maximal variation sampling strategy. According to Creswell and Garrett (2008), “it is a strategy in which the researcher

samples cases or individuals that differ on some characteristics or trait". Age, sex, educational qualification, or geographical location (i.e. rural or urban) can differ among the participants. The researcher then identifies the participants based on specific characteristics. In this study, the researcher selected the mathematics teachers based on the following criteria by using maximal variation sampling technique: (1) mathematics teacher's knowledge on DI, (2) willingness to participate in the study, (3) instructional resources and infrastructure, and (4) demographic characteristics such as gender

The researcher ensured that participants agreed to be interviewed with respect to the participants and following ethical considerations. The study, therefore, excluded those participants with adequate knowledge of DI but not willing to be interviewed.

3.5 Data Collection Instrument

After a careful review of appropriate literature, self-administered questionnaires were used as the instrument to collect data to answer the questions set for this study for the quantitative phase. Questionnaires were utilised because of less time to administer and the anonymity of respondents (Fraenkel & Wallen, 2000; Muijs, 2004). The questionnaire consisted of questions in close format, open-ended format, and type of rating scale.

Appropriate instrument adaptation, including those from Teacher Self-Reflection on Differentiation for Staff Development Planning Survey (Page, 2007), is expected to be used to develop the instrument for the study. This is a survey that the Association for Supervision and Curriculum Development distributed at the Summer Conference on Differentiating Instruction. The selected issues were consistent with the components of the differentiated instruction under investigation. The addition of descriptive information was used to analyze the influence of circumstances and skill

descriptors associated with instructional differentiation. The First part of the questionaire measures the demographics of the respondents. This included gender, the educator's level of education, and years of experience in teaching. The second part of the questionnaire measured (Knowledge and use of differentiated instruction (Knowledge on DI & Level of Use of DI) aim to help in answering research question one (1) and two (2). The third part of the questionnaire (Teacher self-reflection of differentiation of instruction) was used to measure research question three (3) and Four (4). The combination of second part and third part of the questionnaire were used to test the research hypothesis.

At the qualitative stage of the study, the researcher conducted semi-structured interviews probing areas that were too sensitive to explore in the quantitative stage (Taylor, Bogdan, & DeVault, 2015). There are questions about the comprehensive understanding of mathematics teachers' use of DI at the quantitative stage. This information required the researcher to interview the mathematics teachers rather than disclose this information on the survey questionnaire. For over 20 minutes, the researcher audiotaped each of the eight (8) mathematics teachers using an interview etiquette based on the quantitative results. Moreover, the researcher evaluated how participants have responded to some specific items on the questionnaire and statistically significant data variables in the analysis.

3.6. Reliability and Validity of Instrument

3.6.1. *Reliability and Validity of of Quantitaive Instrument*

The reliability of the instrument refers to consistency in the measurement or to the extent to which a device is used on the same subjects in the same condition each time (William, 2006). On the other hand, validity determines whether the research measures what it should measure effectively or whether the results are accurate

(Joppe, 2000). The researcher allowed two Senior Lecturers in instructional strategies in mathematics at the Department of Mathematics to evaluate the questionnaire for construct and content and face validity. The necessary changes to the contents of the questionnaire are made after feedback is received from the panel. The improved questionnaire was subsequently be pilot tested to determine the reliability of the questionnaire and identify defect items and ensure that the questionnaire was straightforward.

When designing a questionnaire, the errors and ambiguities in question can easily be overlooked (Wilkinson & Birmingham, 2003). Moreover, Awanta and Asiedu-Addo (2008) have warned that the questionnaire can be designed reliably because the answers are consistent but invalid, as the concept it is intended to measure is not measured. With this in mind, a pilot test was carried out for the survey instrument. A pilot test is a "procedure in which a researcher makes changes in an instrument based on feedback from a small number of individuals who complete and evaluate the instrument" (Creswell, 2012). 45 SHS mathematics teachers from 8 schools in the Central region was used in the pilot study. SHS Mathematics teachers from the same context where the study was conducted were chosen because they represented the targeted respondents of the study. The respondents' feedback helped the researcher improve the quality of the survey in terms of content coverage, content validity, and reliability.

Reliability (Internal Consistency) of the questionnaire was determine using Cronbach's Alpha. It is viewed as the most appropriate measure of reliability when making use of Likert scales. This measure the inter-correlation of the items of the questionnaire and hence the consistency in the measurement of intended construct. The commonly used method of measuring internal consistency is by calculating the

Cronbach Alpha coefficient. It has been suggested that for an item to be considered reliable, a value of Cronbach's alpha should be 0.7 or more (Kline, 2000; Tavsancil, 2002). The Cronbach's Alpha of all the 46 items under teachers Knowledge and use of differentiated instruction was 0.744 in addition, the cronhach's Alpha of teacher self-reflection of differentiation of instruction was 0.84. Since all the Cronbach's Alpha for the two constructs were above 0.7, the questionnaire was deemed reliable for the data collection.

3.6.1 *Trustworthiness of the Qualitative Data*

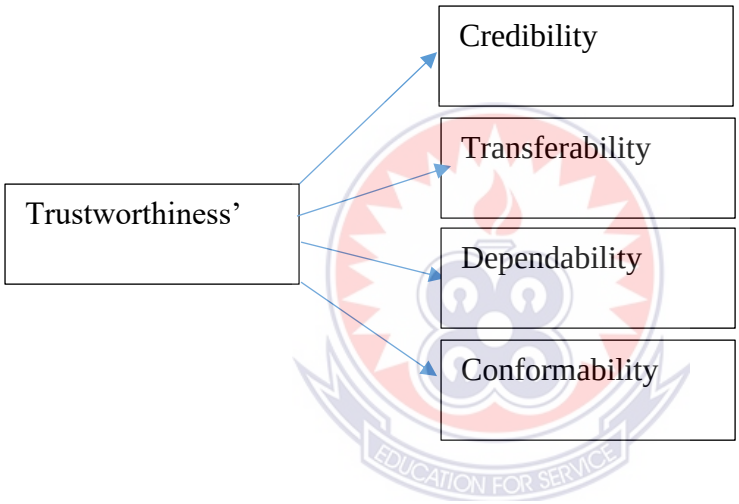

Figure 3: *Trustworthiness of quantitative research.*

To ensure that the qualitative data is devoid of personal biases or personal motivation of the researcher but based on participants responses, the researcher provided an audit trial which highlighted all the steps that the researcher took in analyzing the data in order to provide a rationale for all the decision made. This ensured the conformability of the qualitative data. Also to ensure the dependability of the current study, the research was given to my supervisors and panel of experts in the area of qualitative study to review and examine the whole research process and data analysis in order to ensure that the findings are consistent and can be repeated in different context. Finally, to ensure the transferability of the qualitative data, the researcher used thick

or deep descriptions of the qualitative study to ensure that the findings of the research can be applicable to other situations, contexts and circumstances.

3.7 Data Collection Procedures

The researcher collected an introductory letter from the Department of Mathematics. The Introductory letter was be given to the Headmasters/Headmistress of the participating SHS. With consent from the Headmasters/Headmistress, the Heads of the mathematics department of the participating schools were informed about the study. The questionnaire was personally administered to the mathematics teachers. The questionnaire was personally administered to enhance the questionnaire collection and response rate. The questionnaire is collected once the respondents have completed it. This allowed the researcher to achieve a 100 % response rate. The researcher conducted a qualitative case study of eight mathematics teachers in the qualitative phase to take a broader view of the quantitative statistical results.

3.8 Data Analysis Procedure

The responses from the questionnaire items were coded and analyzed using Statistical Package for Social Science (SPSS) software version 20.0. The SPSS software was used for the data analysis because it is user-friendly and does most quantitative data analysis for the researcher. The researcher did the data entries to check the accuracy of the data. Before any analysis was carried out, data was cleaned. Data cleaning helps the researcher remove errors due to coding, recording, missing information, outliers, or compelling cases.

Descriptive statistics such as mean and standard deviation was calculated for participants' responses to the knowledge and use of DI for research question one. Research question two was be answered using multiple linear regression analysis. A

chi-square goodness-of-fit test was used to answer the research hypothesis. The chi-square test was used as it is suitable for research using non-numerical nominal data categories to evaluate outcomes compared to expected population frequencies (Kiley, 2011). To determine statistical significance, the 0.05 level of confidence was used in all test applications.

However, the researcher converted the field notes produced by audio interviews to Word documents for open-coding qualitative data analysis (Glaser & Strauss, 1967). By analyzing qualitative data, the researcher meant a procedure in which transcribed, field notices, and other materials are systematically examined and arranged to produce results (Bogdan & Biklen, 2007).

Taylor, Bogdan, and DeVault (2015) stated that data analyses continuously involve coding, description, and team development. The connectivity of associated teams, data understanding in context, and reporting of results are associated with data analysis. The researcher coded text data to identify teams using the open coding criteria of Creswell and Garrett (2008). The researcher returned with this refined list to find out if new codes exist and then reduce codes to common themes supported by evidence. The teams were discussed in line with the quantitative data.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.0 Overview

This chapter presents the results and the discussion of the results. The research questions are presented first followed by, (1) demographic information of participants, (2) SHS mathematics teachers' knowledge on DI, (3) factors influencing the use of DI, (4) Teacher characteristics and the use of DI, and (5) institutional characteristics and the use of DI.

4.1 Demographic Information of Participants

The demographic information of mathematics teachers included gender, age, teaching experience, and professional qualification, as shown in Table 3. Out of the 120 SHS mathematics teachers, 67.2% were males, and 32.8% were females. It was not surprising that most SHS mathematics teachers were male because most females do not offer mathematics at the pre-service education.

On the age of the SHS mathematics teachers, as shown in Table 3, the findings indicated that, cumulatively, most mathematics teachers 89 (69.5%) were 40 years and below, and only a small proportion of the SHS mathematics teachers 39 (30.5%) were above 40 years. The results seem to suggest that the majority of the SHS mathematics teachers sampled were at a young age.

The experience of SHS mathematics teachers might influence how they respond to DI. Table 3 indicates gender and age that most SHS mathematics teachers are very experienced as 96 (75.0%) had six years and beyond experience. This was evident as the qualitative face of the study indicated that SHS mathematics teachers who had taught for over six years had some variations in terms of DI use.

Also, 126 SHS mathematics teachers representing 98.4% were professional mathematics teachers, with only two SHS mathematics teachers representing 1.6% were non-professional. This result is not superising as is expected of any SHS mathematics to be professional.

Table 3 - *Demographic Information of SHS Mathematics Teachers*

Variable	Category	Frequency	%
Gender	Male	86	67.2
	Female	42	32.8
	Total	**128**	**100.0**
Age	26-30 years	20	15.6
	31-40 years	69	53.9
	41-50 years	38	29.7
	51-60 years	1	0.8
	Total	**128**	**100.0**
Teaching	1 – 5 years	32	25.0
Experience	6 - 10 years	47	36.7
	11 - 15 years	37	28.9
	16 years and above	12	9.4
	Total	**128**	**100.0**
Profesional	Professional	126	98.4
Qualification	Non – professional	2	1.6
	Total	**100**	**100.0**

Source: Field Data, Animle (2021)

Research Question 1 **: SHS Mathematics Teachers' Knowledge on DI**

In assessing SHS mathematics teachers' knowledge on DI, research question one, "*what is SHS mathematics teachers' level of knowledge on differentiated instruction?"* was addressed.

Results of Research Question 1: Descriptive statistics such as mean, standard deviation, and coefficient of variation were used to answer research question one. SHS mathematics teachers' knowledge of DI were categorised into nine. The categorisations were learner diversity, learner interest, learning style, lesson planning, content, process, assessment, environment and general. As reported in Table 4, SHS mathematics teachers' general knowledge of DI had the highest mean score ($mean = 4.02,\ SD = 0.751, CV = 18.68\%$), indicating a high knowledge of DI. There was high knowledge of DI on learning style ($mean = 3.85,\ SD = 0.686, CV = 17.82\%$), learner interest ($mean = 3.38,\ SD = 0.736, CV = 16.39\%$), process ($mean = 3.48,\ SD = 0.477, CV = 13.71\%$), environment ($mean = 3.47,\ SD = 0.777, CV = 22.39\%$), lesson planning ($mean = 3.38,\ SD = 0.736, CV = 21.78\%$), assessment ($mean = 3.37,\ SD = 0.528, CV = 15.67\%$), content ($mean = 3.11,\ SD = 0.627, CV = 20.16\%$), and learner diversity ($mean = 3.01,\ SD = 0.402, CV = 13.36\%$). In general, SHS mathematics teachers' overall knowledge of DI ($mean = 3.56,\ SD = 0.356, CV = 10.00\%$) was high. Table 4 shows the descriptive statistics of SHS mathematic teacher's knowledge of DI.

Table 4 - *Descriptive Statistics of SHS Mathematics Teachers' Knowledge of DI*

Knowledge	**Mean**	**Std. Deviation**	**Coefficient of variation (%)**
Learner Diversity	3.01	0.402	13.36
Learner Interest	3.80	0.623	16.39
Learning Stlye	3.85	0.686	17.82
Lesson Planning	3.38	0.736	21.78
Content	3.11	0.627	20.16
Process	3.48	0.477	13.71
Assessment	3.37	0.528	15.67
Environment	3.47	0.777	22.39
General	4.02	0.751	18.68
Overall Knowledge of DI	3.56	0.356	10.00

Source: Field Data, Animle (2021)

The collected interview data gave the researcher more insight into the high knowledge of DI reported by SHS mathematics teachers. Respondents indicated high knowledge levels on the general concept of differentiation. According to the interview data, when the respondents' knowledge of the fundamental theories of differentiation was assessed, SHS mathematics teachers had a fundamental understanding of inclusive education. Some of the respondents reported;

> "….*When children with disabilities and typically normal children are placed in the same classroom, this is known as special education…*". *(A, interview data, lines 18 -19).*
>
> *"…Regardless of abilities or disabilities, everyone is included in the same educational system …". (E, interview data, line 16).*

The study's findings further revealed that SHS mathematics teachers know what the learning style of students is. A respondent reiterated;

"…*The learning style of a person describes how he or she typically acquires, retains, and retrieves information …*" *(B, interview data, line 21 - 23).*

Further investigation into the teachers' knowledge of differentiating based on learner interest and culture revealed that every student in their classrooms has their learning interest and culture and expectations. When they were talking about DI, they talked about learning interests, learning culture, and learning expectations, among other things.

A further probe on the participants' knowledge on process differentiation revealed also confirmed SHS mathematics teachers' knowledge on DI. It was well-known to the respondents that a wide range of teaching methods and strategies should be used in the teaching process. Also, they were aware of cooperative learning, group, problem-solving, and other instructional strategies. All the SHS mathematics teachers again knew that learner groups are formed based on ability, intelligence and knowledge levels.

Further investigation into SHS mathematics teachers' knowledge of differentiation through learning environments revealed that SHS mathematics teachers were aware that the classroom environment could be structured to accommodate a variety of activities such as flexible groupings or individual work. On the other hand, one of the SHS mathematics teachers taught that structuring the classroom environment refers solely to arranging classroom seats for the purpose of grouping. In another instance, participants agreed that special children should be included in regular schools. They argued that it would be detrimental to special and general stream children, acquiring knowledge differently. Additionally, the interview data

shows that SHS mathematics teachers in regular schools lack the necessary knowledge, skills, and resources to teach special children.

The results of the interviews confirmed that the SHS mathematics teachers were aware that the learning needs of each of their students should be taken into consideration when planning. They believe that lesson planning should be differentiated to meet each learner's needs and unique requirements. However, one of the SHS mathematics teachers stated that it is not feasible to consider every learner in lesson planning due to the many students in the classroom.

In the interview data on assessment differentiation, the findings revealed that all participants were aware that assessment information should be used to guide instructional development and implementation. The SHS mathematics teachers were also aware that various assessment tools and strategies should be used before, during, and after teaching and learning to maximise student achievement.

The study's findings once again revealed that teachers of SHS mathematics were aware that lesson content could be differentiated for students in the same classroom. As a result of students' differing learning abilities, the content can be changed to ensure that every student understands and benefits from the lesson, especially in SHS. A respondent indicated;

> *"…The same thing shouldn't be taught to all students because their learning abilities differ. At the end of the day, every student should have learned something. Apparently, high achievers lose interest in material that is way below their knowledge level…."*

According to the results of the interviews, even within a single class, no two students have the same learning characteristics. They drew their conclusions based on natural individual differences. For them, it was impossible for children and their

learning to be genuinely homogeneous because people are inherently diverse. According to one respondent;

"…The students aren't all the same because of the differences in learning…."

The interview data confirmed the high knowledge of the SHS mathematics teachers on DI.

Discussion of Results of Research question 1

The findings of the study in line with the research question 1 and hypothesis 1, which is SHS mathematics teachers' knowledge on DI. Regarding research question one, which sought to explore SHS mathematics teachers' knowledge of DI, the study's findings demonstrated that SHS mathematics teachers' knowledge of DI was high. Knowledge can be information, understanding, or abilities gained via experiences or education, according to Merriam Webster Online Dictionary (2015). It can also refer to a condition of awareness of something. Teachers' expertise on any subject is essential in determining their efficacy or lack thereof in their professional endeavours. Teaching has always been a profession in quest of knowledge that may inform classroom practice, according to Kauchak and Eggen (2003). This supports the claim that instructors' knowledge of DI impacts their ability to practice and apply it (Whipple, 2012). Teachers who are in the best position to differentiate instruction in their classrooms rely on a strong and expanding knowledge base (Tomlinson & Imbeau, 2010). Furthermore, DI implementation necessitates a thorough understanding of its process, theoretical background, and methods for putting theory into practice (Franz, 2009). The SHS mathematics teachers' knowledge was judged necessary and, nonetheless, examined based on these underpinnings.

Learner variety, learner interest, learning styles, lesson planning, content, method, product/assessment, environment, and general ideas of differentiation were

used to assess the knowledge of SHS mathematics teachers on DI. The study's findings revealed that all nine subconcepts had high levels of understanding. SHS mathematics teachers levels of knowledge of the nine DI sub-concepts are consistent with Whipple's (2012) findings, which found comparable variances in teachers' knowledge of six DI subconcepts. While instructors' knowledge of process, interest, and product differentiation was high in this study's findings, these three subconcepts appeared to be the least comprehended in Whipple's study.

According to the findings of this study, teachers have previously heard of the concept of DI. It was discovered in this study that teachers were generally knowledgeable about DI and had education or training on it. This is consistent with the findings of several other studies (Hobson, 2008; Logan, 2008; Whipple, 2012; Woods, 2014), which indicated that teachers were knowledgeable about DI because they were given special education and training on it. This was demonstrated when the researcher inquired how they came to know about the DI principles they were familiar with. Many of them stated that they learned about it as part of their introduction to a unique education course in college, while others stated that they learned about it through their teaching experience in a classroom setting. This is consistent with Abbati (2012) findings, who discovered that personal characteristics such as a willingness to persevere and grow professionally, a relatively long period of teaching the same grade level or class, and strong classroom management skills were associated with exceptionally high DI implementation.

The professional knowledge teachers hold determines whether or not they are effective in the classroom and whether or not their students benefit from their instruction. Even the most effective pedagogical approaches may be rendered ineffective if the teacher who would implement them does not have the necessary

knowledge and abilities to carry them out effectively. According to Tomlinson and Imbeau (2010), the classroom teacher is the one who is accountable for transforming distinction from an abstract concept into a fundamental way of life in the classroom environment. Therefore, the degree to which teachers are familiar with and comprehend DI is related to the extent to which it is put into practice (Whipple, 2012). Because of this, it is necessary to close the gap between teachers' awareness and knowledge of DI and their practices (Whipple, 2012). Since teachers have high knowledge in DI, it indicated that teachers see individual learner variance, diversity, difference and uniqueness that are the very basis upon which the DI concept is built are also projected by the MI and the ZPD theories. Both theories propound that individual learner in the same classroom are different and, as such, should not be expected to learn in the same way. This also indicated that the teachers are been able to adopt individualized instruction and scaffolding instruction for the learners to reach ZPD as proposed by the Theory.

4.2 Research question 2: Factors Influencing the use of DI

In exploring the factors that influence the use of DI, research question two, *"What factors influence the use of differentiated instruction by mathematics teachers?"* was addressed. Linear Multiple regression was used to address research question two. Linear Multiple regression was used because there was one continuous dependent variable and more than two independent variables. There was a linear relationship between the dependent and the independent variables. Independent variables were not highly correlated; therefore, there was no multicollinearity. The data did not show any significant outliers and was normally distributed. One multiple linear regression model was developed with the independent variables being the demographic factors (i.e., age and years of teaching experience), teacher

characteristics (training in DI, value of DI), and institutional characteristics (administrative support, workload, class size, and planning) with the use of DI been the dependent variable.

Results of Research Question 2

First, a correlation analysis was conducted between the dependent and independent variables. The correlation results in Table 5 shows that all the independent variables correlated significantly with the dependent variable with the strongest ($r = 0.826, p < 0.01, n = 128$) being reported in training in DI.

Table 5 – *Correlation between Independent and Dependent Variable* ($N = 128$)

		Use of DI
Age	Pearson Correlation	0.432**
	Sig.(2 tailed)	0.000
Teaching Experience	Pearson Correlation	0.719**
	Sig.(2 tailed)	0.000
Training in DI	Pearson Correlation	0.826**
	Sig.(2 tailed)	0.000
Value of DI	Pearson Correlation	0.653**
	Sig.(2 tailed)	0.000
Administrative Support	Pearson Correlation	0.547**
	Sig.(2 tailed)	0.000
Class Size	Pearson Correlation	-0.773**
	Sig.(2 tailed)	0.000
Workload	Pearson Correlation	-0.640**
	Sig.(2 tailed)	0.000
Planning	Pearson Correlation	0.572**
	Sig.(2 tailed)	0.000

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

This was followed by teaching experience ($r = 0.719, p < 0.01, n = 128$), the value of DI ($r = 0.653, p < 0.01, n = 128$), panning ($r = 0.572, p < 0.01, n = 128$), administrative support ($r = 0.547, p < 0.01, n = 128$) and with age ($r = 0.432, p < 0.01, n = 128$) a relatively weaker correlation was reported. However, class size ($r = -0.773, p < 0.01, n = 128$) and workload ($r = -0.640, p < 0.01, n = 128$) were negatively correlated with the use of DI, although significant. Table 5 shows the summary of the results of the correlation between the dependent and independent variables.

A multiple linear regression analysis was performed to explore the best predictor of use of DI. The results, as presented in Table 6, show that approximately 39.8% of the variation in a change in the use of DI score is explained by the variation in age, teaching experience, training in DI, the value of DI, administrative support, class size, workload, and planning. Also the r-square value of 15.8% indicated that 15.8% of variation in DI is explained by the independent variables (age, teaching experience, training in DI, the value of DI, administrative support, class size, workload, and planning). The adjusted r-square of 10.2% indicated that, the model is accounting for only 10.2% variance in the regression. The $F[(8,119) = 2.795, p < 0.01]$ associated with the independent variables was statistically significant, indicating that age, teaching experience, training in DI, the value of DI, administrative support, class size, workload, and planning predict the use of DI. According to the standardised coefficients, the regression model is given as:

$$DI = 0.018\,Ag + 0.061\,\text{Tr. Exp.} + 0.838\,Trn. + 0.667\,Val.$$

$$+0.019Adm. - 0.587Cla. - 0.347Wk. + 0.049Pln.$$

Where, Ag = Age; Tr. Exp. = Teaching Experience; Trn. = Training in DI; Val. = Value of DI; Adm. = Administrative support; Cla. = Class Size; Wk. = Workload;

Pln. = Planning

From model 1 above, an increase in one standard deviation of age resulted in an increased of DI by 0.018 when the effect of teaching experience, training in DI, value of DI, administrative support, class size, workload and planning are held constant. Also, as teaching experience increased by one standard deviation, teachers use of DI increased by 0.061 standard deviation when the effect of teachers age, training in DI, value of DI, administrative support, class size, workload and planning are held constant. In addition, as teachers training in DI is increased by one standard deviation, teachers' use of DI increased by 0.838 standard deviation when age, teaching experience, training in DI, value of DI, administrative support, class size, workload and planning are held constant.

Furthermore , as teachers' use of DI increased by 0.667 standard deviation, value of DI increased by One standard deviation when the effect of age, teaching experience, training in DI, administrative support, class size, workload and planning are held constant. Moreover, as administrative support increased by one standard deviation, teachers use of DI increased by 0.019 standard deviation when the effect of teachers age, teaching experience, training in DI, value of DI, class size, workload and planning are held constant. Again, as class size increased by one standard deviation, teachers use of DI decreased by 0.587 standard deviation when the effect of teachers age, teaching experience, administrative support, training in DI, value of DI, workload and planning are held constant.

Next, as workload increased by one standard deviation, teachers use of DI decreased by 0.347 standard deviation when the effect of teachers age, class size, teaching experience, administrative support, training in DI, value of DI, workload and planning are held constant. Finally, a one standard deviation increased in planning

results in 0.049 increased in the teachers use of DI when the effect of teachers age, class size, teaching experience, administrative support, training in DI, value of DI and workload are held constant.

The result indicates that training in DI seems to be the strongest predictor of the use of DI compared to age, teaching experience, training in DI, the value of DI, administrative support, class size, workload, and planning. Thus, even though age, teaching experience, training in DI, the value of DI, administrative support, class size, workload, and planning are all predictors of the use of DI, the results of the current study show that the impact of training in DI is more conspicuous with the use of DI. This indicates that DI training played a significant role in helping the teachers use DI. Multicollinearity results is shown APPENDIX C. The summary of the regression model are shown in APPENDIX E.

Table 6 - *Regression Analysis of Modes of Assessment and the End of Term Examination*

	Coefficients			**F-Test**	
	Unstandardized Coefficients	Standardized	Sig	F	Sig
Intercept	3.707			2.795	0.007
Age	0.025	0.018	0.018		
Teaching Experience	0.071	0.061	0.027		
Training in DI	0.910	0.838	0.000		
Value of DI	0.539	0.667	0.004		
Administrative Support	0.046	0.019	0.029		
Class Size	-0.564	-0.587	0.000		
Workload	-0.456	-0.347	0.004		
Planning	0.065	0.049	0.014		

Multiple $R = 0.398, R^2 = 0.158,$ *Adjusted* $R^2 = 0.102,$ *Significant at* $P < 0.05$

The qualitative phase's participants' responses better reaffirmed the findings. There was a great deal of debate about the suitability of professional development and instructional support methods for students with different learning styles. Teachers stated that the administration promoted the practice and that training and structure were implemented to ensure that differentiated practices were maintained in the classroom. There was a lot of value in the training they received, and it was described as always being compelling. When it came to differentiated instruction, one of the most common complaints was that training examples were at the secondary school level. Additionally, teachers were pleased to see that the professional development incorporated the same differentiated practices that were taught in the classroom during the initial training.

Discussion of Results of research question 2

Research question two sought to explore the factors that influence the use of DI. The result of the study indicated that training in DI seems to be the strongest predictor of the use of DI compared to age, teaching experience, training in DI, the value of DI, administrative support, class size, workload, and planning. The participants expressed the value of differentiated instruction personally, and they also stated administrative support in DI. Professional development and training efforts with a match between training and need were cited as factors in the acquisition of differentiating techniques. Darling-Hammond, Wei, Andree, Richardson, and Orphanos (2009) researched professional development in the United States and other nations. Their study discovered that professional growth in the United States was comparable to that of other countries regarding the number of short-term chances available. The United States differed from other countries in that it provided more significant opportunities for long-term professional development. This is consistent

with the responses from the participants. Researchers and participants in this study have found that the short workshop model of professional development does operate effectively in terms of research or participant opinion. This implies that for teachers to be able to adopt DI, they need training for effective usage of DI in the classroom.

Teachers training for instance will help them acquired knowledge to apply DI as suggeseted by . For instance, the teachers may have idea that the ZPD is the difference between what a learner has already mastered, their current level of growth, and what they may do with encouragement or future development (Schutz, 2004). The ZPD theory's primary purpose is to illustrate the discrepancy between a learner's ability to solve problems independently and the substantial importance of that ability when given the required assistance. As a results of that they can plan their instruction in line with the theory of ZPD when they have the pre-requistic training.

4.3 Research question 3: Teacher Characteristics and the use of DI

In assessing teachers characteristics and the use of DI, research hypothesis one, "*there is no significant difference between teacher characteristics and the use of differentiated instruction",* was addressed.

Results of Reseacrh Questions 3

The data in Table 7 detail the amount of differentiated instruction training received by SHS mathematics teachers. They assigned it a rating of none, some, or extensive. A chi-square test of independence was used to examine the relationship between training and SHS mathematics teachers' use of differentiation.

Table 7 - *Amount of Training Related to DI Implementation*

DI	Amount of Training in the use of DI			
	None	Some	Extensive	**Total**
Minimal	1	2	7	**10**
Moderate	0	4	61	**65**
Extensive	0	7	46	**53**
Total	**1**	**13**	**114**	**128**

Note. There was a significant relationship between DI use and teacher training, $\mathcal{X}^2(4, N = 128) = 6.718, p = 0.010, p < 0.05, effect\ size = 0.39$

The data in Table 8 examine the relationship between the importance of DI and the value placed on it by SHS mathematics teachers. When instructors were asked to rate the components of DI, they were asked to prioritise the item's importance to effective teaching.

Table 8 - *Teacher Value of DI to Use of DI*

DI	Teacher Value of DI			
	Low	Medium	High	**Total**
Minimal	2	4	9	**15**
Moderate	1	12	49	**62**
Extensive	0	7	44	**51**
Total	**3**	**23**	**102**	**128**

Note. There was a significant relationship between DI use and teacher value of DI, $\mathcal{X}^2(4, N = 128) = 21.439, p = 0.000, p < 0.05, effect\ size = 0.52$

According to the quantitative analysis of survey data, all of the teacher characteristics in relation to the use of DI were statistically significant.

Discussion of Results of Research Question 3

The findings also revealed that there is a relationship between SHS mathematics teachers' experience , class size and the use of DI. However, even

though younger mathematics teachers were exposed to new and innovative teaching techniques, their inexperience may lead them to employ more traditional strategies as they witness their mentors employ them. It is also possible for experienced teachers not to employ DI because they are hesitant to change and believe they are comfortable with what they already know. This research demonstrates that experienced teachers are more likely than inexperienced teachers to employ DI. This finding contrasts with Ahmed (2013), who discovered that experienced teachers are more likely to use student-centred tactics rather than DI in their lessons. Contradictions in the findings of the Ahmed study can be attributed to the fact that the teachers who made up the study's population taught more mature students (in a higher education setting), which resulted in their utilisation of student-centred instruction. More mature students and at higher levels of education are more autonomous in their decision-making and take greater responsibility for their learning. As a result, the students in the Ahmed study were more responsible learners than the SHS students in this study, and as a result, the Ahmed study employed more student-centred tactics than the SHS students. Aside from that, younger students require more individual attention, more specific instruction, and more time to finish a task than older students. These requirements are met by experienced teachers, whose practices have become more sophisticated due to their ongoing practice.

The research conducted by Hamzeh (2014) also discovered that teachers' years of experience substantially impact their utilisation of DI. In terms of research design and the tool used for data collection, both investigations were very comparable. A descriptive survey was conducted, and data was gathered through the use of a questionnaire. It is possible that these characteristics were responsible for the parallels in the findings.

The number of students predicts the usage of DI by SHS mathematics teachers. When the number of students in a class increases, it becomes more difficult for the teacher to maintain, control and manage behaviour. Furthermore, the teacher's equipment and time are no longer sufficient for their needs. DI is more likely not to be used by teachers with many students since it does not allow them to control behaviour better and manage time. In this study, the findings are similar to those of Bolachandran (2015), who asserted that the makeup of a class in terms of numbers impacts a teacher's decision to adopt DI. Aside from the teachers in Bolachandran's study being mathematics teachers, the composition of their classes in terms of the number of students was very similar to the composition of the classes in this current research. In both studies, the teachers were teaching large classes. This could explain why the size of the class had an impact on the use of DI.

This is also in line with the theory ZPD, because experience teachere may understand the content of the curriculum interms of instruction, assessment etc and as a results can adjust their lessons for the learners to achieve ZPD when using DI as compared to inexperience teachers. For example experience teachers may come to be in agreement with the theory of ZPD which proposes that ssessment, curriculum scaffolding, the learning process, flexible classification, and learner preference are essential concepts in the ZPD theory (Miller, 2002). In the ZPD theory, evaluation is crucial for assessing readiness and scaffolding content (Whipple, 2012). Teachers' knowledge of ZPD helps them assess their learners and provide content-rich instructions at each learner's level.

4.4 Research Question 4: Institutional Characteristics and the use of DI

In assessing institutional characteristics and the use of DI, research question 4 and Research hypothesis two, "*there is no relationship between institutional*

characteristics and the use of differentiated instruction", was addressed. To answer the research hypothesis, chi-square was used.

Result of Research Question 4

The data in Table 9 address the relationship between the degree of administrative support and the use of DI; instructors use the ratings of supports and encourage, doesn't encourage or discourages the use of DI.

Table 9 – *Administrative Support to Use of DI*

DI	Administrative Support			
	Low	Medium	High	**Total**
Minimal	0	1	17	**18**
Moderate	0	5	38	**43**
Extensive	0	12	55	**67**
Total	**0**	**18**	**110**	**128**

Note. There was no significant relationship between DI use and administrative support, $\mathcal{X}^2(4, N = 128) = 4.143, p = 0.071, p > 0.05, effect\ size = 0.49$

Table 10 shows the relationship between the number of students who were taught per day in their classes and their use of DI. The SHS mathematics teachers chose from three options: Per day, 0 – 40, 41 – 70, or 71 or more.

Table 10 – *Class Size to Use of DI*

DI	Class Size			
	0 – 40	41 - 70	> 70	**Total**
Minimal	4	16	7	**27**
Moderate	8	21	27	**56**
Extensive	7	34	4	**45**
Total	**19**	**71**	**38**	**128**

Note. There was a significant relationship between DI use and class size, $\mathcal{X}^2(4, N = 128) = 32.042, p = 0.000, p < 0.05, effect\ size = 0.52$

Table 11 shows the relationship between the number of classes taught per day and differentiated instruction implementation. Respondents could choose from one of three options: 1–3, 4–5, or 6 or more. This was compared to the use of DI.

Table 11 – *Workload to Use of DI*

DI	Workload			
	1 – 3	4 - 5	6 +	**Total**
Minimal	3	12	6	**21**
Moderate	2	34	11	**47**
Extensive	1	37	22	**60**
Total	**6**	**83**	**39**	**128**

Note. There was a significant relationship between DI use and workload, $\mathcal{X}^2(4, N = 128) = 13.162, p = 0.003, p < 0.05, effect\ size = 0.38$

Table 12 shows the relationship between planning time and DI implementation. SHS mathematics teachers were asked to estimate how much planning time they had per day in increments of 0 – 30, 31 – 60, or 61 minutes or more per day.

Table 12 – *Amount of Planning Time to Use of DI*

DI	Planning time Per Minute			
	0 – 30	31 - 60	61 +	**Total**
Minimal	1	4	2	**7**
Moderate	0	16	38	**54**
Extensive	1	23	43	**67**
Total	**2**	**43**	**83**	**128**

Note. There was a significant relationship between DI use and the amount of planning, $\mathcal{X}^2(4, N = 128) = 4.314, p = 0.000, p < 0.05, effect\ size = 0.45$

Except for administrative support, all the institutional characteristics showed were significantly related to the use of DI. Thus class size, teacher workload and planning time were significantly related to the use of DI.

Discussion of Results of Research Question 4

The research hypothesis demonstrated a statistically significant relationship between DI use and training in DI, the value of DI, class size, workload and planning time. However, there was no significant relationship between the use of DI and administrative support. Teacher qualities, such as teaching strategies and student accomplishment, have been linked to various outcomes in previous studies (Anthony & Walshaw, 2009; Austin, 2013; Holzberger et al., 2013). Researchers discovered that teachers who had training in DI and placed a high value on DI were more likely to use DI in content. As previously reported, teachers who have received extensive training in differentiation and who place a high value on differentiation put forth tremendous effort in implementing new teaching methods, strategies, and personalised learning support (Holzberger et al., 2013), as well as greater flexibility in classroom engagement and lesson design (Temiz & Topeu, 2013), all of which are critical for effective differentiation (Tomlinson & Strickland, 2005). Furthermore, it has been shown that teachers who have received training in DI and value DI are better able to organise and execute instructional activities for unique settings (Skaalvik & Skaalvik, 2007). The training in DI for instance can assist teachers to understand that every learner is intelligent in one way or the other as suggested by theore of multiple intelligent. It also confirms that each learner has different strengths and limitations in different areas of intelligence. Gardner defines intelligence as a person's ability to process and apply information to construct something or solve a problem. For teachers to teach for learners to achieve ZPD, training of teachers in DI is very essential.

4.5 Summary

The results of the current study show that, while factors such as age, teaching experience, training in DI, the value of DI, administrative support, class size, workload, and planning are all predictors for using DI, the impact of training in DI is more noticeable with the use of DI than with the use of other methods. It is argued from the study's discoveries that SHS mathematics teachers are knowledgeable in the use of DI. Expect administrative support; the hypothesis set for the study demonstrated a statistically significant relationship between DI use and training in DI, the value of DI, class size, workload and planning time.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.0 Overview

The chapter presents the summary, conclusion and recommendation of the study.

5.1 Summary of the Results of the Study

The study results demonstrated that SHS mathematics teachers highly knew DI's primary concepts and practices. The SHS mathematics teachers' knowledge of the nine DI components varied. The SHS mathematics teachers' knowledge level was determined as SHS mathematics teachers' general knowledge of DI, learning style, learner interest, process, environment, lesson planning, assessment, content, and learner diversity in descending order of magnitude.

The findings also revealed that SHS mathematics teachers in the Central Region decision to use DI are influenced by training in DI, age, teaching experience, training in DI, the value of DI, administrative support, class size, workload, and planning. However, the best predictor of the use of DI was training in DI.

The study results demonstrated a statistically significant relationship between DI use and training in DI, the value of DI, class size, workload, and planning time. However, there was no statistically significant relationship between DI use and administrative support.

5.2 Conclusions

The possession of the necessary knowledge in the use of DI is an important consideration that determines the extent and exact use of DI by SHS mathematics teachers. A good proportion of the SHS mathematics teachers in the sampled schools

rated themselves high regarding their knowledge levels on all the nine subconcepts of DI. It is concluded from the study findings that SHS mathematics teachers in the Central Region of Ghana are highly knowledgeable in the use of DI.

SHS mathematics teachers are more likely to use DI if there is improvement in training in DI, valuing DI, reducing class size and workload, increased time for planning and administrative support. The study revealed that the best predictor of use of DI was training in DI. Teachers require more professional development to differentiate across all domains: curriculum, methods, resources, learning activities, and products. Training did indicate a significant association in the quantitative study of variables related to SHS mathematics teachers' use of DI. This could be a result of the training's quality. It should be highlighted that during the qualitative phase of the study, SHS mathematics teachers described their training as adequate and, when obtained, excellently executed. Practical training may very likely have a substantial impact on SHS mathematics teachers' use of DI. Teachers in the qualitative phase discussed and expressed what they considered to be effective training. The training should be adapted to the SHS mathematics teacher's specific needs. There should be a considerable emphasis on collaboration among faculty members. According to participant comments, this is the most engendered way of teacher training. The most critical part of assisting teachers in implementing DI would be to collect data demonstrating its success. Teachers aspire to be effective in their work educating children and adolescents. When students observe the efficacy of DI, their value for differentiation increases. As demonstrated by this study's quantitative analysis, teachers who value DI use DI in their classrooms. Differentiation of instruction could occur fast through a well-designed procedure that incorporates both intelligent training and collaborative work and support among personnel.

5.3 Recommendation

The findings of the study led to the formulation of a number of recommendations. Some of the recommendations call for action on the part of educational stakeholders, while others call for additional studies.

Recommendations for Practice

1. The Central Regional Educational Directorate should continuously organise teachers' professional development programs on differentiation of instruction to provide them with the necessary knowledge, skills, and support to meet the learning needs of all students in their classrooms.
2. Central Regional Educational Directorate should facilitate the employment of more SHS mathematics teachers to reduce the teacher-student ratios in the schools to increase their ability to tailor instruction towards students' needs.

Recommendations for Further Research

1. Further studies involving larger samples using SHS mathematics teachers in Ghana should be undertaken to evaluate how the validity of the present findings can be confirmed.
2. The impacts of differentiated instruction on students learning outcomes should be investigated.
3. A further study involving observations is recommended to give an in-depth knowledge of teachers' knowledge to ascertain the validity of their self-reported practices.

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APPENDIX A

MATHEMATICS TEACHERS' QUESTIONNAIRE

Dear Colleague,

The purpose of this questionnaire is to gather data on the extent to which you use differentiated instruction as a senior high school mathematics teacher. Your thoughtful and truthful responses will be greatly appreciated. Would you please answer each question to the best of your knowledge? Your name is not required. Your responses will be kept entirely confidential. Thank you for taking the time to complete this questionnaire.

SECTION A: KNOWLEDGE AND USE OF DIFFERENTIATED

INSTRUCTION

Please **tick [√]** in the appropriate space provided below and supply answers where required. Please read the descriptions and tick the number that best describes the degree of your knowledge on DI in the left and right columns, indicating your use level?

Strongly Disagree = 1; Disagree = 2, Neutral = 3, Agree = 4; Strongly Agree= 5

S/N	**Knowledge on DI**					*Statement*	**Level of Use of DI**				
	Strongly	***Disagree***	***Neutral***	***Agree***	***Strongly Agree***		***Strongly***	***Disagree***	***Neutral***	***Agree***	***Strongly Agree***
Learner Diversity											
1.						I see all students in my classroom as homogeneously the same					
2.						Students in my classroom have the same learning characteristics					
3.						Every classroom has students with learning disabilities/abilities					
4.						Lessons must be taught to satisfy each learner in the classroom					

5.						Gifted learners are also special students who need extra attention					
6.						Lessons must be taught to all students generally in the same way					
Learning interest											
7.						Every learner in the same class should understand the content after teaching a lesson using the best single method of teaching					
8.						Every student in the classroom has their learning interest					
9.						Every individual learner has a learning culture and expectations					
10.						Every student's interests, cultures and expectations should be considered when teaching (that is if they have)					
Learning Style											
11.						Individual students' life situations impact their learning greatly					
12.						Every student in the classroom has their learning style					
13.						Each learner learns through a particular learning style					
14.						Every student's learning disabilities and abilities must be addressed through their learning style when teaching					
Lesson Planning											
15.						Every student's needs must be considered when planning lessons					
16.						Lesson objectives should consider individual leaner's needs					
17.						Lessons should be planned considering students' differences					
18.						The same lesson plan must satisfy all learners in the same class					
Content											
19.						Content can be varied for students in the same classroom					
20.						Specifically, contents can be reduced for students with learning difficulties and upgraded for gifted learners (in					

						the same class)					
21.						All learners in the same classroom must learn the same content no matter their learning differences or learning needs					
22.						Content must satisfy the curriculum needs or examination requirements instead of individual student's needs					
Process											
23.						Teaching/Learning activities should mainly/primarily be based or centred on individual student's needs during lesson delivery					
24.						Lessons should be taught strictly to complete the syllabus instead of varying instruction to satisfy learner needs					
25.						Each learner in the classroom should be allowed to choose their preferred way of learning					
26.						Learner groups in the classroom should be formed based on learners' abilities, interests, styles and learning preferences					
27.						Students should be provided with the choice to work alone, in pairs or small groups during teaching/learning					
28.						Some students can be given individual attention during teaching					
29.						A variety of teaching methods should be used during teaching					
30.						I am familiar with entering into learning contracts with students					
31.						I am familiar with engaging learners in tiered activities/lessons					
32.						I am familiar with scaffolding learners in teaching/learning					
Assessment											
33.						Questions asked during teaching should only measure students' understanding and progress on the content being taught					
34.						Students should be provided with the					

						choice to work alone, in pairs or small groups during classroom assessment					
35.						I provide a variety of assessment tasks for students to choose from					
36.						A variety of assessment tools/strategies should be employed before, during, and after teaching and learning					
37.						Every learner must work on the same assessment tasks					
38.						Assessment should not be separated from learning					
Environment											
39.						The classroom environment should be structured to support a variety of activities like flexible grouping or individual work					
40.						Materials should be varied to satisfy students' interests/abilities					
41.						A learning environment should favour every learner					
42.						A regular classroom environment should include special children or students with disabilities (physical, emotional, mental etc.)					
General											
43.						I know much about equity and accessibility for all learners					
44.						I have enough knowledge on Special Education					
45.						I have enough knowledge on Inclusive Education					
46.						I have enough knowledge of differentiated instruction					

SECTION B: TEACHER SELF-REFLECTION OF DIFFERENTIATION OF INSTRUCTION

Please **tick [√]** in the appropriate space provided below and supply answers where required.

47. Age: _____

48. Gender: Male [ ] Female [ ]

49. Professional Qualification: Professional [ ] Non-Professional [ ]

50. The number of years teaching: _____

51. I would describe my differentiated instruction training experience as:

    None [ ] Some [ ] Extensive [ ]

52. What training have you had (check all that applies):

    Course from University (please specify) [ ] _____

    In-service activity (please specify) [ ] _____

    Conferences, meetings, or workshops (please specify) [ ] _____

    No training [ ]

53. My school's management (pick the one best answer):

    Supports and encourages the use of differentiated instruction [ ]

    Doesn't encourage nor discourage differentiated instruction [ ]

    Discourages the use of differentiated instruction [ ]

54. How many classes do you teach per day (average over a week if there is day to day variance): 1 to 3 [ ] 4 to 6 [ ] 7 and above [ ]

55. How many students do you have on your class rosters per day (average over a week if there is day to day variance): 10 to 30 [ ] 31 to 60 [ ] 61 and above [ ]

56. How much planning time is designated for you per day (average over a week if

there is a day to day differences)?

0 to 30 minutes per day [ ]

31 to 60 minutes per day [ ]

61 and above minutes per day [ ]

Thank You for Your Time!

APPENDIX B

MATHEMATICS TEACHERS' INTERVIEW GUIDE

1. Do you think that students in your classroom have the same or similar learning characteristics? Yes [ ] No [ ]. Briefly explain.....
2. Do you deliver/teach lessons to satisfy each learner in the classroom or the syllabus requirement? Why?.....
3. Do you know that every student in the classroom has their learning interest, culture and expectations? Yes [ ] No [ ] Specify .....
4. Can you mention or explain any of such learning interests, cultures and expectations?
5. Do you know that every student in the classroom has their learning interest, culture and expectations? Yes [ ] No [ ] Specify.....
6. Can you mention or explain any of such learning interests, cultures and expectations?
7. Do you consider every student's interest, cultures and expectations when teaching (that is, if they have) Yes [ ] No [ ] Briefly explain how you that..... .....Skip if the answer in (8) above is No
8. Do you have any idea about the learning styles of students? (How students learn) Yes [ ] No [ ] Briefly explain if yes ……
9. Do you address each student's learning disabilities and abilities through their learning style when teaching? Yes [ ] No [ ]. If yes, How?.....
10. Do you consider each student's needs when planning lessons? Yes [ ] No [ ] Why?

11. Do you consider individual leaner's needs when setting lesson objectives? Yes [ ] No [ ]. Why?
12. Do you vary the content of your lessons for students in the classroom? Yes [ ] No [ ]
13. Do you reduce content for students with learning difficulties and upgrade them for gifted learners (in the same class)? Yes [ ] No [ ] Give reasons ……...
14. Do you provide a variety of assessment tasks for students to choose from? Yes [ ] No [ ] Yes – How?..... No – Why?.....
15. Do you agree that various assessment tools and strategies should be employed before and after teaching and learning? Yes [ ] No [ ]
16. In your opinion, how important is it that you should differentiate instruction?
17. What has led to your assessment of differentiated instruction's importance?
18. What most influences your thoughts on differentiated instruction?
19. What kinds of results have you seen from addressing the learning differences of students in your teaching?
20. What is most helpful in assuring that you differentiate instruction?
21. · What most impairs your ability to differentiate?

APPENDIX C

MULTICOLLINEARITY TEST (CORRELATION AMONG IDEPENDENT VARIABLES)

Correlations

		Age	Teaching Experience	Training in DI	Value of DI	Administrative Support	Class Size	Workload	Planning
Age	Pearson Correlation	1	.350**	.070	-.098	.193*	-.111	.150	-.147
	Sig. (2-tailed)		.000	.431	.271	.029	.211	.092	.097
	N	128	128	128	128	128	128	128	128
Teaching Experience	Pearson Correlation	.350**	1	-.034	-.262**	.168	-.048	.124	-.005
	Sig. (2-tailed)	.000		.699	.003	.057	.594	.162	.959
	N	128	128	128	128	128	128	128	128
Training in DI	Pearson Correlation	.070	-.034	1	-.172	.064	.071	-.148	-.147
	Sig. (2-tailed)	.431	.699		.052	.473	.423	.096	.099
	N	128	128	128	128	128	128	128	128
Value of DI	Pearson Correlation	-.098	-.262**	-.172	1	-.174*	-.084	.165	.113
	Sig. (2-tailed)	.271	.003	.052		.049	.348	.063	.203
	N	128	128	128	128	128	128	128	128
Administrative Support	Pearson Correlation	.193*	.168	.064	-.174*	1	.130	.081	-.148
	Sig. (2-tailed)	.029	.057	.473	.049		.144	.366	.094
	N	128	128	128	128	128	128	128	128
Class Size	Pearson Correlation	-.111	-.048	.071	-.084	.130	1	.043	.145
	Sig. (2-tailed)	.211	.594	.423	.348	.144		.629	.103
	N	128	128	128	128	128	128	128	128
Workload	Pearson Correlation	.150	.124	-.148	.165	.081	.043	1	.255**
	Sig. (2-tailed)	.092	.162	.096	.063	.366	.629		.004
	N	128	128	128	128	128	128	128	128
Planning	Pearson Correlation	-.147	-.005	-.147	.113	-.148	.145	.255**	1
	Sig. (2-tailed)	.097	.959	.099	.203	.094	.103	.004	
	N	128	128	128	128	128	128	128	128

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

*. Correlation is significant at the 0.05 level (2-tailed).

APPENDIX D

SUMMARY OF THE REGRESSION MODELS

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.398[a]	.158	.102	.34005

a. Predictors: (Constant), Age, Teaching Experience, Training in DI, Value of DI, Administrative, Support, Class Size, Workload and Planning

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
	(Constant)	3.707	.272		13.253	
	Age	.025	.040	.018	-2.142	.018
	Teaching Experience	.071	.053	.061	.298	.027
	Training in DI	.910	.051	.838	-1.088	.000
	Value of DI	.539	.070	.667	-1.467	.004
	Administrative Support	.046	.066	.019	1.823	.029
	Class Size	-.564	.061	-.587	1.464	.000
	Workload	-.456	.062	-.347	-.694	.004
	Planning	.065	.106	.049	1.712	.014

a. Dependent Variable: Overall Knownloage on DI

ANOVA[a]

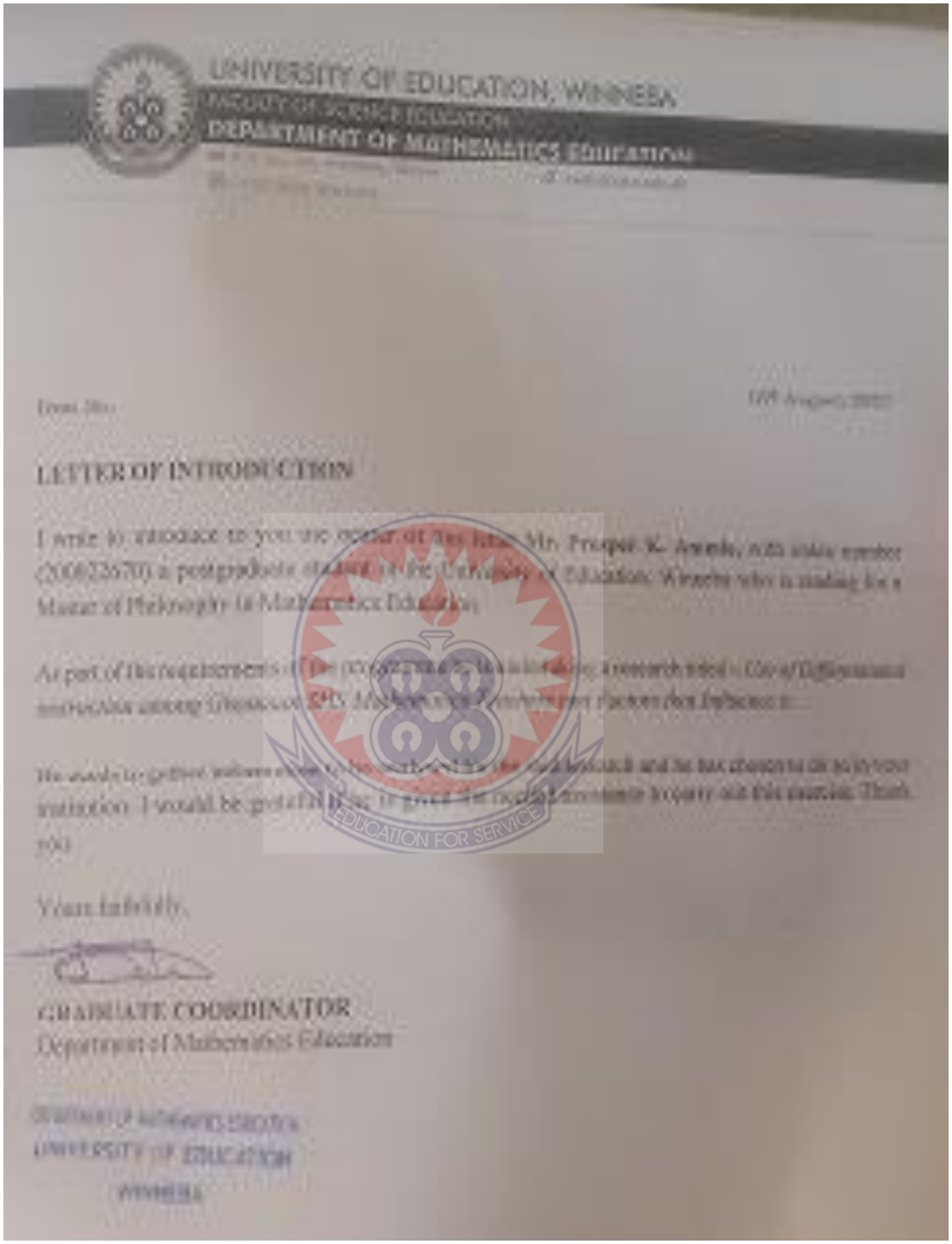
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2.903	8	.363	2.795	.007
	Residual	13.761	119	.116		
	Total	16.664	127			

a. Dependent Variable: Overall Knownloage on DI

b. Predictors: (Constant), Age, Teaching Experience, Training in DI, Value of DI, Administrative, Support, Class Size, Workload and Planning

APPENDIX E

INTRODUCTORY LETTER



UNIVERSITY OF EDUCATION, WINNEBA
FACULTY OF SCIENCE EDUCATION
DEPARTMENT OF MATHEMATICS EDUCATION

Dear Sir/

LETTER OF INTRODUCTION

I write to introduce to you the bearer of this letter, Mr. Prosper K. Awuah, with index number (20022670) a postgraduate student in the University of Education, Winneba who is reading for a Master of Philosophy in Mathematics Education.

As part of the requirements for the programme, he is undertaking research titled "Use of Differentiation Methods among Ghanaian SHS Mathematics Teachers: Factors that Influence it".

He wants to gather information from you which will help him in his research and he has chosen to do so in your institution. I would be grateful if you could assist him to carry out this exercise. Thank you.

Yours faithfully,

GRADUATE COORDINATOR
Department of Mathematics Education

UNIVERSITY OF EDUCATION
WINNEBA