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INFLUENCE OF THE DIPLOMA IN BASIC EDUCATION PROGRAMME RUN BY COLLEGES OF EDUCATION ON BEGINNING TEACHERS' TEACHING EFFICIENCY IN MATHEMATICS

BY

JAPHET KWASI OSIAKWAN

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

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DECLARATION

Candidate's Declaration

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

Candidate's Signature:..... Date: 13/02/2023

Name: Japhet Kwasi Osiakwan

Supervisors' Declaration

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

Principal Supervisor's Signature ..... Date 13-02-23

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Name: Prof. Ernest Kofi Davis

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ABSTRACT

This study examined the influence of the Diploma in Basic Education (DBE) programme run by Colleges of Education on beginning teachers' teaching efficiency in mathematics. The study employed sequential explanatory mixed method design. In all, the study used 184 teacher participants comprising 104 beginning and 80 in-service teachers selected using multistage sampling techniques – simple random, purposive and proportionate sampling. Observation schedule, questionnaire and semi-structured interview guide were used to collect data which were analysed and discussed within the framework of Valsiner's Zone Theory. The quantitative data were analysed using descriptive statistics (mean, standard deviation) and inferential statistics (independent sample t-test, one-way analysis of variance – ANOVA) while the qualitative data were analysed narratively. It was found that the DBE programme was effective in building the teaching practices and attitude of beginning teachers. The teaching practices of the DBE trained teachers were rated very high. There was no statistically significant difference between teaching practices of beginning teachers and in-service teachers. Attitude of the beginning teachers towards teaching of mathematics was also positive. Overall, the beginning teachers perceived the training programme as being useful. However, teaching practices and attitudes of beginning teachers were found to differ across specialties (early childhood, primary and junior high). It was therefore recommended that Mentoring Universities should consider extending the duration of the method of teaching mathematics course from one semester to at least two semesters to give room to preservice teachers to internalise the content of the methods course to improve teaching efficiency. Suggestions were made for further studies.

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KEY WORDS

Beginning teachers

Colleges of Education

Diploma in Basic Education programme

Methods of teaching mathematics

Teaching efficiency

Teaching practice

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DEDICATION

To my mother, Elizabeth Akosua Osiakwan, of blessed memory.

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CHAPTER ONE

INTRODUCTION

Overview

Academic scholars are of the view that the key to transforming schools and improving academic achievements is improving teacher-training programmes. Further, studies have indicated that the teacher is the main determinant of what pupils learn and the aspect of the teacher that mostly affects pupils learning is their teaching practices. Despite the continual investment in training of teachers to improve the quality of teaching and learning in schools in Ghana, the underachievement of Basic School pupils in mathematics still lingers, suggesting that there is a challenge with the way mathematics is perceived and taught at that level. This study therefore examined the influence of the regular Diploma in Basic Education (DBE) programme on beginning teachers' Teaching Efficiency in Mathematics (TEM). Teaching efficiency was herein assessed using Valsiner's zone theory as a lens on some aspects of teaching practices that have been shown to positively relate to teaching and learning. Understanding how preservice teachers' training programme influences beginning teachers TEM is a necessary precursor to developing policies that could support them. This chapter therefore presents the background to the study, the statement of the problem, purpose of the study, research questions and hypotheses, significance and the organisation of the study.

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Background to the Study

Darling-Hammond (2000) argued that, holding other factors constant, the strongest factors that determine student's achievement are teacher preparation and certification, especially in mathematics and reading. Preparation of teachers for the teaching profession is critical to any country that seeks to improve the quality of its education (Boudersa, 2016). To achieve quality learning outcomes in mathematics education, the teacher must facilitate learning in the mathematics classroom (Prempeh, 2018). To do that, the teacher needs not only be equipped with knowledge and skills but also the behaviour required for teaching mathematics since teaching is considered as an art and science. The teacher therefore has the responsibility to efficiently utilize appropriate methodology to teach in ways that will bring out the best from pupils in terms of academic achievement (Yara, 2009).

The view that the "teacher is more important than the equipment of his laboratory for the understanding of the chemical concepts has always been evident" (Bajah (1979) as cited in Abu, & Fabunmi, 2009, p.14). The argument has been that no matter how good the laboratory equipment may be, they remain mere teaching aids for improved performance. However, the assumption that effective teaching only requires understanding of a few basic ideas has led to the misconception that teaching is easy (Darling-Hammond & Baratzs, 2005). Darling-Hammond and Baratzs noted that an effective teacher must possess an understanding of three things: learners, subject matter and teaching. Thus, a real understanding of teaching mathematics goes beyond mastery of few basic facts, but includes knowledge of the learner, content specific pedagogies, classroom organization and management

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strategies and approaches for creating and using assessment to check for understanding. In other words, for quality teaching and learning of mathematics, teachers need to acquire some level of competencies through training.

The first place where teachers develop their competencies is the preservice teacher training (Wolf, 2018). The objective of any teacher-training programme should therefore be directed towards equipping teachers with the necessary competencies for them to act as agent of change in the classroom. For teachers to be able to discharge their duties diligently, they need to possess two kinds of competencies: academic competencies and methodological competencies (Siddique, 2010). The academic competences include the ability of the teacher to possess certain basic subject matter knowledge necessary for the subject they teach. In this case, the mathematics teacher should possess sufficient knowledge and understanding in all the areas specified in the Basic School mathematics curriculum. The methodological competences, on the other hand, includes knowledge of the processes of teaching; thus, knowledge and skills necessary to create conducive learning environment for effective learning to take place. It is expected that teachers who successfully complete their training should be knowledgeable in both content and the appropriate methodology to effectively communicate mathematics concepts to learners in the classroom.

Indeed, the quality of teaching and learning largely depends on teacher preparation or training (Akyeampong, Lussier, Pryor & Westbrook, 2013). As Struyf, Adriaeensens and Meynen (2011) puts it, teacher training evidently influences several competences of beginning teachers. For instance, teachers who

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are prepared in teacher education programmes feel better prepared for teaching than those who enter teaching without preparations (Darling-Hammond, Chung & Frelow, 2002). Empirically, the achievement scores for students who were taught by most qualified teachers far outweigh the scores for students taught by least qualified teachers (Darling-Hammond, 2010).

In a related study to investigate the impact of teacher training on students learning and whether trained teachers make any difference in organizational performance, it was evident that teacher training has positive impact on students learning attitude and consequential improvement in organizational performance (Ali & Hamza, 2018). The study further explained that, through training, teachers can adopt novel instructional techniques that arouse students' The implication is that trained teachers should be able to use their tailored training experiences to create a supportive and engaging classroom environment for pupils to learn mathematics with understanding.

In recent times, improving the qualities of teaching and learning of mathematics has been a major concern to teacher training institutions in many countries. For example, the National Institute of Education, the teacher training arm of the Singapore Ministry of Education, had put in place mechanisms to ensure that teacher trainees who are to be trained to teach mathematics have basic mathematics mastery (Toh, Chua & Yap, 2007). In particular, the Singapore teacher trainees are expected to pass a mathematics qualifying test by at most three attempts before their graduation from the National Institute of Education. Trainees who pass the test are deemed to have adequate knowledge, both in terms of sound pedagogy and in terms

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of proficient content knowledge to teach mathematics. On the other hand, those who fail the test (on third attempt) are deemed to have inadequate mathematics content knowledge to teach mathematics (Toh et al., 2007). The aim of the qualifying test is to ensure that teacher trainees have the minimum content that is essential for teaching mathematics at a particular level.

Further, in Poland, all preservice teachers who are supposed to teach Grade 4 and beyond are given specific training in mathematics, and they are expected to demonstrate a high level of mathematics knowledge and competencies as such (Brese, 2012). In addition to the special training in mathematics, the requirement for entry into teaching in Poland had been raised as one of the quality assurance policies. Also, in some other countries such as Canada, Norway and Malaysia, as part of the measures to ensure quality teaching of mathematics, entry into teacher preparation programmes is limited to only students who have successfully completed mathematics course at the University level (Brese, 2012).

Again, in USA, the No Child Left Behind Act, NCLB (as cited in Greenberg, Rhodes, Ye, & Stancavage, 2004), stipulates that highly qualified teachers must demonstrate that they have sufficient subject-matter knowledge and teaching skills with a minimum of bachelor's degree to be able to teach. These measures highlight the importance of teacher quality and the need for teachers to be given special training in order to teach mathematics efficiently.

In Ghana, the quality of teaching and learning in schools have been described as an area of concern (Akyeampong & Furlong 2000; Asare & Nti, 2014; Buabeng, Ntow, & Otami, 2020). To this end, attention has been directed towards

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improving teacher training programmes (Akyeampong & Furlong, 2000; Asare & Nti, 2014) with the aim of improving the quality of the teachers sent into the classroom, especially to teach mathematics at the Basic School level. The impetus to improve the quality of teaching and learning in schools has led to many forms of quality assurance measures in the Colleges of Education.

For instance, to ensure that teachers who completed their programmes of study were competent enough to teach in schools, each trainee was expected to pass an end of training examination conducted by the Institute of Education, University of Cape Coast (Asare & Nti, 2014a). In addition, student teachers in their first year are expected to pass both internal and external promotional examinations of which mathematics is an integral part. Student teachers who pass all their subjects in the external examination are considered to have sound subject knowledge for professional development in teaching (Akyeampong & Furlong, 2000). On the other hand, student teachers who fail this examination are made to withdraw from the programme with the reason that they do not have the necessary subject knowledge background for teacher development.

The key to transforming schools and improving academic achievements in Ghana is improving teacher-training programmes (Armah, 2017). Teacher training programme is seen as an important avenue for improving the knowledge and skills of teachers. The concern has been that teachers need to acquire some kind of special preparation or skills to be able to teach at all levels (Asare, & Nti, 2014; Buabeng, Ntow, & Otami, 2020).

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One recent study that had confirmed the need for Ghanaian teachers to be prepared adequately in order to teach mathematics for conceptual understanding at the Basic School is that of Butakor, Ampadu and Cole (2017). In their study, they analysed the Trends in International Mathematics and Science Study (TIMSS) 2011 mathematics data to find out which school level variable contributed significantly to the abysmal performance of Ghanaian students. The study concluded that inadequate preparation of teachers partially contributed to the poor performance of Ghanaian students in mathematics of which emphasis was on lower rather than higher thinking skills. Clearly, teachers need special preparation or training to be able to influence their pupils' learning outcome in mathematics. Such concerns and similar others have led to systematic efforts by educators in the country to investigate teacher preparation programmes to ensure that they produce teachers who can perform competently as teachers (Asare, Mereku, Anamuah-Mensah & Oduro, 2012), especially in mathematics.

Ghana over the years, has charted the path of investing in high quality teacher preparation in ensuring that teacher trainees have at least the minimum competencies necessary to enter the teaching profession (Armah, 2017). As such, there have been several programmes to upgrade teachers' competences in teaching mathematics and other subjects especially at the Basic School level. For instance, new programmes were introduced to upgrade teachers with Certificate B to Certificate A (Akyeampong & Furlong, 2000). Further, there was the need for teachers to specialize in specific subject areas such as Mathematics, English, Science and the Arts. As such in 1962, there was the introduction of specialist

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courses to train teachers in some subject areas. To further improve the professional competences of trained teachers, there was an introduction of a 3-year post-secondary residential teacher training programme of which the first batch completed in 1978.

Furthermore, in order to equip all Ghanaian preservice teachers with the needed mathematical skills, insight, attitude and values that they will need to be successful in their chosen careers and daily lives, the Ministry of Education (MoE) in collaboration with Teacher Education Division (TED), upgraded the then 38 initial Teacher Training Colleges to 3-year Diploma in Basic Education (DBE) programme. The introduction of the DBE programme was in response to a general outcry that teacher education programmes in sub-Sahara Africa lacked real classroom practicum (Akyeampong, 2017). As a result, the Diploma in Basic Education programme was introduced with the aim of giving preservice teachers opportunity to learn how to teach in real classroom with hands-on activities. So, the then three-year residential programme was reduced to a model known as IN-IN-OUT, where preservice teachers spend the first two years on campus and the whole of the third year dedicated to real classroom practicum in attached schools outside the college known as off-campus teaching practice (Akyeampong, 2017).

Under the DBE programme, all preservice teachers received training in both subject matter content and pedagogy of teaching mathematics at the Basic School level (Davis & Ocansey, 2016). Prospective teachers who successfully complete the preparation programme are expected to acquire basic competences to teach at the Basic School level. The question is whether these beginning teachers are

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teaching mathematics with efficiency that will bring conceptual understanding. Although the DBE curriculum documents in mathematics strongly advocated pupil-centred approach of teaching mathematics, Agyei and Voogt (2016) asserted that the most common teaching approach used in teaching mathematics in Ghanaian schools is the teacher-cantered approach, where the teacher does most of the mental works in the classroom leaving the pupils as passive recipients of knowledge.

An earlier study indicated that the mathematics teacher needs more than just a strong knowledge of the content in order to teach mathematics (Thompson & Thompson, 1996). The way teachers teach mathematics is equally important as the content they teach. As such, teachers need to possess strong background in both content and pedagogy of teaching mathematics to be successful in their classroom. For instance, although a teacher possessed a strong understanding of rate, he could not explain that understanding in a way that would help students develop conceptual understanding of rate (Thompson & Thompson, 1996). What this means is that there is more to learning plenty of mathematics courses for one to teach mathematics efficiently. The beginning teachers in this current study have had training in both content and methods of teaching at the Basic School level. The expectation was that these teachers would be able to apply the strategies and techniques learnt during training to explain mathematical concepts in ways that will foster pupils' understanding.

Interestingly, methods of teaching mathematics has been identified as one of the main factors contributing to the low achievement of Ghanaian pupils in mathematics (Agyei & Voogt, 2016). Indeed, methods of teaching is very important

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to achieving the goals of teaching, since it is no longer considered as repertoire of techniques employed by teachers to maintain discipline or order in the classroom (Kennedy, 2018). The focus of this study was therefore on the DBE programme with attention on methods of teaching mathematics course since it forms an integral part of the programme and includes mastery of specific pedagogies of teaching such as skills in preparing lesson notes, selection of appropriate teaching learning materials and teaching approaches, effective classroom organisation and management techniques. The methods of teaching course further builds the confidence of the preservice teachers in teaching through on-campus and off-campus teaching practices (Adu-Yeboah & Kwaah, 2018).

Considering the many reforms in teacher preparation programmes in Ghana, which were as a result of needs assessment of the country, one would have expected that teacher-preparation programme in the country should have great influence on teachers teaching practices as well as their attitude toward teaching with the corresponding improvement in pupils' achievement in mathematics. But it has been shown that there has not been much improvement in pupils' achievement in mathematics at the Basic School (Agyei & Voogt, 2016). It is unclear how beginning teachers make use of the ideas they acquired from their training programme to teach mathematics. It is also not clear whether the methods of teaching mathematics, as a component of preservice teacher preparation programme, has any influence on teachers' attitude towards teaching mathematics; and whether, beginning teachers (BTs) perceive their preparation programme to be useful in connection with their teaching practices in mathematics.

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Until recently, the DBE programme has been the main preservice teacher-training programme that prepares teachers for Basic Schools in the country. The programme trains all teachers at the Colleges of Education with the same national curriculum and assessment procedures (Akyeampong, 2017). This study focused on beginning teachers who are products of the Diploma in Basic Education programme for two reasons: First, beginning teachers have the most recent exposure to both theory and practicum from college and have not been exposed to any form of professional learning or in-service training. As such, all their practices can be attributed to the training programme. Second, at the time of the study, the beginning Basic School teachers who were available and had undergone complete cycle of teacher training were all products of the DBE programme. It was therefore necessary to use the DBE programme as the basis to study the influence of preservice teacher training programme on beginning teachers' teaching efficiency in mathematics.

The assumption underlying preservice teacher education programme is that after going through preparatory programmes, prospective teachers should be able to apply the knowledge and skills they have acquired during course work to bring changes in their actual classrooms (Asare, et.al., 2012; Liljedahl et al., 2009), particularly concerning the ways mathematics is taught and the curriculum in general. Studies have shown that initial teacher preparation has strong influence on beginning teachers' teaching practices (Akyeampong et al., 2013). However, other studies have shown that few teachers in their early years of teaching felt very prepared to select and adapt curriculum materials, control students indiscipline and

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other classroom managements as well as students assessments (Coggshall, Bivona & Reschly, 2012). These suggest that although beginning teachers may have acquired the necessary ideas and skills for teaching from training, they may have challenges using these ideas on the field.

In addressing the challenges beginning teachers (BT) encounter as they try to adapt to their new environment, some institutions have designed stretchered programmes involving mentoring or peer support to help teachers in their early years of teaching career (Wong, Britton & Ganser, 2005). In Ghana, the National Teaching Council (NTC), having realised the concerns of BTs, recently earmarked the first year in service as induction year for all beginning teachers who successfully complete College of Education and in addition passed the teacher licensure examination (NTC, 2019). The programme is to usher BTs into the teaching profession. As such, all the products of the DBE programme had to do a mandatory one-year National service before regularizing their posting to schools. Before then, in Ghana, the initial teacher preparation programme has been the first and the main source of competences of professional teaching for Basic School teachers in their early years of teaching.

All BTs in Ghana are therefore expected to be ready to engage in meaningful teaching of mathematics in the real classroom right after completing their training programme. The assumption is that beginning teachers should be able to make efficient use of the knowledge and skills they have acquired to help pupils to acquire transferable skills. Knowing how initial teacher preparation programmes

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shape beginning teachers' teaching practices is therefore critical to improving Basic School mathematics teaching and learning.

With the foregoing background preparatory programme in content and methods of teaching mathematics, beginning teachers should have their attitudes, beliefs and practices towards the teaching of mathematics changed positively. It is possible that, although beginning teachers go through the same coursework at the college, individual teachers exit the training programme with variations in their teaching practices, behaviour and ability to implement the content of the training programme (Rosenberg, Griffin, Kilgore & Carpenter, 1997 as cite in Sparrow, 2000). Some beginning teachers are likely to maintain their initial attitudes even on completion while others may also have their attitudes changed superficially.

Earlier studies have also shown that teachers do not necessarily apply the knowledge and skills acquired from training in their early years, particularly first year of the teaching profession (Jordan, Kuriloff, Sutherland, Ponnock & Hoffman, 2018). This suggests that beginning mathematics teachers may use the ideas learned from their training programme over time. Could this mean that mathematics teachers who have more years of teaching experience perform better than those who are just beginning teaching in terms of teaching efficiency? Examining the teaching practices of beginning and non-beginning (in-service) mathematics teachers could provide an insight into how both groups of teachers teach mathematics with respect to efficiency. Understanding this relationship could give an indication for future professional development programmes for both groups of teachers in order to improve the teaching and learning of mathematics at the Basic School.

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The concept of teaching efficiency could be explained by comparing it with teaching effectiveness. First, it should be noted that teaching efficiency is determined by comparing educational output with educational input (Darvas & Balwanz, 2014). In this case, educational input represents the competencies that the preservice training programme provided to beginning teachers while the output represents the aspect of the training experiences that beginning mathematics teachers give out to pupils in the classroom. Now, the relationship between effectiveness and efficiency is that effectiveness is a measure of 'goodness' of the output, while efficiency is a measure of the resources required to achieve the output. The resources here refer to the teachers' teaching practices or competencies and their attitude towards teaching mathematics. The logic is that once the resources are good there should be productive learning outcomes in mathematics.

Different authors have defined and measured teaching efficiency using several approaches. For instance, Wang, Zhang and Zhou (2013) defined high teaching efficiency in mathematics as "teacher's classroom instructional behaviour that may stimulate students' high learning efficacy" (pg. 56). In a meta-analysis of studies on measurement and prediction of teaching efficiency, Barr (2020), pointed out five different ways by which different authors defined teaching efficiency. Teaching efficiency have been defined in terms of: (i) qualities of the teacher; (ii) expected competencies; (iii) desired pupils' learning outcome; (iv) behaviour control – knowledge, generalized skills, interest, attitude and ideals; and (v) all other definitions considered under miscellaneous.

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In this study, the purpose was to examine the influence of preservice teacher training programme, Diploma in Basic Education (DBE) on beginning teachers' teaching efficiency in mathematics (TEM). In view of this purpose, teaching efficiency was operationalised in terms of behaviour control – teachers' teaching practices and their attitudes towards the teaching of mathematics which result in increasing learners' performance in mathematics. Teaching efficiency is thus the ability to utilise the ideas learned from training to teach mathematics lessons in an easy flowing and direct manner. In other words, the teachers' teaching practices in respect of both content and methods of teaching mathematics course. It is hypothesised that beginning teachers who have successfully gone through their training programme, specifically, the Diploma in Basic Education (BDE) programme, should be able to teach mathematics efficiently.

The reason for focusing this study on teaching efficiency is that, quite recently in Ghana, attention has been shifted from over reliance on summative assessments to formative assessments to support meaningful teaching and learning at the Basic School level (Buabeng, Ntow & Otami, 2020). Emphasis is more on getting pupils to make sense of the mathematics they learn rather than memorizing facts, rules and formulas. Pupils at the Basic Schools are to focus on making grounds on academic work as reiterated in a circular signed by the deputy Director General of Ghana Education Service, Dr. Kwabena Bempah Tandoh (Citinewsroom, 2021). If the focus is on how to help pupils acquire basic mathematical skills for healthy living, then educators should be concern about improving the resources required to achieve this goal (that is teaching efficiency).

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One important resource identified to play a vital role in efficiency of teaching mathematics is the behaviour of teachers in the classroom (Wang et.al. 2013). Empirical evidences had shown that the attitude of teachers towards the teaching of mathematics is a significant factor that affects their practices in teaching mathematics (Domino, 2016; Tabuk, 2018), and consequently affects the attitudes of pupils towards the learning of mathematics (Ernest, Wilson, &Wilson, 2004; Standslause, Maito, & Ochiel, 2013). This means that teaching for conceptual understanding in mathematics is dependent not only on cognitive abilities but also on the attitude of the teacher towards teaching the subject. It is therefore important to study how teacher preparation programme influences teachers' attitude towards teaching mathematics.

Attitude is a way of thinking about something (Standslause et al., 2013). It is a mental state involving beliefs and feelings (Latchanna & Dagnew, 2014). Zan and Martino (2007) defined the attitude of an individual towards mathematics simply as negative or positive emotional disposition the individual holds for mathematics. This current study adopted the definition of attitude suggested by Latchanna and Dagnew (2014), as the individual's thoughts, beliefs and feelings about teaching mathematics and the consequential influence on their instructional decisions in the classroom – the way teachers view the teaching of mathematics; whether they feel teaching mathematics is an easy or a difficult task.

Studies have shown that there is a strong relationship between teachers' positive attitudes towards mathematics and their teaching practices (Mewborn & Cross, 2007; Thompson, 1992). What it means is that teachers' attitudes to the

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teaching of mathematics are well informed by the decisions they make in their classrooms, and these decisions go a long way to affect pupils learning of mathematics. Exploring the mental and emotional attitudes of beginning teachers towards teaching mathematics is an important area of research.

Indeed, the behaviour of a teacher towards the teaching of mathematics can change the attitude of pupils towards the learning of the subject (Domino, 2016; Standslause, Maito, & Ochiel, 2013). For example, if a teacher's attitude towards teaching mathematics is positive, it will be manifested in their practices while teaching and that will have rippling effect on pupils' learning. It is therefore important for teachers of mathematics to develop passion or positive attitudes for teaching the subject in order to create conducive learning environment for pupils to learn and understand mathematics. As such, any intervention targeted at improving pupils' achievement in mathematics should be directed toward helping mathematics teachers to develop positive attitudes towards the teaching of the subject.

Pupils at the Basic School are young and vulnerable and that any attitude or behaviour they develop at that stage can follow them for life. The reason is that it is this early stage of life that pupils encounter the first formal learning experience (Akyeampong et al., 2013). It is therefore important for Basic School teachers to create the enabling classroom environments for pupils to develop the basic competences in numeracy that serve as foundation for future learning of mathematics. This study therefore examines the attitude of Basic School teachers

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towards the teaching of mathematics because of its consequential effects on pupils' attitudes to learning the subject.

Despite the massive investment in teacher education programmes in Ghana, in terms of improving the quality of teaching and learning of mathematics, the issue of underachievement of pupils in mathematics at the Basic School level still lingers. It is unclear whether beginning teachers are making good use of the knowledge and skills they received from their initial preparation programme, how they perceive their training programme in relation to their teaching practices and how the preparation affects their attitude towards teaching. To address the poor performance of pupils at the Basic School, it is important to examine the influence of preservice training programme on beginning teachers teaching efficiency in mathematics. Understanding how preservice teachers' training programme influences beginning teachers teaching practices and their attitude towards teaching mathematics is a necessary precursor to developing policies that could support them in their early years of teaching career.

The approach employed by this study is the extent to which beginning mathematics teachers' teaching practices measures with expected competences from the training programme and not necessarily how the practices improve pupils' performance. The assumption is that the mastery of these competences by teachers will result in quality teaching of mathematics, and this will in turn lead to improved pupils' performances. Even though emphasis is not on pupils' performance, the researcher believes that the outcome has implication for pupils' performance in mathematics.

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Statement of the Problem

Mathematics is a foundation course that has application across all other subject areas; as such, a good grasp of the subject, especially at the early stages of life, has the potential of improving pupils understanding of the world around them. Accordingly, it is expected that every child of school going age must do mathematics. In Ghana, mathematics is a compulsory subject at the basic and senior high school levels due to its importance. Students are expected to pass mathematics before entering any high institution in Ghana. Despite the compulsory nature of mathematics, the performance of Ghanaian pupils at the Basic School level continues to be low. This abysmal performance of pupils in mathematics has reflected in Ghanaian pupils performance in mathematics on some national and international examinations, especially when analysis, critical thinking and problem solving skills are required (Butakor et al., 2017).

On the international stage, Ghanaian students' level of performance in the Trends in International Mathematics and Science Study (TIMSS), in 2007 and 2011 though showed a significant improvement over the performance in 2003 when Ghana first participated, remains among the lowest in Africa and the world. In 2011 for instance, Ghana was ranked at the bottom of the list of participating countries (Butakor, Ampadu & Cole, 2017). One of the factors identified to have contributed to the poor performance of Ghanaian pupils in the TIMS 2011 assessment was inadequate preparation of teachers. Butakor et al. recommended that teacher preparation programmes focus on the development of teachers' subject matter knowledge and pedagogical content knowledge; such a programme should provide

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preservice teachers the opportunity to learn modern and innovative teaching methods and strategies that will enable students think critically.

In addition, the result of the Early Grade Reading Assessment (EGRA) and Early Grade Mathematics Assessment (EGMA) indicate abysmal performance of Ghanaian students on national assessment (USAID, 2016). The EGRA and the EGMA are various forms of assessments designed to determine how students in a country are performing overall compared to its curriculum and examine the effectiveness of a specific intervention or teacher training programme. Specifically, EGMA determines whether children are developing the fundamental skills upon which other mathematical skills are built. In 2013, the Ghana Education Service (GES) conducted the first EGRA and EGMA throughout the country and the second in 2015. Like the 2013 EGMA, the 2015 EGMA report indicated that by the end of Primary 2 (P2), majority of public-school pupils were not doing mathematics beyond the most procedural level. The EGMA result showed that in general, pupils in Ghana do not have the foundational skills required to grasp the basic concepts in mathematics.

It became evident from the data gathered by EGMA that Ghanaian pupils have difficulty with mathematics beyond memorisable level as pupils tend to memorise facts, rules and procedures rather than learning the basic concepts needed to make meaning (USAID, 2016). Also, the National Education Assessment (NEA) survey has shown important learning gaps in mathematics at the Basic School level (NEA, 2016). The poor performance of pupils in mathematics at the Basic Schools

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suggests that something is fundamentally wrong with the teaching and learning of mathematics at that level.

Particularly, the difficulty of Basic School pupils in Ghana to grasp conceptual understanding of school mathematics indicates that there is a challenge with the way mathematics is taught at the Basic School. This is because literature has shown that the way mathematics is presented to pupils have much influence on what and how they learn the subject (Kennedy, 2018). Other studies have also indicated that most pupils do not appreciate the importance of the mathematics they learn at school because of the way the subject is conceived and taught (Agudelo-Valderrama, 1996; Ampadu, 2013). Specifically, it has been found that the presentation of mathematics lessons in Ghanaian primary schools had been more of teacher-centered approach, where pupils have little chance of even asking questions in the classroom (Mereku, 2016).

This situation of the teacher domineering mathematics classroom discussions makes it difficult for pupils to relate mathematical concepts to real life situations; thereby, making them lose interest in the subject. Mathematics is not a difficult subject as pupils perceive it to be. The problem has to do with the way concepts are presented to learners. Pupils will appreciate mathematics if teachers should present lessons in ways that will enable pupils make meaning of the mathematics they learn by employing innovative methods and strategies as well as worthwhile activities that will engage all leaners deeply in learning the subject.

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A study by Wenglisky (2002) has also shown that teachers' classroom practices have significant relationship with what pupils learn in mathematics. According to Wenglisky, the classroom is the "primary venue" through which students learn. Indeed, the classroom is the main place where both students and teachers largely interact in the knowledge acquisition process (Franke, Kazemi & Battey, 2007). As such, the techniques and strategies the teacher employs in the classroom affect how students learn mathematics. For example, when pupils were asked to indicate with reasons why they liked or disliked mathematics, majority of them indicated that the way teachers teach mathematics was the main reason that made them develop interest or hatred for the subject (Domino, 2016). Whatever actions the teacher takes in the mathematics classroom in terms of their attitude and practices will have effect on pupils learning (Sweeting, 2011). Teachers are therefore responsible for creating an enabling classroom environment for meaningful teaching and learning of mathematics. Lessons should be planned and sequenced logically in order to help pupils grasp the mathematical concept that is being taught. It is also the responsibility of the mathematics teacher to create a positive teacher-pupil interaction to facilitate meaningful discourse in the classroom.

The understanding that teacher's classroom practices play a pivotal role in how pupils learn mathematics (Wenglisky, 2002) and the fact that to improve quality of teaching and learning is to improve initial teacher preparation programme (Akyeampong et al., 2013) has called for the need to examine the influence of initial teacher preparation programme on beginning teachers' teaching efficiency in

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mathematics. In measuring the teaching efficiency, the study relied on four competencies identified in literature to relate to teachers teaching practices with the consequential effect on pupils learning. These competencies are ability to plan lesson coherently, classroom management and organisation skills, ability to apply appropriate methods for lesson delivery, and professional engagement on the part of the teacher. As alluded to earlier, for the mathematics teacher to be successful, he/she should be able to plan and enact their lessons coherently and create cordial teacher-pupil interaction in the classroom.

Literature had also revealed that teachers make use of the ideas they learnt from initial training over time and not necessarily immediately after completion (Jordan, et.al., 2018). It presupposes that the teaching practices of teachers who have taught mathematics for more years could be better than that of teachers in their early years of teaching. This was the motivation behind the inclusion of non-beginning (in-service) mathematics teachers in this study. The rationale was to examine whether indeed there existed significant difference between the teaching practices of beginning and in-service Basic School mathematics teachers.

A number of studies have examined the impact of teacher preparation programmes (Good, et.al., 2006; Ali, & Hamza, 2018; Will, Kuriloff, Sutherland, Ponnock, & Hoffman, 2018), impact of mathematics method course (Durkee, 2019; Ensor, 2001) as well as prospective teachers' attitude towards teaching mathematics (Tabuk, 2018). Good et al., for instance, examined whether teacher preparation makes a difference in how first year teachers teach and found that type of preparations related with higher quality management practices among the

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beginning teachers. Ali and Hamza (2018) investigated the impact of teacher preparation programme on pupils learning and found that pupils' learning is dependent on teacher preparation. Durkee assessed elementary mathematics method courses and beginning teachers' readiness to teach numbers and operations and found that mathematics method courses could positively affect preservice teachers' attitude towards the teaching and learning of mathematics. Ensor looked at recontextualisation of mathematics method course by beginning teachers. After examining the performance of the beginning teachers in relation to the mathematics method course and later of their performance in relation to pupils learning, Ensor concluded that the beginning teachers' biographies and school context shaped their teaching practices.

In Ghana, research on initial teacher education have focused on the impact of pre-service teachers training programme (Wolf, 2018) and impact of initial teacher training on early primary grade teachers' classroom performance in reading and mathematics (Adu-Gyamfi, Donkoh, & Addo, 2016). Other studies on teacher education in Ghana had also focused on teacher educators' practices and their vision of good teaching in the context of teacher education reform, and prospective primary teachers attitude towards teaching mathematics (Tabuk, 2018). For instance, Tabuk explored prospective Ghanaian primary school teachers' attitude towards teaching mathematics and found that the prospective teachers showed positive attitude towards teaching mathematics. According to Adu-Gyamfi, et al., initial teacher preparation had strong influence on newly qualified teachers' classroom performance in reading and mathematics.

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However, though the aforementioned studies (Adu-Gyamfi, et al., 2016; Akyeampong, 2017; Durkee et.al., 2019 ; Ensor, 2001; Good et al., 2006; Tabuk, 2018; Wolf, 2018), have highlighted the vital role teacher preparation plays in the quality of teaching mathematics, they did not specifically examine how preservice training programme influenced beginning teachers' teaching efficiency in mathematics and their attitude towards teaching the subject. Further, most of the previous studies used either qualitative or quantitative approach by selecting few beginning teachers from just few colleges, which could limit the generalisability of the findings.

In addition, most previous studies that have focused on preservice teachers' preparation programme and its influence on teachers teaching practices were carried out in more developed countries. This study aimed to address the gaps in literature by examining the influence of preservice teacher training programme on teaching efficiency in mathematics among a number of beginning Basic School teachers from various Colleges of Education in Ghana using the explanatory sequential mixed method design to ensure in-depth understanding of the phenomenon.

Purpose of the Study

The purpose of this study was to examine the influence of the Diploma in Basic Education programme run by Colleges of Education beginning teachers' teaching efficiency in mathematics, using the explanatory sequential mixed method design. The focus was to examine the influence of the DBE programme on beginning teachers' lesson planning, teaching methodology and delivery,

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classroom management and organisation as well as their professional commitment. It also examined the perception of beginning Basic School teachers about the influence of their method of teaching mathematics course on their teaching practices. This was to assess whether the teachers attribute their success in the classroom to the methods of teaching mathematics course they did at the college. Was the method course necessary in terms of their teaching practices. Further, the study investigated the impact of the training programme on beginning teachers' attitudes towards teaching mathematics and whether there was significant difference in attitude of the teachers towards teaching mathematics at the Basic School based on specialism.

Research Questions

The following were the research questions that guided the study.

1. What is the influence of Diploma in Basic Education (DBE) programme on beginning Basic School teachers' teaching practices (teaching efficiency) in mathematics?
2. What are DBE trained teachers' perceptions about the influence of the methods of teaching mathematics course taken at the college on their teaching practices (teaching efficiency)?
3. What is the influence of the method of teaching mathematics course on beginning teachers' attitudes towards teaching of mathematics?

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Research Hypotheses

The following research hypotheses were formulated and tested:

H_0^1: There is no significant effect of specialties (early childhood, primary and Junior high school) on the influence of methods of teaching mathematics course on teaching practices of beginning teachers.

H_0^2: There is no significant effect of specialties (early childhood, primary and junior high school) on the attitude of beginning teachers towards teaching of mathematics.

H_0^3: There is no significant difference between teaching practices of beginning teachers and in-service teachers at the Basic School.

Significance of the Study

This study sought to examine the influence of preservice teacher preparation programme on beginning teachers teaching efficiency in mathematics. The findings of this study could contribute to the understanding of the relationship between preservice teacher preparation programme and teachers' teaching practices in mathematics at the Basic School. Further, knowing the perceptions of beginning teachers about the influence of methods of teaching mathematics course taken at the college on their teaching practices could help understand how serious preservice teachers take up their training programme as this may affect their instructional practices.

Again, the attitude of teachers towards the teaching of mathematics affects their decision in the classroom. This decision also has effect on how pupils learn mathematics. As such, understanding the kind of attitudes beginning teachers have towards teaching mathematics could inform heads/managers of educational

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institutions about the state of mathematics teachers' classroom practices in our Basic Schools for the necessary remedial measures to be implemented in case there are shortfalls in teachers' attitude towards teaching mathematics.

In addition, the preparation of teachers for Basic Schools in Ghana is based on specialties (early childhood, primary and Junior high school) in order to cater for the varied needs of all pupils of school going age. Exploring how method of teaching mathematics influences teachers' classroom practices in each specialties could be helpful in future curriculum planning in mathematics for both Basic Schools and preservice teacher education. The influence of the method of teaching mathematics course on beginning teachers practices could also uncover how such a course may or may not be supportive of participating teachers teaching efficiency.

Furthermore, knowing how beginning teachers' practices in mathematics compare with their counterparts who had had more than two years' teaching experience could give an indication about whether future professional development programmes for in-service teachers or induction programmes for beginning teachers will be needed. Finally, this study is a contribution to extant knowledge on impact of preservice teacher preparation programme on beginning teachers' practices in mathematics.

Delimitations

This study was delimited to beginning teachers who completed the 3-year Diploma in Basic Education programme in 2019 and 2020, from the Colleges of Education in Ghana. Only teachers who offered early childhood, general and Junior high school options of the DBE programme were included in the study. Also, in-

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service (non-beginning) teachers who are products of the DBE programme and have taught for more than two years were also included in the study. Teachers' teaching practices, their attitudes and perception about the influence of their methods of teaching course were the main variables studied. Attention was on five characteristics of teaching efficiency in mathematics: Teachers lesson plan, teaching methodology and delivery, classroom organization and management and finally teachers' professional commitment.

Limitations

Most of the data collected for this study were lesson observations and field notes on beginning and in-service teachers. One of the limitation of this study had to do with the small number of participants since participation was voluntary. Some of the teacher participants declined to be part of the classroom observations. A few of them also agreed to take part in the study but later withdrew. The reason being that they were not comfortable teaching mathematics. In addition, some head teachers could not permit the researcher to observe their teachers. These made it difficult for the researcher to get the expected number of in-service teachers to compare their teaching practices with that of the beginning teachers who participated in the study. This reduced number of in-service teachers may have implication on the generalisability of the result of the comparison. However, it was encouraging to have about 78% turnout on the part of the in-service teachers.

Another limitation of this study was the fact that it was cross-sectional in nature. The classroom observations were carried out in one school term due to time constraints. It could have been extended to cover at least one academic year in order

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to get deeper insight into the teaching practices of the participants. This cross-sectional sample of observation may also have implication on the generalizability of the results. To minimize these effects, each participant was observed by two observers at a sitting on three different occasions, totally six observations per beginning teacher.

The primary limitation to the generalisation of the results of this study was the initial assumption that all the beginning teachers who participated in the study entered the training programme right after completing senior high school as per the entry requirement. As such, no attempt was made to find out prior experiences (called the Zone of Achieved Development, ZAD) of the teachers before entering the training programme. The possible influence of the teachers ZAD could have implication on the outcome of this study. However, about 98% of the participants attributed their success in teaching mathematics to their initial training programme.

Finally, it should be noted that due to time constraint, college tutors who taught the teacher participants were not involved in the study. The result would have been robust if college tutors views about the training programme were solicited to augment it. However, this limitation could be addressed in future studies on the influence of preservice teacher training programme on teachers teaching efficiency in mathematics.

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Operational Definition of Terms

For the purpose of this study, the following terms were defined as follow:

Beginning Teachers: Teachers who have completed Diploma in Basic Education programme and are in their first two years of teaching career. That is, newly trained teachers with at most two years prior teaching experience on the field.

In-service Teachers: Teachers who are products of the DBE programme and have been teaching mathematics for more than two years at the Basic School level.

Preservice Training Programme: This comprises all the training preservice teachers receive while they were in college. It includes content courses, method courses, professional courses as well as on-campus and off-campus teaching practices.

Methods of Teaching Mathematics Courses: Courses that introduce preservice teachers to basic-school-level-pedagogies of teaching mathematics. There are three methods of teaching mathematics courses, one for each specialties (early childhood, primary and Junior high school).

Teaching Efficiency: This was operationalised in terms of behaviour control – teachers' teaching practices and their attitudes towards teaching mathematics that results in increasing learners' performance in mathematics (Barr, 2020). It includes planning, organising and managing a class in order to maximise students learning of mathematics.

Teaching practices: Actions and strategies teachers deploy in the classroom during the teaching and learning process. It includes classroom discourse, feedback and formative assessment.

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Effective teaching: A kind of teaching that actively engages the learner in the classroom and brings about conceptual understanding of mathematics. Effective teaching includes how hands-on activities are employed in the classroom, systematic delivery of instructions and authentic ways of assessing students in the classroom.

Attitude: The beliefs and feelings that a beginning teacher holds for teaching mathematics.

Perception: Reported experiences of beginning teachers about the influence of their method of teaching mathematics course on their teaching practices.

Organisation of the Study

Chapter One presents the introduction of the study. The introduction includes the background to the study, statement of the problem, purpose of the study, research questions guiding the study and the limitations and delimitations of the study. The significance of the study is also included in chapter one. Chapter Two presents the review of related literature on the subject. Right after the literature review is Chapter Three, which gives the overall methodology of the study. Chapter Four presents the result and the discussions of the major findings. Finally, the summary, conclusion and the recommendations of the study are presented in Chapter Five.

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CHAPTER TWO

LITERATURE REVIEW

Overview

This chapter presents literature related to the current study in three parts. In the first part, the researcher reviewed a theory of teaching and learning that promotes individual cognition, personal action, and goals as well as interaction with the learning environment. The concepts of teacher education in Ghana, Diploma in Basic Education programme, teacher preparation in general, teaching efficiency, teaching practices, attitude of teachers towards teaching mathematics, training based on specialism. Beginning and in-service teachers were also discussed under the first part of the literature review. In the second part, the researcher presented the empirical studies where the researcher reviewed literature on teacher preparation and teaching practice; perception about the influence of methods course on teaching practices; and teacher preparation and attitude towards teaching. The last part presents the conceptual framework that incorporates the theory reviewed and finally the chapter summary was presented.

Theoretical Framework

This study is concerned with how preservice teacher preparation programme influences beginning teachers' teaching practices and their attitudes towards teaching of mathematics. Consistent with this purpose, theoretical frame that organises individuals social and psychological functioning had been adopted for the study. Specifically, Valsiner's (1987) zone theory has been adopted for the study. This theory is further discussed in detail the next section.

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Valsiner's zone theory

Valsiner's (1987) zone theory is a sociocultural theory of learning that posits that personal as well as contextual factors influence the development of an individual. The theory is an extension of Vygotsky (1978) Zone of Proximal Development (ZPD). According to the zone theory, Valsiner (1987) argued that aside the ZPD, there are other factors that influence the development of the individual. As a result, Valsiner proposed two additional zones to explain how individuals learn as they interact with others and the physical environment. These are Zone of Free Movement (ZFM) and Zone of Promoted Action (ZPA). The Zone of Free Movement (ZFM) was conceived as the freedom at the disposal of an individual to act within the learning environmental while the Zone of Promoted Action (ZPA) was conceived as the practices within the learning environment that promote the actions of the individual.

Though Valsiner's theory was initially conceived as a learning theory for the development of children, prior scholars (Blanton, Westbrook & Carter, 2005; Goos, 2008) have applied the theory to both preservice and novice teachers. Goos argued that Valsiner's zone theory could be applied, particularly to the field of mathematics education, by two different approaches: (1) teacher-as-teacher – where all zones are defined with respect to students, and (2) teacher-as-learner – where all zones are defined with respect to the teacher.

Considering how the theory had been applied in prior literature, this study adapts the application of the Valsiner's zone theory in the perspective of beginning teacher-as-learner. According to Goos, the ZPD includes a set of possibilities for

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development of the individual, as they interact with the environment and the people therein. Thus, in the context of teacher training, the set of possibilities belonging to the ZPD includes content knowledge, pedagogical knowledge and the skills that the training programme offers preservice teachers under the guidance of tutors and other experienced peers (Goos, 2005). In other words, preservice teachers have been exposed to the content of the training programme (that is, the 'what' and 'how' to teach) to enable them develop their potentials as they interact with their colleagues, tutors and the environment to move to a level where their training programme expects them to be as professionals.

Further, the Zone of Free Movement (ZFM) represents the constraints within the beginning teachers' professional context (the school) that limit their choice of actions, techniques, and thoughts (Goos, 2008). Goos reiterated that these constraints might include the behaviour of pupils, the way pupils are motivated, access to resources and other teaching materials, curriculum and assessment requirements as well as organisational structures, which may constraint the teachers' decisions and teaching actions. The ZFM also includes all the teaching approaches or methods that the beginning teachers have been exposed to during training under the guidance of tutors and other experienced peers.

The Zone of Promoted Action (ZPA) on the other hand, represents a range of activities, materials and the aspect of the teaching and learning environment that tend to promote the individuals' actions (Goos, 2008). Access to teaching materials, access to technology, good classroom organisation, support from colleague teachers are all aspects that promote the actions of the teacher hence, belong to

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ZPA. In other words, the ZPA includes a set of possibilities that may influence or promote the actions, thinking and decisions of the individual teacher as they interact with others and the environment. The ZPA also includes all the practices that are consistent with the beliefs of beginning teachers towards teaching of mathematics that are supported by the preservice training programme. That is, within the space of the ZFM, the beginning teacher turns to use actions or skills that he/she believes to be practicable. The ZPA also includes the teaching strategies, professional commitments and the practices by the beginning teacher that might be provided by preservice teacher-training programme and the interaction with other colleagues in the school learning environment.

Just like Goos (2005), this study focused on the ZFM/ZPA complex that beginning teachers experience in the school in order to understand how they make use of the knowledge and skills they have acquired from their initial training programme. Valsiner argued that the individuals ZPD is shaped by interaction with people and the environment. However, the ZPD is ontogenetic – within the individual while the ZFM/ZPA complex is microgenetic – between the individual and the environment. It becomes feasible to assess the individuals ZPD by examining the ZFM/ZPA complex. In other words, the ZFM and the ZPA that a beginning teacher experiences are observable and can therefore be used as a means to get insight into the teacher's ZPD (Blanton et al., 2005), as a possible measure of influence of preservice training programme on beginning teachers' teaching practices. Empirically, the zone theory creates the opportunity to understand how the social and school context enable or limit teaching actions.

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Having talked about the teachers' ZPD, as far as the Valsiner's zone theory is concerned, it should be stated that Valsiner's theory was built on Vygotsky's (1978) zone of proximal development – a sociocultural theory of learning. As alluded to earlier, the ZPD is a major concept that explains the relation between social interaction and an individual's cognition (Goos, 2008). Vygotsky (1978) identified the zone of proximal development (ZPD) to be the distance between the actual development level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers (Goos, 2005). That is the difference between what a learner can do without any support and what he/she can do with support from tutors or experienced peers. The ZPD in this study was therefore conceptualised as a range of tasks that lie between what the beginning teacher knows when he/she just started the training and what could be learned through interaction with more knowledgeable individuals. Vygotsky viewed this zone as the space within which learning takes place (Warren & Cooper, 2006). However, Valsiners' Zone Theory posits that learning can only take place if the actions that are being promoted (ZPA) are within the individual's repertoire of knowledge (ZPD).

From the foregoing discussion on the zone theory, it can be said that the ZPA aligned with the individuals ZPD could be situated within the ZFM. (Goos, 2005). The zone of proximal development, zone of free movement and the zone of promoted actions of beginning teacher-as-learner are presented in Figure 2.

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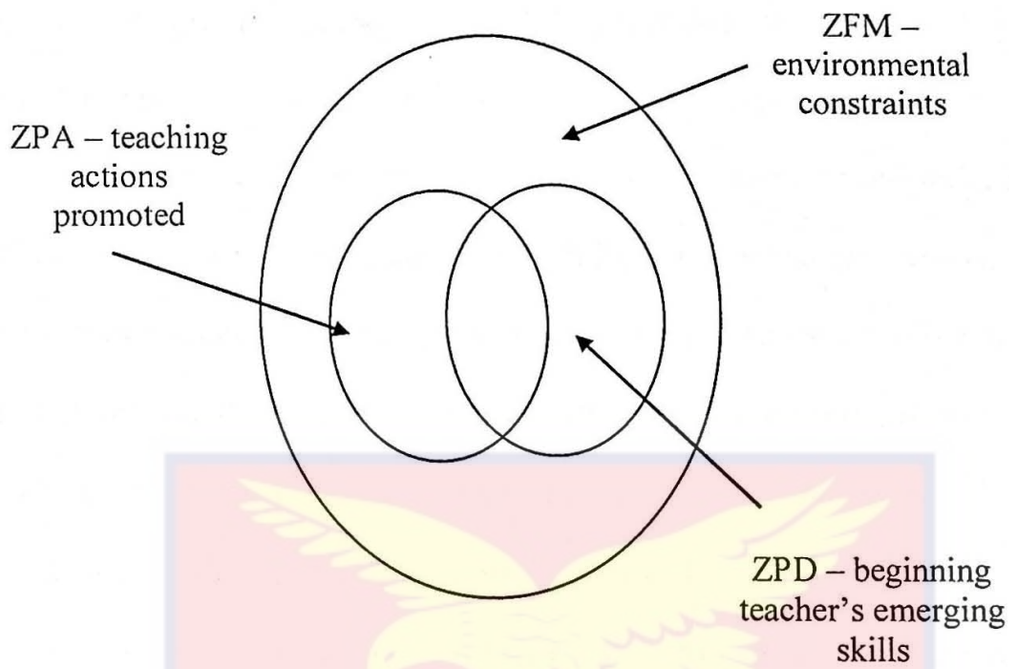


Figure 1: Valsiner's Zone theory for Beginning Teacher-as-learner
Source: Adopted from Goos (2005)

John-Steiner and Mahn (1996) upholding Vygotsky's theory, averred that in the construction of knowledge, there is a relationship between the individual and the social processes. Similarly, Scott and Palincsar (2013) explained that it is through working with others on a number of tasks that a learner experiences and acquires meaningful strategies and knowledge. In similar manner, teacher preparation programmes offer preservice teachers a lot of exposure as they interact with their own colleague student teachers, tutors and the school environment.

Further, preservice teachers are supervised and are been guided by their tutors as well as mentors during practicum using available resources and other teaching materials along the programme outlined in the curriculum. In the learning process, every learner at a point reach his/her frustration level, as Vygotsky termed it proximal, and needs help from an adult or a more knowledgeable peer in order to

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get out of the frustration; eventually, expanding their zone of proximal development.

Linking the above assertion to the current study, during training at the college level, the DBE programme provided beginning teachers with content and methods of teaching mathematics courses. The content courses exposed them to the various topics in the Basic School mathematics curriculum whereas the methods of teaching mathematics course, exposed teachers to pedagogy of teaching mathematics. The pedagogy includes how to plan lessons to meet individual differences and cross-cultural differences, how to use small groups where less skilled children are paired with children who have higher skill level; how to give clear instructions, how to offer hints and prompts where necessary to help improve learners' ability levels and how to use scaffoldings in teaching mathematics. Also, the prospective teachers embark on teaching practices to put the ideas learnt into practice and also build their confidence (Adu-Yeboah, & Kwaah, 2018).

After a successful completion of the training programme, the prospective teachers are certified and posted to the Basic Schools to teach as professional teachers. These beginning teachers are left on their feet to make their own choices from the seemingly environmental constraints (ZFM). At the school level, there may be activities, materials, school organizational structures and other resources that may promote the actions of the teacher (ZPA). The assumption is that, the beginning teachers, having been exposed to a range of experiences (ZPD) during their training programme, should be able to align their classroom teaching practices with the ZFM and ZPA, to teach mathematics with efficiency. In other words, the

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beginning teachers are expected to demonstrate practices that are consistent with their beliefs and goals with regards to the set of possibilities (ZPD) they received from their training programme (Goos, 2008).

Teacher Education in Ghana

Education is crucial to the development of every nation. Thus, educators need to be accorded the necessary supports as they make sure relevant knowledge and experiences are imparted to their students. According to Adu-Gyamfi, Donkoh and Addo (2016), education involves the act of transferring knowledge in the form of experiences, ideas, skills, customs, and values from one individual to another, or from one generation to another generation. This means that education is basically achieved when there is a transfer of knowledge from an individual who is knowledgeable in a particular field to another individual who has no or little knowledge or skills in that field.

Education has usually been cited as the foundation of civilisation and development (Adu-Gyamfi et al., 2016). Education is held in high esteem by many countries, both developed and developing, due to its contributions to human capital development, as well as its impacts on technological advancements. This implies that without education, most developed countries would not have been at their current states. Also, developing countries would not be able to really develop their human resources for robust economic development. This simply explains why most developing economies, such as Ghana, have recently focused most of their resources on education (Bangs, MacBeath, & Galton, 2010).

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Reform is normally used to describe changes in, or modifications of, policies, practices or organisations (Bangs et al., 2010). Also, reforms can be termed as intended attempts to correct identified problems in organisations or policies (Adu-Gyamfi, Donkoh, & Addo, 2016). Per the current study, teacher educational reform is defined as changes or modifications to policies to enable the production of qualified teachers that will positively affect learning outcomes. In Ghana, there have been a number of teacher education reforms and interventions since independence in 1957.

Teacher education reform has continued to receive much attention in literature. The main reason for this is the belief that learning outcomes of pupils, particularly those coming from less privileged and underserved communities, are largely influenced by their teachers (Buabeng, Ntow, & Otami, 2020). These outcomes, as averred in literature, depend largely on the quality of education and the effectiveness of the education system at large (Archibald, 2006; Buabeng et al., 2020). Based on this, the argument has been that how quality and efficient an educational system of a country is, is reflected in its human resources and the managerial capabilities of the nation (Buabeng et al., 2020; Anamuah-Mensah, 2006).

Teacher education in Ghana has been cited to be multifaceted (Anamuah-Mensah, 2006; Asare, & Nti, 2014) since an individual can enter the teaching profession in Ghana through several pathways. The first pathway is the Three-year Diploma in Basic Education, where teachers are trained by accredited Colleges of Education to teach at the at the Basic School level; Second is a Two-year Post-

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Diploma in Basic Education, which is designed for teachers already holding Diploma in Basic Education certificates. Usually, these teachers are trained by the University of Cape Coast and the University of Education, Winneba, both in Ghana. In Ghana, this training was not compulsory, as teachers at the Basic Schools were not required to acquire bachelor's degrees before they could teach at the basic level (Buabeng et al., 2020).

In addition to the two foregoing pathways, the third pathway is a four-year Bachelor's degree for both Basic Schools and second cycle schools in Ghana. These graduates usually come from the two aforementioned universities, normally referred to as the traditional teaching universities (Buabeng et al., 2020). The fourth entry pathway is a Two-year Diploma in Basic Education Programme offered through sandwich. This programme is particularly designed for teachers who already have professional teachers' Certificate "A". Finally, the fifth pathway is the Untrained Teacher's Diploma in Basic Education (UTDBE), usually dubbed "Our-year", offered through distance education. It is for practising teachers who have not received any professional training but possess senior high school certificates (Buabeng et al., 2020). The essence of the UTDB programme is to increase the number of Basic School teachers, mainly in the rural areas (Asare, & Nti, 2014).

Colleges of Education, formerly known as the Teacher Training Colleges, previously, were offering 2-year Post Middle Certificate "B" programmes. This was later followed by 4-year Post-Middle Certificate "A" and 2-year Post-Secondary Certificate "A" programmes (Ministry of Education (MoE), 2017). However, the 2-year Post-Secondary programme was extended to a 3-year

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programme in the 1980s, but was run alongside the 4-year Certificate "A" programmes; nevertheless, according to the Ministry of Education (2017), these reforms produced little impact on students' learning outcomes, such as level of achievement of success in their examinations and development of critical thinking.

There was therefore the need to introduce student-centered and hands-on instructional approaches of teaching in the teacher training institutions for preservice teachers to develop conceptual understanding (MoE, 2017). Hence, the launch of the Junior Secondary School Teacher Education Project (JuSSTEP). Interestingly, the teaching and learning of mathematics was one of the major subjects targeted by the JuSSTEP project because of its importance. But this project was also short-lived due to some major structural challenges (MoE, 2017). Furthermore, in 2008, all Teacher Training Colleges in Ghana were upgraded to Diploma awarding institutions and re-designated as Colleges of Education (Asare & Nti, 2014b); all in an attempt to improve the professional competences of teachers. The assumption, generally, has been that once the competences of teachers are improved, the quality of teaching and learning would automatically be enhanced.

Recently, there have been two main pieces of legislation on transforming Ghana's teacher educational system. The first legislation has to do with the Education Act (778) passed in 2008. Under this Act, Section 9 focused on the establishment of a National Teacher Council (NTC). The Council was successfully established in pursuant to provision of this Section of the Act. The core mandate of the National Teacher Council is to set forth professional practices and ethics for

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teachers and teaching and also responsible for registering and licensing individuals who seek to enter the teaching profession. Also, the Act authorizes the National Teacher Council to revoke licenses of teachers under its umbrella for misconducts or violation of the ethics governing the teaching profession. Thus, the Act is bent on ensuring that teaching is a profession with clear codes of ethics and minimum required levels of competencies.

The second legislation, the Colleges of Education Act 847, unlike the first Act, focuses on upgrading Colleges of Education to tertiary institutions. This Act took effect from October, 2018, and saw Colleges of Education upgraded to 4-year degree awarding tertiary institutions instead of the 3-year diploma awarding colleges. Before the Act took effect, the Teacher Training Colleges were under the supervision of the Ghana Education Service. Further, the enactment of the Act 2012 (Act 847) provided a legal backing to the new status of the Colleges of Education in Ghana.

The call for quality education has led to the development of National Teachers' Standard (NTS) for Ghana. The National Teachers' Standards for both pre-service and in-service teachers clearly outlines what teachers are expected to know, understand and be able to do as teachers in order to improve teaching and learning (NTC, 2017). Finally, National Teacher Education Curriculum Framework (NTECF) was also developed on the premise that, achieving quality education for all is to train effective, engaging and inspirational teachers (Armah, 2018).

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From the aforementioned, it is evident that teacher education should be given attention as the development of every nation, largely, is tied to education, and teachers are needed to facilitate the process of education. Therefore, the current study, which focuses on teachers teaching practices and their attitudes towards the teaching of mathematics is critical to addressing the underachievement of pupils especially at the Basic School level. Also, from the discussion so far, it is clear that teacher education will continue to go through reforms as long as the country continues to experience socio-political changes.

Teacher preparation

Although factors such as number of resources available, school climate, quality of school leadership and curriculum have been identified to be important in students' achievement (Darling-Hammond, 2000, 2006), educators agree that teacher quality surpasses all. It is evident that everyone acquires some knowledge and skills from school, yet the training of the teacher is necessary to address any knowledge gap (Rae, Mckenzie, & Murray, 2011). In other words, important skills or knowledge gaps that are likely to influence students' learning outcome are well addressed through proper training of teachers (Sonour, Goda, & Mine, 2017 as cited in Ali, & Hamza, 2018). Teachers are therefore very important in any educational enterprise and should be equipped with the needed knowledge and skills in order to carry out their professional duties smoothly (Osiakwan, 2014).

The importance of teacher preparation cannot be underestimated as it plays a vital role in ensuring quality teaching (Akyeampong et al., 2013). Teacher preparation programmes are programmes that are designed to develop teachers

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competencies and proficiency that will enable them discharge their professional responsibilities efficiently (Asare, Mereku, Anamuah-Mensah & Oduro, 2012; Ball, & McDiarmid, 1989). According to Ball and McDiarmid, teacher preparation includes the development of teaching skills, pedagogical theory and professional skills. During preparation, teachers are equipped with specific techniques and pedagogies that will help them to be successful in their classrooms (Black, & Wiliam, 2018).

Training can improve teachers' knowledge in both content and pedagogy and subsequently enhance students learning outcomes. Indeed "how much a student's teacher knows about what he or she is teaching has positive effects on pupils learning"(Monk, 1994. pg.125). During training, teachers learn basic classroom organization and management skills as well as some professional ethics that are necessary for the teaching and learning of mathematics. As such, trained teachers are able to address the diverse needs of their pupils (Black, & Wiliam, 2018). Other studies have also shown that dedicated and well-trained teachers are better positioned to monitor the learning trajectory of children making learning more relevant and meaningful.

Teacher preparation in all Colleges of Education in Ghana, had for some time followed a structure that was commonly termed "in-in-out", where preservice teachers do course work for the first two years in the college and then move to the field to practice teaching for one year (Adu-Yeboah, & Kwaah, 2018). The last group of teachers under this programme completed in 2020 and had since been posted to the Basic Schools to teach. This cohort of teachers and their counterparts

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who completed in 2019 were the target for this current study since they are the immediate beginning teachers who have gone through complete cycle of training at the time of the study.

Diploma in Basic Education programme

The Diploma in Basic Education (DBE) Programme is a three-year programme run by all Colleges of Education in Ghana. This programme prepares teachers for Basic Schools, as such, it serves as the minimum qualification for teaching at the Basic School level (Akyeampong, 2017). The programme was designed mainly for preservice teachers who have no prior teaching experience. The programme began in 2005 by training generalist teachers who will be able to teach at the Basic School level. The programme was also aimed at producing teachers who will have a better understanding of the intended outcomes of their teaching activities as well as be better positioned to monitor and diagnose pupils learning (Davis & Ocansey, 2016).

Initially, due to the general nature of the training under the DBE programme, some trainees could not teach certain subjects such as mathematics and science. So to address this setback, in 2008, some colleges were selected to be exclusively responsible for the training of teachers for mathematics and science. Again, in 2014, the Diploma in Basic Education curriculum was reviewed by the Institute of Education, University of Cape Coast, to address the challenges confronting the previous curriculum. The aim of the 2014 curriculum was to include the training of specialist teachers who would be able to teach specific subjects such as mathematics, science, technical skills and French at the Basic School level

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(Davis & Ocansey, 2016). Later, experts in education having realised that the education system in Ghana was still struggling to keep pace with the changing world, especially in mathematics, science and technology, raised issues concerning the content and structure of the 2014 DBE curriculum; so in 2015, the curriculum was reviewed again. The review addressed issues such as overloaded curriculum, little attention on the development of local language, little attention on assessment for learning as well as over-emphasis on passing exams (Armah, 2018).

To augment the DBE programme, the government of Ghana initiated a UKaid sponsored change programme, Transforming Teacher Education and Learning (T-TEL) to overhaul pre-service teacher training in the country. The launch of the T-TEL project was aimed at improving the quality of teaching and learning by improving the level of tutoring in all public Colleges of Education in the country (Armah, 2018). The project was therefore to develop teachers who could demonstrate interactive and student-focused instructional methods as well as develop student teachers with skills in critical analysis and thinking; a type of teaching and learning that has the tendency to improve children problem solving skills. Also, the project provided support for tutors' professional development, leadership, management and curriculum assessment.

In general, the DBE programme simultaneously provided preservice teachers with training in subject matter content and pedagogy (Davis & Ocansey 2016). Teachers received training in all the subjects that were taught at the Basic School. The programme exposed trainees to Primary and Junior High School content and pedagogies. The pedagogy related courses were designed to expose

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preservice teachers to methods of teaching Basic School topics or contents. This was achieved through methods of teaching and teaching practices (both on-campus and off-campus).

The first year of the programme focuses on building the content knowledge of trainees. At the end of the first year, the preservice teachers are attached to schools to embark on observation of real classroom practicum during vacation. In the second-year preservice teachers, are exposed to methods of teaching at the Basic School in order to prepare them for teaching practices in the third year of the programme. The preservice teachers then embark on on-campus teaching practice in the first semester of the third year alongside other contents and professional courses. Finally, preservice teachers embark on off-campus teaching practice together with project work in the second semester of the third year (Davis & Ocansey, 2016). Both teaching practices were designed to meet the professional needs of teacher trainees and to close the gap between theory and practice.

Method of teaching mathematics was a major component of the DBE programme. The course equips teachers with skills that will allow them effectively communicate their content knowledge to pupils. In the method course, the preservice teachers learn specific concepts in mathematics as well as strategies and techniques of teaching these mathematical concepts. All the topics in the Basic School mathematics syllabus are covered in the method course.

The general objectives of the methods of teaching mathematics course are (1) to equip preservice teachers with an in-depth knowledge and understanding of Basic School mathematics curricula. (2) to train preservice teachers to plan

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activities and prepare materials for teaching investigation with numbers, operations on numbers; integers and rational numbers; rates; money and taxes, and finally (3) to explore ways in which calculators could be used to enhance teaching and learning and problem solving by children (Davis & Ocansey, 2016).

The DBE mathematics methods of teaching course for primary school was designed specifically to equip preservice teachers with knowledge and understanding of the nature of mathematics, factors influencing the selection and sequencing of the content of the Primary school mathematics curriculum, developing problem-solving and investigation skills (Davis & Ocansey, 2016). It also exposes preservice teachers to the development of number concepts and operations, preparation for lesson delivery, methods and materials for effective teaching and learning, the use of activity method and grouping of children for effective teaching and learning. Finally, the course equips teachers with the necessary skills of assessing children's learning in mathematics (Davis & Ocansey, 2016). It is mandatory for all preservice teachers to do methods of teaching mathematics course irrespective of the specialty – Early Childhood Education, Primary Education and Junior High School. However, each specialty had a separate syllabus for the method of teaching course.

In order to equip early childhood teachers with the pedagogy of teaching mathematics, preservice teachers were made to do a compulsory method of teaching mathematics course titled; "Mathematical Activity for Early Childhood Education" which covers mainly the Kindergarten (KG) syllabus. This course exposes preservice teachers to practical approaches to mathematics teaching and

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learning at the early childhood education level. The course focuses on ensuring that preservice teachers design appropriate activities for the teaching and learning of mathematics. Specifically, the course emphasises how children learn mathematics, classification of objects, number and numerals, shapes and patterns, measurement and estimation, pictorial representation of data, problem solving as well as how to prepare scheme of work and lesson plan (Davis & Ocansey, 2016).

Similarly, method of teaching primary school mathematics course exposes preservice teachers to the methods of teaching at the primary school level. The primary school method course covers twelve units of which trainees were expected to cover all the units. According to the DBE syllabus (GES, 2005), the units for the methods of teaching primary school mathematics are:

(1) Nature of Mathematics;

(2) How children learn mathematics;

(3) Gender issues in mathematics;

(4) The study of the Primary school Mathematics Curriculum;

(5) Pre-number Activities and Number work;

(6) Developing ideas about shapes and space;

(7) Preparation of scheme of work weekly forecast, lesson plans and Generic learning skills;

(8) Teaching Fractions;

(9) Teaching Number patterns and Investigations with numbers;

(10) Teaching measurement;

(11) Collecting and Handling data; finally,

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(12) Assessment in mathematics.

Further, methods of teaching Junior High school mathematics course provides preservice teachers with knowledge and understanding of teaching and learning of numbers and measurement. It also provides preservice teachers with the skills for teaching and learning geometric construction, number plane, vectors, rigid motions as well as teaching the use of calculators and ICT in the learning of mathematics. The methods of teaching Junior High school mathematics course span over twelve-unit course content and trainees were expected to cover all. The units for methods of teaching JHS mathematics, according to the DBE syllabus (GES, 2005), are:

(1) The study of the Junior High School mathematics curriculum;

(2) Investigation with numbers;

(3) Teaching of integers;

(4) Teaching rational numbers;

(5) Teaching powers of numbers;

(6) Teaching measurement;

(7) Teaching geometric constructions;

(8) Teaching number plane;

(9) Teaching of vectors;

(10) Teaching rigid motion;

(11) Use of calculators and ICT; and lastly,

(12) Catering for 'High Achievers' and 'Low Attainers'.

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The hypothesis was that all teachers who have gone through the DBE programme should acquire the competencies well enough to teach mathematics efficiently at the Basic School (Asare et.al., 2012).

Training based on specialism

In Ghana, Basic School consists of two years of Kindergarten, six years of primary and three years of junior high school (JHS) (Buabeng et al., 2020). Basic School is free and compulsory and it is the minimum period of schooling for all children of school going age. All Colleges of Education in Ghana prepare teachers for Basic Schools. The preparation of teachers for Basic Schools is based on three specialism: early childhood education teachers who are trained to teach at kindergarten level, primary education teachers trained to teach at the primary level (grades 1 to 6), and Junior high school education teachers who are trained to teach at the junior high school level.

Both early childhood and primary education teachers' teach all the subjects at their respective grade bounds while junior high education teachers do subject teaching (i.e. they teach only specific subjects that they have been train to teach). Scholars have advocated the idea of subject teaching at the Basic School level (Ntow, Tackie & Sokpe, 2009). The argument has been that only those who have the capabilities to do mathematics should be trained as mathematics teachers.

The education needs and requirements of pupils vary at each grade level, as such, preparation of teachers by specialism is essential to equip teachers with specific skills to teach at the respective levels (Buabeng et al., 2020). Regardless of the area of specialism, all preservice teachers are given training in three main

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areas. These areas are content courses to prepare them to teach the Basic School curriculum contents, methods of teaching courses to equip them with pedagogical skills, and practicum to equip them with real life practical skills of teaching pupils at the grade they are been trained to teach (Buabeng et al., 2020).

This study focused on all the three specialism at the Basic School because the early years of a child's education is very important as it forms the foundation upon which the child's future is built. In other words, a good foundation in mathematics at the Basic School level is very crucial to the child's future success. At the Basic School level, children develop good habits, numeracy and literacy skills as well as lifelong passion for learning. Teachers must therefore be prepared with the requisite knowledge and skills to respond to the diverse needs of pupils at all levels.

The way mathematics is taught at the early stage has much influence on how pupils view the subject. Teachers should therefore present mathematics lessons through fun and exciting ways to encourage pupils to develop interest in learning mathematics. Teachers at the Basic School level should also teach mathematics through role-play or modelling and practice positive social interaction with all pupils. Pupils should be engaged in group activities to develop mathematical values such as cooperation, teamwork, respect, patience, confidence, self-esteem and tolerance for one another. It takes a teacher to possess special skills to satisfy the diverse needs of pupils in learning mathematics, especially at the basic level.

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Teaching Efficiency

Efficiency is simply "making the best possible use of available resources to meet educational goals" (Darvas & Balwanz, 2014. p.95). Darvas and Balwanz explained that educational efficiency could be measured by comparing educational inputs with educational outputs. In this study, the educational inputs represent the knowledge and the skills that the preservice training programme provided to beginning teachers while the outputs represent the aspect of the training experiences that beginning teachers give out to pupils or the society in general. Different authors have use different criteria to measure teaching efficiency. Some studies have used teachers teaching practice scores, in-service ratings, college grades, pupils' achievement growth, consensus opinions while others have used descriptive (Barr, 2020). Barr reiterated that any attempt to employ a single dimension of defining efficiency may be problematic.

According to Wang et.al. (2013), the idea of efficiency of teaching mathematics has been in existence since 1896 when it was first developed. To Wang, teaching efficiency in mathematics includes the "analysis of teachers' classroom instructional behaviour" (p.56). In other words, teaching efficiency involves planning, organising and managing a class in order to maximise students learning of mathematics. It involves setting up learning experiences that actively engage pupils to produce desired learning. Teaching efficiency is dependent on a good understanding of the processes of teaching (Bella, 2016). Wang identified some instructional behaviours of mathematics teachers that contribute to high teaching efficiency. They are: using examples of daily life or pupils' previous

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knowledge in mathematics to arouse the pupils' interest and understanding, paying more attention to helping pupils develop the habit of using mathematical symbols and language correctly, concentrating on pupils' practice and exercise, helping pupils to appreciate the beauty of mathematics as well as helping pupils to appreciate the origin and development of mathematical concepts (Wang et.al., 2013).

The essence of teaching efficiency in mathematics is to ensure conceptual understanding on the part of the learner (Bella, 2016). The teacher should, therefore, be able to apply both subject matter knowledge and pedagogical skills to teach in ways that will bring about meaningful learning of mathematics. That is, teacher's ability to plan their lessons sequentially, select and use different strategies in the classroom, organise appropriate materials for lessons, demonstrate good classroom management skills and adopt multiple techniques of evaluating students' learning of mathematics are among the teaching processes that would eventually lead to teaching efficiency.

Other studies have augured that teaching mathematics for conceptual understanding becomes possible only when the teacher has a good command of the subject matter and has different ways of communicating the knowledge to learners (Ingvarson, Beavis, Bishop, Peck & Elsworth, 2004; Khan, 2012). Nevertheless, it is one thing having the subject matter knowledge and quite another having ways of transferring the knowledge meaningfully to learners. Hence, teaching for conceptual understanding of mathematics requires a strong link between subject matter knowledge and the mode of transferring it to the learner (Khan, 2012).

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Also, to improve understanding of students in mathematics, the teacher should create enabling environment for students to make sense of the mathematics they learn through exploration, connections and sometimes modelling (Smith, & Freels, 2017). This can also be done by given pupils the opportunity to do collaborative group work, to explore and justify the mathematics they learn and the use of technology to support exploration. According to Smith and Freels, in mathematics, instructional techniques that emphasise active engagement of student's cognition also promote the development of conceptual understanding and procedural knowledge. As such, pupils should be engaged on meaningful activities for deeper understanding in the course of teaching mathematics.

Generally, teachers agree that teaching and understanding are inseparable; thus, teaching for understanding is always recommended (Wiggins, Wiggins, & McTighe, 2005). However, the meaning of the term "understanding" remains an issue, as individuals have tended to attach subject meanings to the term (Swafford, & Findell, 2001). According to Wiggins et al.,"understanding" is about an individual's ability to think and act flexibly with a particular topic or concept, in this case, mathematical topic or concept. The term simply goes beyond knowing, and more than just having the ability to follow procedures and collect information, facts or data (Swafford, & Findell, 2001).

Thus, the main hallmark of mathematics understanding is the ability of students to justify why a particular mathematical assertion is true or why a given rule in mathematics makes sense, according to the Council of Chief of State School Officers (CCSSO) (Darling-Hammond, 2010). This means, teachers of

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mathematics should ensure that their students know why an answer to a particular mathematical question is correct. According to the National Council of Teachers of Mathematics (NCTM) (2000), problem solving, reasoning and proof, representation, communication, and connections are some of the ways through which students can be engaged in the learning content as they develop both procedural fluency and conceptual understanding.

Also, an influential research conducted by the Swafford and Findell (2001) to ascertain how students learn mathematics identified five major strands of mathematics proficiency which indicate that a student understands, or can do mathematics. These strands are: conceptual understanding – which involves comprehension of mathematical concepts, operations and how these concepts relate; procedural fluency – which has to do with skills in carrying out procedures without difficulty; strategic competence – which is concerned with the ability to formulate, present and solve mathematical problems; adaptive reasoning – which focuses on the capacity for consistent and logical thoughts, reflection, elucidations and succinct justifications; and finally, productive disposition – which has to do with the habit of seeing mathematics as practical, workable, useful and worthwhile.

According to Swafford and Findell (2001), for students to have conceptual understanding of mathematics, the teachers should appreciate the fact that these strands of mathematics proficiency are interrelated, interwoven and interdependent. This implies that the development of one strand leads to, and supports the development of others. Also, Darling-Hammond (2010) averred that the development and understanding of mathematics is a key responsibility of the

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teacher and, therefore, teachers are required to demonstrate good mathematics practices to enhance deep understanding by the learner. The key mathematical practices includes making sense of the problems and persevering in solving them, reasoning abstractly and quantitatively, constructing viable arguments and critiquing the reasoning of others, modelling with mathematics, strategically using appropriate tools, attending precision, looking for and making use of structure, and looking for and expressing regularity in repeated reasoning (Darling-Hammond, 2010). These core practices are discussed in detail below, according to CCSSO.

The first practice, making sense of mathematical problems and persevering in solving them, helps mathematics students to learn how to analyse given information, parameters and relationships in a problem so that the situation can be understood, and enables them identify possible strategies to solve the problem. Here, teachers are encouraged to use concrete materials, such as diagrams and tables to investigate and find solutions to problems, and once the students learn the strategies for making proper sense of the problems, teachers are to encourage them to stay committed to solving them.

The second practice involves reasoning abstractly and quantitatively. At this stage, teachers are to encourage students to reason with quantities and their associations in problem situations. Teachers can then support students in the development of these practices by assisting them generate representations that agree to meanings of quantities and associated units. Teachers should also, when appropriate, encourage students to represent problems symbolically, and encourage them to find links between abstract symbols and illustrations. For instance, when

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students utilise drawings or other illustrations to show that they have 10 fruits from 6 pears and 4 bananas, they can be encouraged to link this representation to the number sentence $10 = 6 + 4$. This, eventually, will make learners move without difficulties between symbols and representations.

The third practice, construction of viable arguments and critiquing the reasoning of others, stresses the relevance of learners using mathematical reasoning to support and justify their ideas, findings and solutions, including the ability to recognise and use counter-examples. Here, teachers are to encourage learners to evaluate or assess each other's arguments in order to determine whether they make sense, and to find ways to clarify or improve the arguments. This practice actually stresses the fact that mathematics is based on reasoning and should be evaluated in a community, not in isolation.

The fourth practice, which has to do with modeling with mathematics, encourages learners to use the mathematics they already know to solve everyday life problems. For instance, for learners at the Basic School, this could mean using simple addition or subtraction equations to illustrate a given problem, or using their sense of numbers to decide whether there are enough playing materials for all the children in their class. Also, teachers are to encourage the learners to determine whether their mathematical results make sense in the contexts of the given situation.

The fifth practice is concerned with strategically using appropriate tools. Here, teachers are to encourage learners to get familiar with variety of problem-solving tools that they can use to solve problems, and also be encouraged to learn how to choose appropriate tools for a given mathematical problem. For instance,

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pupils at the lower primary should be taught how to use pencil and paper, manipulatives, hundreds chart, and number lines for computation. So that, when an estimate is needed for the sum of 21 and 53, some pupils might think using pencil and paper, manipulatives, and number lines as tools would slow down the process and so would select a hundreds chart to speedily move from 50 down two rows (20 spaces) to get to 70.

The sixth practice has to do with attending to precision. Learners should be taught in a way that they will appreciate that in communicating to others, it is imperative that they do it with explicit reasoning. For instance, learners need to be clear about the meanings of the operations, illustrations and symbols they use, in indicating the units involved in a mathematical problem, and to vividly label the diagrams they provide in their explanations. This is to say that as learners tend to share ideas, as a teacher, try and make expectations clear and ask clarifying questions that can help make details of their reasoning more clear. Further, teachers can encourage learners to pay attention to precision by making known to them, and highlighting the use of appropriate mathematical terminologies in explanations and diagrams.

Further, the seventh practice of teaching mathematics for conceptual understanding has to do with looking for and making use of structure. According to Darling-Hammond (2010), learners who look for and recognise a structure can experience a shift in their perspective or comprehension. Thus, as a teacher, set the expectation that learners will look for structures or patterns and assist them reflect on their relevance. For instance, as a teacher, look for opportunities to assist

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learners to notice that the order in which they add up two numbers does not change the total; learners can add 2 + 6 or 6 + 2 to arrive at 8. Once learners are able to recognise this pattern or structure with the help of examples, they are likely to have new understanding and the use of a powerful property of the number system – the commutative property.

Finally, the eighth practice is concerned with teachers encouraging learners to look for and express irregularity in repeated reasoning. Students should be encouraged to step back and reflect on any irregularities that occur, to help them form a general idea or method or identify shortcuts. Teachers should, therefore, make conscious efforts to create a lively and engaging learning environment for pupils to learn mathematics with understanding. One way of creating such environment for students is the implementation of the four Aces of meaningful teaching conceptual framework by Walls (1999). The four Aces are: Outcomes, Clarity, Engagement and Enthusiasm. According to Bulger, Mohr and Walls (2002), when the Four Aces of meaningful teaching is systematically implemented, it can enhance students learning and help to improve the instructional effectiveness of the teacher. These Four Aces are discussed in detail below.

Outcome: According to Bulger et al. (2002), the first aspect of meaningful teaching is the learning outcome. Clear outcomes help students to know where they are going and how they will get to their destination as far as the teaching and learning is concerned. It gives students direction and makes them remain focused. Outcomes also help the teacher to plan his/her lessons in line with the general educational goals. Also, with clear outcomes, teachers are able to assess their

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students as well as the efficiency of their own instructional practices. Further, the outcome tells students why the content they learning are is important and should be taken seriously (Bulger et al., 2002). Indeed, students will develop interest in learning mathematics if they know the importance of the mathematical concept they are learning.

Clarity: This involves explicit or unambiguous explanations when delivering instructions. A good teacher should not hide or withhold relevant information from students; rather, he/she gives out every piece of information needed for comprehension. Clear instruction in the classroom enables students to make connections between what they already know and the new content that is being presented (Bulger et al., 2002). The clarity of the information you give to your students determines their level of understanding of the concept that is being communicated to them. Bulger, Mohr and Walls assert that a way of checking if students are meeting your expectation in the classroom is to check the clarity of the teaching strategies you are using.

Engagement: Students learn when they are actively involved in a lesson and more so when they are given opportunity to learn by doing. Children remember what they do in the classroom; as such, mathematics teachers should endeavour to arrange for students to encounter relevant activities in the classroom either continually or intermittently. According to Bulger et al. (2002), an effective teacher should not teach for more than 30 minutes without engaging learners in an activity.

Enthusiasm: Teachers with good subject matter knowledge exhibit high level of enthusiasm in the classroom (Bulger et al., 2002). If the teacher is more

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knowledgeable about the subject he/she teaches, it reflects in the coherence of the instructional delivery creating such a positive learning environment. When the teacher is passionate about teaching mathematics, his/her students will as well be passionate about learning the subject. As Bulger, Mohr and Walls put it, "if you hate to teach it, your students will hate to learn it" (p.4).

Students' success is one of the major keys that promote enthusiasm in the classroom for both students and teachers.

Thus, the more successful students are in the classroom, the more enthusiastic they become in learning mathematics. In order to enhance student's success in mathematics, the teacher must be excited about teaching the subject and the students must equally be excited about learning the subject. Students become passionate when they find the learning of mathematics meaningful and become more passionate when it is connected to their prior experiences and engages them repeatedly (Bulger et al., 2002). From the discussions so far, to get a good measure of teaching efficiency, teachers' classroom practices need to be examined thoroughly as this current study sought to do. The practices begin right from the planning stage through the delivery stage to the time the teacher exit the classroom.

Teachers' Classroom/Teaching Practices

Teaching practices are the actions and the strategies teachers deploy during the teaching and learning process. It includes the attitude of the teacher as well as classroom organisation and management skills. How teachers manage the classroom environment and the kind of discourse they establish in the classroom towards achieving set of objectives is very important to how pupils learn

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mathematics. Teachers classroom or teaching practices has been found to be the greatest teacher factor that determines students learning outcomes (Hoge, 2016; Rockoff, Jacob, Kane, & Staiger, 2011).

The quality of the interaction that take place between the teacher and the pupils is crucial in producing quality learners (Asare, & Nti, 2014a). As Wenglisky (2002) puts it, teachers' classroom practices can change students' knowledge and attitude overnight. For instance, Kennedy (2018) argued that the methods and the techniques teachers employ in teaching mathematics give pupils a general picture about the nature of the subject, "whether the subject is interesting or boring, debatable or authoritative, clear or fuzzy, applied or theoretical, relevant or irrelevant, and challenging or routine" (pg.5). For pupils to develop interest in learning mathematics, the teacher must first demonstrate strong enthusiasm for the subject. It is not surprising that pupils turn to like mathematics when they find out that their teachers like it, and hate it when they realise their teachers hate it (Domino, 2016). The common knowledge is that, pupils look up to their teachers in the classroom and try to model their practices. Consequently, teachers teaching practices, whether good or bad, will have effect on how pupils learn mathematics. Teachers of mathematics should therefore be conscious of their practices in the classroom.

Despite the strong link between mathematics teachers' teaching practices and pupils' learning of the subject, and the idea that beginning teachers poses the most current knowledge and skills, in Ghana, much attention has not been given to beginning teachers' teaching practices in mathematics. There seems to be a missing

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link between teacher preparation programme and beginning teachers' teaching practices as the performance of Basic School pupils' in mathematics has not seen much improvement over the years. It is as a result of this that this study sought to observe teachers directly in the classroom to get a first-hand information about the influence the training programme taken at the college on their teaching practices in mathematics.

There are a number of indicators that have shown to be related to quality teaching practices. This study adopted four of these indicators from the University of Cape Coast, teaching practice unit. They are lesson plan, methodology and delivery, classroom management and organisation, and professional commitment of teachers (UCC, teaching practice unit). These four aspects of teaching practices have been used to assess the teaching practices of all preservice teachers in the Colleges of Education in Ghana over the years. There is no doubt that quality teaching and learning of mathematics begins with proper lesson planning. Through the planning of a lesson, the teacher considers the age and the mental capabilities of learners. These considerations will help the teacher to select appropriate strategies or teaching techniques that will help communicate the content meaningfully to learners. Planning a lesson also helps the teacher to select relevant teaching and learning activities and organise them sequentially in ways that will enhance pupils understanding. Further, by planning, the teacher is able to outline learning activities and collect relevant materials that are linked to the lesson objectives.

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With regards to classroom management skills, Henaku and Pobbi (2017) in a study on teachers' classroom practices, iterated that a major determinant of quality teaching is the teacher's ability to effectively manage the classroom. According to Henaku and Pobbi, for effective classroom practices, the teacher has a dual responsibility of managing the classroom: management of learners' behaviour and management of the learning/classroom environment. Thus, just as the teacher has the responsibility of transmitting the content to pupils meaningfully, there is also the responsibility of controlling the behaviour of the pupils in the classroom in order to maximise learning. The way teachers interact with learners in the mathematics classroom paints a big picture of the subject to the learners.

Mathematics teachers should therefore create a friendly teacher-pupils interaction in the classroom. Further, mathematics teachers should be able to control the behaviour of pupils in the classroom by engaging them with worthwhile mathematical activities. The assumption is that when the teacher manages the classroom properly, pupils will develop a sense of togetherness that will promote their interest in learning mathematics.

Concerning methodology and delivery, literature has revealed that one of the factors contributing to effective teaching practices is the ability of the teacher to employ variety of teaching methods in the classroom (Franke, Kazemi, & Battey, 2007). The teaching and learning of mathematics is not all about the content but also about ways of transmitting the content to pupils. The use of concrete materials, worthwhile activities and relevant strategies does not necessarily lead to quality classroom practice. Rather, how the teacher engages pupils with teaching and

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learning materials, relevant teaching strategies and worthwhile activities in the mathematics classroom matters (Franke, Kazemi, & Battey, 2007).

For meaningful teaching of mathematics, the teacher should be able to use varied teaching strategies and instructional materials in ways that will enable the pupils to understand the concept been communicated. The teacher must know where and how to begin the lesson, where to give examples, non-examples and counter examples as well as the type of questions to pose in order to assess pupils understanding in the mathematics classroom. Engaging pupils actively in a mathematics classroom will arouse their interest in learning the subject. Mathematics teachers should therefore enact their lessons in a coherent manner that will promote conceptual understanding.

The way mathematics is perceived and taught in Ghanaian Basic Schools has made some pupils to believe that mathematics is difficult and abstract in nature leading to the abysmal performance of pupils in the subject. Mathematics is presented as disjointed pieces of information without linking them together for pupils to make sense of the subject. This prescriptive and procedural approach to teaching mathematics make the subject boring and non-appealing to Ghanaian pupils (Sakyi, 2014). Pupils learning of mathematics depends on the kinds of strategies or methods used by the teacher in the classroom. The teaching practices of Basic School mathematics teachers need to be examined thoroughly since it has effect on pupils learning.

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The most prudent way of measuring the impact of the teachers' classroom interaction is through systematic classroom observations (Pianta, 2003). It has become necessary to look critically at teachers' classroom practices and skills of teaching because it heavily affects the achievement of students in schools (Sabates, Westbrook, Akyeampong, & Hunt, 2010). What the teacher knows and believes about the subject matter, pedagogy, students and learning in general can clearly be identified through direct observation of the actual practices of the teacher in the classroom (Kennedy, Ball, & McDiarmid, 1993). The use of qualitative approaches to measure teachers' classroom practices provides a better understanding of the quality of intervention or professional engagements that had taken place as well as the gaps that need to be addressed. This study employed both qualitative and quantitative methods that will ensure triangulation for reliable results.

According to Sabates et al. (2010), teaching observation, when done well, can build a community among colleagues and motivate both the teacher being observed and the observer to reflect on their teaching, helping them to constantly develop and improve their teaching practices. Also, classroom observations can provide feedback on aspects such as teachers' content knowledge and implementation of some specific teaching methods (Seldin, Miller, & Seldin, 2010).

However, apart from the seeming benefits of classroom observations, there are limitations and challenges. First, classroom observations require a great number of investments in time and resources in order to be effective (Chism, & Banta, 2007). Secondly, lack of agreement on what constitute teaching efficiency can

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create a communication hurdle between the observer and the beginning teacher. Finally, data gathered through classroom observations, most often than not, are unreliable, and if used for personal decisions, they should be considered as just one of the available multiple measures (Seldin et al., 2010). To minimize the limitations, there should be a debriefing at the end of each observation as well as post observation interview for selected teachers (Chism, & Banta, 2007).

Data collected through classroom observations are either used for summative or formative purpose; in some cases, both purposes are sought to be achieved using the same set of data (Seldin et al., 2010). The formative purpose is to assist teachers to improve and innovate whereas the summative purpose is for personal decisions. However, those who have studied teaching observations are of the view that incorporating the formative aspect into the observational process, as this study sought to do, is more beneficial (Chism, & Banta, 2007; Seldin et al., 2010).

Attitude of Teachers towards Teaching Mathematics

Attitude plays an important role in teaching and learning mathematics. The attitude of the teacher in the classroom can make pupils like or dislike the subject. Attitude can be defined in terms of one or a combination of the following constructs: Liking and enjoyment, difficulty, confidence, anxiety and valuing of an attitudinal object (Hannula, 2002). Other studies have also defined attitude as having three components; emotional response, beliefs and behaviour (McLeod, 1992). Just like McLeod, other studies have disintegrated attitude into three different aspects. These are the cognitive aspect, which is made up of thoughts and

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beliefs towards the attitudinal object, in this case, mathematics; the emotional aspect made up of one's feelings towards the attitudinal object; and the behavioral aspect of attitude which is made up of how a person is predisposed to act towards the attitudinal object (Hannula, 2002; Olufemi, 2012). Nevertheless, in mathematics, it is not practicable to give stereotype definition for attitude towards mathematics that will address all situations (Di Martino & Zan, 2003), rather a working definition for the phenomenon under study may be suitable.

Beginning and experienced teachers

There is no generally accepted single definition for beginning or newly qualified teacher. Studies have defined beginning teacher based on the period of being a newly qualified teacher. For instance, Struyf, Adriaeensens and Meynen (2011) restricted the definition of beginning teacher to individuals in their first year of teaching. Leong (2012) also defined beginning teachers to include teachers who have completed one or two full years of teaching experience. Similarly, Lam & Yan, (2011), studied beginning teacher's right after graduation from their training programme to a maximum of two years. Other studies have also defined beginning teachers to include teachers who have recently graduated from their training programme and had only one to three-years' experience in the classroom (Ham, 2011). While others have conceived beginning teachers as newly qualified teachers in their early years of teaching, especially having five or fewer years of teaching experience at the Basic School (Williams, Cubb, & Hollebrands, 2020).

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In Ghana, beginning teacher is defined as a teacher in his/she first three years of teaching (NTC, 2019). Such a teacher has acquired basic knowledge and skills in teaching and capable of performing basic functions such as preparation of lesson notes, preparation of TLMs for effective lesson delivery as well as classroom management. Currently, the first year after completing teacher training is earmarked for national service for all newly qualified trained teachers (NTC, 2019). The National Service Secretariat posts these teachers directly into the classroom to teach as fully trained mathematics teachers. The Ghana Education Service then takes full responsibility of posting teachers who have completed their national service to schools to assume the role of permanent class teachers. In this second posting, teachers are sent to schools other than schools where they did their national service. What it means is that, teachers in Ghana begin the teaching profession right after completing their training programme.

However, for the purpose of this study, to examine the influence of a training programme on teachers teaching efficiency, a beginning teacher has been defined as a teacher in his/her first two years of teaching after training. The assumption was that, when teachers stay longer on the field, their teaching practices might be influenced by factors such as in-service training and other professional development programmes other than the initial training programme. Thus, beginning teachers were conceived as teachers who have been teaching mathematics right after graduating from their training programme to a maximum of two years. Specifically, Diploma in Basic Education teachers who graduated from the class of 2019 and 2020 were the targeted group of beginning teachers. The

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understanding is that these beginning teachers are new to the system (real classroom teaching) and could apply their knowledge and experiences gained from college. All the beginning teachers in this study have successfully completed the regular DBE programme run by the Colleges of Education and have passed the teacher licensure examination. On the other hand, all teachers who are products of the regular DBE programme and have been teaching mathematics for more than two years were considered in this study as in-service (non-beginning) teachers.

The reason for not delimiting the study to include only beginning teachers is the assertion that teachers apply the knowledge and skills acquired from preparation over time and not necessarily in the first year of their teaching carrier (Jordan et al., 2018). What it means is that, with time, teachers integrate the knowledge and skills they acquired from their preparation programme in their mathematics classrooms. Could this imply that non-beginning (in-service) teachers perform better than beginning teachers in terms of their teaching practices? This question was the motivation behind the comparison of the teaching practices of beginning and non-beginning mathematics teachers at the Basic School level. This comparison could give a clear indication of whether beginning teachers teaching practice in mathematics may improve, remain the same or decline over time for the necessary actions.

Teacher Preparation and Teaching Practices

Studies have shown the impact of teacher preparation programmes on teachers' teaching practices and how these affect what and how pupils learn mathematics (Akyeampong et al., 2013; van Heerden, & Ruedin, 2019; Quadhi et

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al., 2020; Good et.al., 2006). Akyeampong et al. (2013) using the mixed methods approach, with a focus on six African countries of which Ghana was part, found initial teacher preparation to have a strong influence on newly qualified early grade teachers' classroom performance. Though Akyeampong et al.'s study appears to have covered many major issues as far as preparation programmes and teaching practices are concerned, their study was limited to only early grade teachers; hence, one cannot tell whether their finding can be applied to other grade-bounds. Moreover, the study focused on multiple countries and reported general findings, as such it is not clear how the preparation programme influence Ghanaian beginning teachers' teaching practices.

Literature has also examined how initiatil teacher preparation supported newly qualified teachers' classroom practices. It was reported that newly qualified teachers found their initial teacher preparation to have had mixed effects on their classroom practices. While van Heerden and Ruedin (2019) reported both positive and negative effects of preparation programmes on teaching practices, Quadhi et al. (2020) showed that there is strong relationship between professional teaching competences and professional training through teacher preparation programme. Will et al. (2018) found no significant difference between teacher education programme attended and subsequent teacher effectiveness. Despite the fact that these studies provided insights into how preparation programmes could influence teachers' practices, these studies were conducted outside Ghana.

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Just as the foregoing prior studies have shown teacher preparation programme to be relevant to teaching practices, others studies have also shown how teacher preparation affects students' learning outcome (Ali, & Hamza, 2018; Will et al., 2018). An instance is a study by Ali and Hamza (2018) which intimated that teacher training had positive impact on students' learning attitude and consequential improvement in organisational performance. Indeed, teachers classroom practices have significant relationship with students' learning (Wenglisky, 2002). Barr and Carolyn (2012) further indicated that teachers who were given critical thinking-integrated instructions through preparation programmes had their students' achievement improved, compared to the students who were taught with the conventional instruction. However, the focus of these studies were on students' learning; implying that intelligence drawn from their findings may only be more effectively applicable to learning context, compared to the teaching context being considered by the present study.

Other researchers are also of the view that although teachers are professionally trained with teaching competencies, these competencies do not necessarily reflect in their teaching practices. It is thus not surprising Siddique, Bakhari and Mughal (2010) observed that although majority of teachers had knowledge about standards of effective classroom practices, most of them did not use these competences in their classrooms as expected. Also, Borko et al. (1992) observed that a teacher could not provide conceptual explanation for standard division of fraction algorithm, even though this teacher had received preparation. Further, Good et al. (2006) rated teachers' classroom management the highest with

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assessment of pupils' learning rated the lowest. These prior finding suggest that there are other possible factors that limit or promote the actions or the instructional decisions of teachers in the classroom (ZFM/ZPA complex). Hence, to examine the teaching practices of teachers, it is important to consider the ZFM/ZPA complex.

Previous studies have also shown the importance of teacher preparation on teachers' classroom performance. For example, Darling-Hammond, Chung and Frelow (2002) conducted a study to find out whether teachers who enter through different training programmes and pathways have different experiences of classroom teaching. The finding showed that teachers who were prepared in teacher education programmes felt better prepared than those who entered through alternative programmes. This highlights the importance of teacher preparation and the need for teachers to be prepared in order to teach efficiently. However, because this study was conducted outside Ghana, their practical implications to the Ghanaian context may not be as realistic as implications of studies conducted in Ghana; hence, the need for the present study.

Studies have also confirmed that teacher preparation does matter for efficient teaching of mathematics (Kilic, 2011). Through preparation, teachers are able to develop ability to identify errors and possible misconceptions students have in mathematics as well as mathematical concepts students find difficult to understand as termed "knowledge of students" by Kilic (2011). The concern has been that when teachers have strong conceptual and procedural knowledge of the mathematics they teach, they will be in a better position to recognise the sources of students' misconceptions, common errors and also help the students to overcome

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such difficulties (Kılıç, 2011). It was realised that prior studies focused more on teaching for conceptual understanding for students, with little attention on the practices of teachers who are charged to teach for the students' conceptual understanding. Thus, it is unclear whether the practices acquired through the preparation programme by teachers actually translate into conceptual understanding for students. This implies a gap in extant literature that the present study sought to fill.

Similar studies conducted in Ghana have also shown that teacher preparation programmes, either through regular or outreach, influence teachers teaching practices. For instance, investigating the impact of outreach preparation programme on teaching practices, Davis and Baba (2005) argued that training programmes are necessary to improving mathematics teachers' teaching practices. Similarly, Davis and Ampiah (2008) assessed the impact of in-service teacher training programme on pedagogical skills and attitudes of Basic School teachers towards the teaching of mathematics, and indicated that in-service teachers perceived outreach programme as having high positive impact on their pedagogical skills. Though these studies focused on preparation programmes in Ghana, they did not specifically consider beginning teachers' teaching efficiency.

Further, it has been shown that Ghanaian teachers, though scored relatively high on items that are measured under teacher preparation construct in TIMSS, the performance did not reflect in their pupils' achievement (Buabeng, Acheaw, & Ntow, 2014). This result suggests a weak link between teacher preparation and pupils' learning outcome. It is unclear how teacher preparation programmes shape

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the practices teachers and the consequential effect on pupils learning outcomes. Studies on influence of teacher preparation programme on beginning teachers' teaching efficiency in mathematics is therefore necessary.

All said and done, the concern is that teachers are still graduating from training institutions all over the world and are being posted to the classroom to teach. As to whether these practices are efficient enough to produce learning outcomes remain a green area to be investigated. Prior studies on teachers' practices seem to have focused more on teaching effectiveness with little attention on teaching efficiency (Kılıç, 2011; Barr, & Carolyn, 2012; Wenglisky, 2002; Will et al., 2018). Also, it could be seen that the studies reviewed so far relied heavily on self-evaluations of teachers' ability to teach with little attention on how beginning teachers use the knowledge and skills acquired in the classroom (van Heerden, & Ruedin, 2019; Darling-Hammond et al., 2002).

Moreover, majority of the prior related studies were conducted outside Ghana, with few related studies focusing on Ghana (Akyeampong et al., 2013; Buabeng et al., 2014; Davis, & Ampiah, 2008; Davis, & Baba, 2005). Again, to the best of knowledge of the researcher, no study has focused specifically on the influence of pre-service teachers training programme on beginning teachers' teaching efficiency in mathematics. The present study, therefore, focuses on the influence of the Diploma in Basic Education programme on beginning mathematics teachers' teaching efficiency using direct classroom observations, face-to-face interviews, and questionnaires.

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Influence of Methods of Teaching Course on Teaching Practices

With regards to methods of teaching course and teaching practices, few prior studies have been found to show the influence of methods of teaching course on teachers' teaching practices (López, & Assaf. 2014; Kajander, 2010; Ensor, 2001). López and Assaf (2014), for instance, examined how method course, service-learning programme and field experiences shaped instructional practices of preservice teachers. After going through a semester-long method course, the result indicated that the service-learning, method course and the field experiences supported the preservice teacher generative learning and hence influences their instructional practices.

Other studies are of the view that for teachers to teach mathematics efficiently, methods of teaching is necessary and should focuse on mastery of conceptual understanding of basic mathemamtical concepts that would enable the teacher to communicate effectively in the classroom (Kajander, 2010). Specifically, Kajander (2010) examined the impact of method course on preservice teachers' knowledge and understanding of basic mathematical concepts needed for teaching at the elementary school level. The results indicated a significant increase in both procedural and conceptual knowledge of the preservice elementary school teachers. This result shows that methods of teaching course is relevant to teaching efficiency in mathematics. As such, more time should be devoted to methods of teaching in the preparation of mathematics teachers, especially for elementary schools.

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On the contrary, studies have shown that methodology course has little or no impact on preservice teachers, especially on their beliefs (Ensor, 2001; Kunt & Özdemir, 2010). In an attempt to recontextualise the pedagogic practices of beginning teachers from their preservice mathematics method course, Ensor (2001) examined seven student teachers through a year-long mathematics method course and then followed them into their first year of teaching in the classroom. The result of the exploration of the transition from teacher education course to the classroom by Ensor indicated that method course had influence on student teachers' ways of talking about teaching and learning of mathematics rather than their classroom practices. The beginning teacher participants were able to recontextualise relatively little amount of the experiences they were exposed to during the method course.

Similarly, Kunt and Özdemir (2010) investigated possible variations regarding the beliefs of preservice teachers who took methodology course at the beginning and those who took it at the end of a four-year teacher education programme. The result of the study showed that the participation of the preservice teachers in the methodology course had little or no influence on strengthening their beliefs. This finding, although contrary to other studies that have concluded that teachers need some special knowledge to be able to teach, argued that the beliefs the preservice teachers formed during the teacher education programme may change when they are engaged in teaching practice and real classroom teaching. Could this suggests that mathematics teachers who have been teaching for a number of years would perform better than teachers who are just beginning teaching in terms of teaching practices? A study to investigate the impact of methods of

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teaching course on beginning teachers' teaching practices in mathematics could help explain the reported gap between theory and practice.

Although studies reviewed thus far acknowledged the importance of methods of teaching course in preparing teachers for efficient teaching, to the best of my knowledge, there was little or no attempt to observe teachers directly in their classroom to understand how their training programme influences their teaching practice in mathematics. In addition, some of the studies were not directly linked to teachers' teaching practices in mathematics while those seemed to have some link to teaching practices have focused on only few teacher participants; thus, making generalisability of finding untenable (Kunt, & Özdemir, 2010). What sets the present study apart is that, all the teacher participants in the study were observed directly in the classroom as they teach mathematics.

From the literature review, it could be seen that studies on the influence of method of teaching mathematics course were scanty. Majority of the prior studies the researcher came across considered teachers of subjects other than mathematics, and these studies were predominantly conducted outside Ghana (Ünal, 2017; Kunt, & Özdemir, 2010). No study that I am aware of has examined the influence of methods of teaching course on beginning teachers' teaching efficiency in mathematics. It was against this backdrop that this study set out to investigate the influence of methods of teaching mathematics course on teaching practices, with the focus on Ghanaian Basic School teachers.

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Perception about the Influence of Method Course on Teaching Practices

Studies have shown how teachers at various levels perceive their initial training programme (Durkee, 2019; Isikoglu, 2008). The way teachers perceive their training programme can influence their teaching efficiency and hence pupils learning outcome in mathematics. For instance, Durkee (2019) investigated the extent to which beginning first-year elementary teachers felt their method of teaching coursework had influenced their attitude and confidence, mathematical content knowledge and mathematical pedagogical knowledge, specifically in teaching numbers and operations. The findings revealed that most of the teachers perceived their method coursework had much influence on their attitude towards mathematics; however, they perceived the method coursework did not have much influence on their content knowledge. What was not evident in prior studies is whether teachers of other grade-bounds would have the same perception about the influence of the methods course.

In like manner, Isikoglu (2008) assessed the effect of method course on early childhood preservice teachers instructional beliefs. It was found that the beliefs of the preservice teachers significantly changed at the end of the teaching method course. The preservice teachers' beliefs about the constructivists' principles of teaching were highly upheld at the end of the programme. Nonetheless, Isikoglu focused only on earlychildhood preservice teachers, as such, the result obtained could only be fittingly applied to early childhood level of education. A study considering teachers at all grade-bounds – early childhood, primary and junior high education – should be given attention; hence the present study.

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Other studies, however, have shown that many beginning teachers do not perceive their training programme to be a major source of their classroom success (Leong, 2012; Ham, 2011). For example, Ham (2011) examined beginning mathematics teachers perception about what is required to be successful in the classroom during their early years of teaching. The study also examined what experiences helped the beginning teachers to achieve success in the classroom and where these experiences were learned. Interestingly, it was found that beginning teachers attributed their success in the classroom to their experiences before and after their preparation programme and not during the preparation programme.

Among the major factors the beginning teachers felt contributed to their classroom success were their content knowledge, classroom management, collaboration with colleagues and tutors, reflections and a belief in the ability to influence student learning in mathematics. These attributes: content and pedagogical knowledge, classroom management skills, professional commitment, method of delivery and attitude of teachers have shown up in a number of studies to have contributed significantly to teachers teaching practices (Durkee, 2019; Isikoglu, 2008; Leong, 2012). Yet, very few studies have employed these immerging attributes to measure beginning teachers' teaching efficiency in mathematics. The present study therefore sought to fill this gap.

Leong (2012), in a study similar to that of Ham (2011), examined the perception of beginning mathematics teachers about the experiences or attributes that make them successful in their first year of teaching as well as where such experiences were acquired – before, during or after teacher education programme.

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Unlike the findings of Ham (2011), where beginning teachers attributed their success to experiences outside their training programme, the beginning teachers in Leong's (2012) study felt their success was the result of the practical skills and the theory that their teacher education programme provided. Key among the attributes they felt contributed to their success were pedagogy and the instructional strategies modelled by their educators and field experience that helped them to link theory to practice. The beginning teachers, however, repeatedly reported that they learned classroom management skills and how to adapt to school and classroom environments on the field (i.e., after their training programme). It appears there is a weak link between the theory of teaching and the realities of the classroom as John outlined in a think piece series (UNICEF, 2018).

Although literature has shown the impact of initial teacher training on newly trained teachers teaching practices, results of studies on perception of beginning teachers about the effect of their training programme had been mixed. Understanding perception of beginning teachers about the influence of their training programme is therefore a critical consideration to any intervention to support beginning teachers in their early years of professional engagement. Thus, the present study sought to address this issue by empirically studying beginning teachers' perception about the influence of methods course on their teaching practices.

Teacher Preparation and Attitude towards Teaching

Teacher education course can positively change preservice teachers' understanding of, confidence in, and liking for mathematics (Macnab, & Payne,

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2003). For instance, Tabuk (2018) examined the attitude of prospective primary school teachers towards teaching mathematics. It was found that the prospective primary school teachers have positive attitude towards teaching mathematics. Also, in terms of their specialties, the prospective teachers had the same attitude towards teaching mathematics. Nevertheless, Tabuk's study was conducted outside Ghana; thus, creating a gap in local literature. This suggests that a study in this area will contribute to filling the local gap.

Furthermore, it has been shown that teachers attitude have influence on students' attitude towards mathematics (Domino, 2016; Okyere-Kwaye, 2013). Specifically, Domino (2016) engaged students to write autobiography in the mathematics courses they had taken in the past. The students were asked to indicate with reasons whether they liked or disliked mathematics, what they liked and disliked about mathematics as well as their past mathematics classroom experiences. Interestingly, the way teachers teach mathematics was the main reason students claimed made them develop interest or hatred for mathematics. Indeed, the way teachers behave in mathematics class has effect on how pupils learn the subject. Pupils may not show interest in learning mathematics simply because of bad classroom discourse created by the teacher (Okyere-Kwaye, 2013). For pupils to like mathematics, teachers should first demonstrate the right attitude in class by showing enthusiasm when teaching the subject and encourage pupils to learn the subject. Unfortunately, existing literature has not considered attitude of teacher as a major factor of teaching efficiency, hence the present study.

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Aside the foregoing prior empirical studies, many other studies have been conducted on attitudes, but these either focused on students (Hannula, 2002; Mata, Monteiro, & Peixoto, 2012; Standslause, Maito, & Ochiel, 2013; White, Way, Perry & Southwell, 2006), preservice teachers towards mathematics (Bhargava, & Pathy, 2014; White et al., 2006; Jacobs , & Spangenberg, 2014) or in-service teachers towards mathematics (Standslause, Maito, & Ochiel, 2013; Sweeting, 2011). To the best of the researcher's knowledge, no study has focused on attitudes of beginning teachers towards the teaching of mathematics, considering the influence of teacher preparation programme in Ghana. Thus, the need for the present study.

Conceptual Framework

Drawing on the theory and the empirical studies reviewed, a conceptual framework was constructed to guide this study. The framework is in two main parts: The first part of the framework is the method class where the preservice teachers have the opportunity to learn mathematical concepts and strategies to teach these concepts. Literature has indicated that preservice teachers enter the training programme with some knowledge, attitudes and perception about teaching mathematics called the zone of achieved development (ZAD). Thus, the content knowledge beginning teachers acquired from the senior high school prior to entering the training programme represents their ZAD. The space between what the preservice teachers already know (ZAD) and what the training programme wants them to know is the Zone of Proximal Development (ZPD) (Vygotsky (1987).

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Within the space, the preservice teachers have limited repertoire of knowledge about teaching mathematics, and need some level of support to develop. With the support of college tutors and other experienced peers (knowledgeable colleagues), the preservice teachers then develop positive attitude and pedagogies specific to mathematics instruction; thereby, expanding the zone of proximal development (ZPD). Impartation of knowledge and skills about teaching mathematics therefore occurs at the ZPD. According to Valsiner, aside the ZPD, other factors may have influence on the development of the preservice teacher. The teaching and learning environment present a wide range of resources and activities that could influence the performance of the preservice teacher (ZFM). Some, not all, of the resources and activities may support the actions or beliefs of the preservice teacher (ZPA). The relationships between the variables have been indicated in Figure 2 by the arrows pointing from the Tutor to the method class (preservice teacher) and from the experienced peers to the method class, respectively

The second part of the framework is the real classroom (field) teaching where the teachers are sent to the classroom and left on their own to begin teaching mathematics as permanent classroom teachers. At this stage, the beginning teachers are expected to teach mathematics efficiently without any support based on the training received at the college (ZPD). Again, the beginning teachers in their schools are exposed to a wide range of resources and have to make their own choice based on the knowledge and skills they have acquired from the training programme as well as their beliefs (ZFM). The resources and activities of the school might

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promote not all the ideas learnt from the training programme (ZPA). The decisions or actions of the beginning teacher in the classroom are then restricted to the region created between the two interlocking circles in the framework. This common region is the region left for beginning teachers to demonstrate their teaching practices. The square represents the ZFM and for the two interlocking circles, one represents ZPD and the other ZPA. The conceptual framework is displayed in Figure 2.

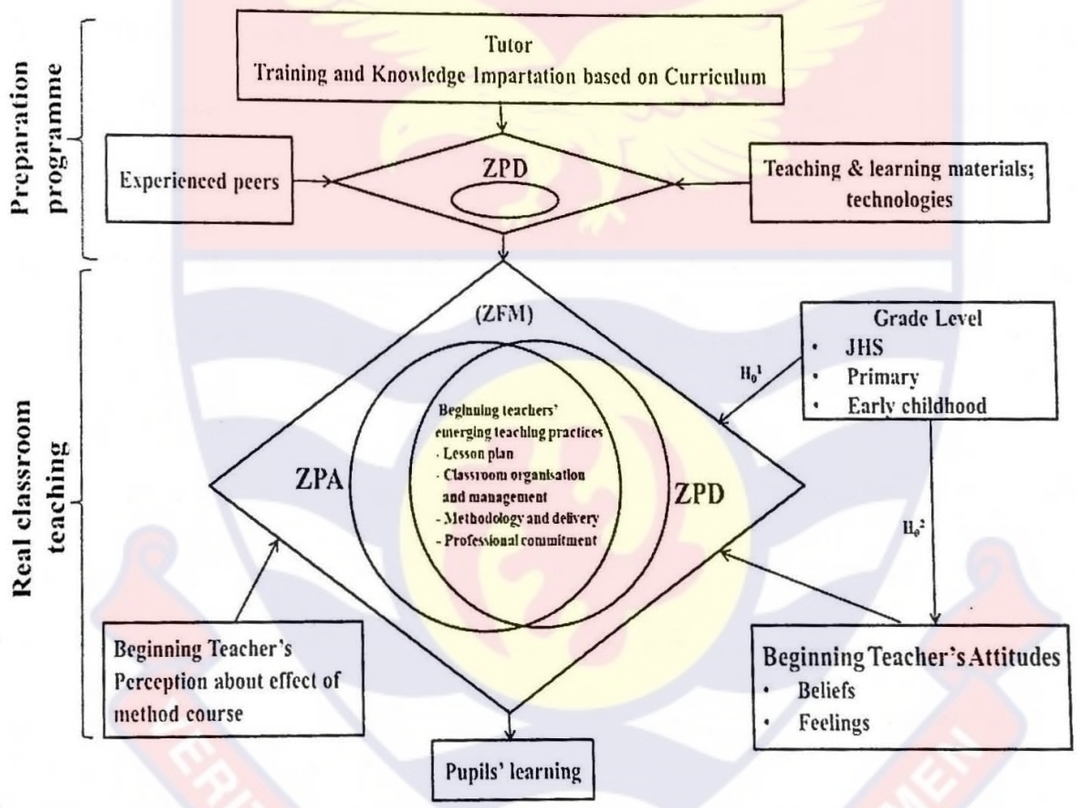


Figure 2: Conceptual Framework

Source: Author's construct (2022)

To measure the teaching efficiency, the study focused on the teachers teaching practices in general and three other teacher related variables (attitude, perception and specialism) that are likely to influence the teaching practices. The main variables under study in the framework are (a) teachers teaching practices, which have direct influence on pupils learning. (b) Teachers attitude, which may

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influence the teachers teaching practices. (c) Perception of teachers on the influence of methods of teaching course, which may also influence the teachers teaching practices as indicated by the arrow from teachers' perception to the classroom. Lastly, (d) Teachers specialism, which may have direct effect on the teaching practices and teachers attitude as indicated by the arrows labelled H_0^1 and H_0^2 in the figure, respectively. The teachers' teaching practices have four dimensions: Lesson plan, methodology and delivery, classroom organisation and management, and professional commitment. The various variables under the framework have been explained in the next paragraphs.

Lesson planning: The first component of the teaching practices, lesson planning, focuses on statement of clear and achievable objectives for mathematics lesson, summary of all core points which relate to the lesson. It also concerns how learning activities are sequenced to foster pupils understanding of mathematics lesson. The statement of appropriate teaching and learning materials, indicating when and how they will be used in a lesson will also be examined. Finally, the lesson plan includes how teachers' linked subject knowledge to objectives stated in order to facilitate pupils understanding.

Methodology and delivery: Methodology and delivery part of teaching practices was considered in this study as the 'heart' of teaching mathematics. It includes the introduction of mathematics lessons in ways that will arouse the interest of pupils in the topic to be taught. The introduction could either be by re-teaching a previous lesson or by relating pupils' fans of knowledge or previous knowledge to the topic. It includes how teaching and learning of mathematics is unfolded in class by using

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varied pedagogical skills. The pace of the lesson presentation as well as the audibility of the teachers' voice is paramount at this stage. How the teacher uses clear and concise language to explain mathematical concepts to learners to enhance understanding.

The teacher is also expected to ask a mixture factual and high order questions and distribute these questions fairly in the class. Teacher encourages pupils to answer and also ask their own questions in class. Whether the teacher uses the chalkboard effectively; topic is written on the board, all core point relating to the lesson are clearly written on the board and pupils are given time to write the core points in their books. Whether the teacher is using appropriate teaching and learning resources and how these materials are linked to the pupils' previous knowledge and the stated objective(s).

The use of simple language by the teacher is encouraged during the delivery stage. Also, the teacher must exhibit command of the subject matter by giving precise information in class, cites a lot of good examples and also relate the content to pupils' experiences. Not all, the teacher must demonstrate some level of confidence in teaching mathematics. In addition, the teacher engages all learners actively in the lesson, monitors the progress of the lesson and provides immediate feedback to the class. Further, the teacher uses variety of assessment techniques to determine pupils understanding of the lesson. Finally, the teacher draws the attention of pupils to the end of the lesson by using questions and answers or by summarizing the main points of the lesson along the lesson objectives.

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Classroom organisation and management: This component of the teaching practices includes management of both learners and the learning environment. The teacher should create enabling environment for meaningful learning of mathematics. Teacher interacts cordially with pupils, make use of pupils' ideas in the class and encourage cooperative learning. Teacher set up clear and appropriate classroom rules to prevent and deal with pupils' behaviour.

Professional commitment: This includes the behaviour of the teacher in the classroom and record keeping. Here, the teacher should show enthusiasm and positive attitude towards the teaching of mathematics. The relationship between the teacher and the pupils should be cordial. The teacher should be able to maintain pupils' attention throughout the lesson and encourage pupils to verbalise the mathematics been learnt. Teacher should accept constructive feedback and reflect on his/her own teaching practices to improve teaching.

Attitude towards teaching of mathematics: This is the teacher's beliefs and feelings towards the teaching of mathematics. Whether the teacher likes or dislikes teaching mathematics and how this attitude affects teaching practices; whether the attitude of teachers also differs in terms of specialties – early childhood, primary and Junior high school education.

Perception about the influence of method course on teaching practices: These are reported experiences of beginning teachers about the influence of their methods of teaching course taken at the college on their teaching practices. Whether or not the teachers perceive their method course to have any influence on their teaching

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practices, the beginning teachers were interviewed to solicit responses on the impact of their method coursework on their teaching practices.

Experienced peers and teaching and learning materials: Though not a major focus of the study, tutors, experienced peers, teaching and learning materials are potential factors that influence teachers' ZPD, since these factors cannot be ignored in the context of teacher training (Valsiner, 1987).

Chapter Summary

Employing the Valsiner's theory in conjunction with review of extant empirical studies, a conceptual framework was constructed. The empirical review revealed three main gaps – gap related to location, gap related to design, and an overall non-existence of a study conducted on this topic. Concerning location or geography, the researcher did not come across any study on this current topic in the current study locale; even those closely related to the topic were conducted outside Ghana. Secondly, the participants involved in these related studies were mostly either experienced in-service teachers or pre-service teachers, unlike the present study that considered both beginning and in-service teachers as participants.

Regarding design, prior related studies either used quantitative approach or qualitative approach with descriptive design employed in most cases. To fill this gap, the present study employed a mixed method design in order to ensure triangulation of findings. Finally, to the best of the researcher's knowledge, no study has, so far, been conducted on the topic under consideration. Considering all this, it is obvious that the present study is relevant to filling these gaps in literature

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as it employs the mixed method design conducted in a locale which lacks literature on this topic, and fills the gap in literature.

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CHAPTER THREE

RESEARCH METHODS

Overview

The purpose of the study was to examine the influence of the regular Diploma in Basic Education (DBE) programme run by Colleges of Education on beginning Basic School teachers' teaching efficiency in mathematics. This chapter presents the research paradigm, research design, population, sample and sampling procedure, instrumentation, validity and reliability, ethical considerations, data collection procedure as well as data processing and analysis.

Research Paradigm

The pragmatic paradigm was employed for this study. The pragmatic paradigm provides a middle position that embraces both positivist/postpositivist and constructivist/interpretivists paradigm in answering research questions (Brierley, 2017). This paradigm was employed because it gives some flexibility in answering research questions using different but most practicable methods (Brierley, 2017). Considering the purpose of this study, the use of only quantitative method might not show the true picture of the influence of the training programme on beginning teachers' teaching practices and their attitudes towards teaching mathematics. The researcher was of the view that the quantitative data (i.e., survey data) though covers many participants it may not reflect the entire situation on the ground, as far as the influence of training programme on beginning teachers' teaching practices and attitudes are concerned. As such, it was more appropriate to get the participants' views on the subject in order to have an in-depth understanding

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of the outcomes of the quantitative data gathered (Easterby-Smith, Thorpe, & Jackson, 2012); hence, the choice of the pragmatic paradigm.

Based on the purpose of the study, the mixed method research approach, which combines aspects of qualitative and quantitative techniques in a single study was deemed appropriate. One importance of using both qualitative and quantitative data in a single study is that, the inherent disadvantages associated with one aspect may be addressed by the other aspect and visa vice (Brierley, 2017). Further, the mixed methods approach made it possible to integrate, at a point, the results of the qualitative and the quantitative analysis. This ensured deeper comprehension of the influence of training programme, DBE, on beginning teachers' teaching practices as well as their attitudes towards teaching mathematics.

Based on the mixed method, the quantitative and the qualitative data collected were analysed separately and the results integrated at a point to draw inferences (Tashakkori, & Creswell, 2007). This corroboration of outcomes from the two approaches (Creswell, Plano-Clark, Guttman, & Hanson, 2003) made the choice of the mixed method approach appropriate for this study.

Research Design

This study employed the explanatory sequential mixed method design where quantitative phase precedes qualitative phase (Creswell, 2013). The study started with the collection and analysis of quantitative data followed by the collection and analysis of qualitative data based on the trend of the quantitative data. Since the design was in two phases, observation and survey were carried out in phase one after which interview followed in phase two. This design was chosen

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because it was needful to contextualise the result of the quantitative analysis using qualitative findings in order to enhance comprehension and authenticity of the overall findings of the study (Creswell, et.al., 2003). In addition, the design was deemed a good fit since it ensured appropriate assessment of the hypothesised relationships between different specialties (early childhood, primary and JHS) and beginning teachers' teaching practices and attitudes, (Cooper, Schindler, & Sun, 2006).

Further, since the researcher sought to examine the effects of specialty on beginning teachers' teaching practices and attitudes towards teaching, the production of reliable results and all-encompassing recommendations for the consumption of teachers and other stakeholders of the educational system in general was necessary. As such, it was just in the right direction to employ a design which incorporates elements from multiple research methods and viewpoints (Saunders et al., 2019). The design ensured triangulation, corroboration, as well as facilitate integration of findings from both the quantitative and qualitative aspects of this study, as multiple sources of data (i.e., survey, observation, and interviews) were employed. The study therefore moved away from only objective stance to include subjective stance. The two-phase study plan is presented in Figure 3.

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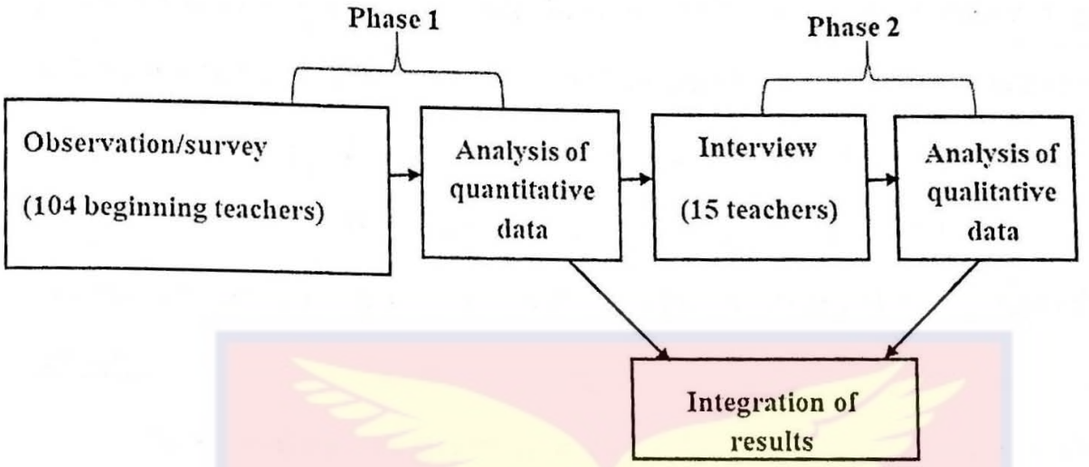


Figure 3: Study Plan

Study Area

The current study area was the Central Region of Ghana. The region is one of the sixteen (16) administrative regions of Ghana. To the north, the Ashanti and the Eastern regions border it. It is bordered by the Western Region to the west, Greater Accra Region to the east, and to the south by the Gulf of Guinea. The region has twenty-two (22) districts including the regional capital, Cape Coast metropolitan assembly. The region is popularly known for its elite higher educational institutions and economy founded on the abundance of industrial minerals and tourism. The region boasts of many tourist attractions including the Cape Coast and Elmina castles, forts, national park such as the Kakum National Park, among many others (Ghana Districts, 2017).

The region has a population of about 2,201,863 people and a total land area of 9,826km^2, giving a population density of 220/km^2 (Ghana Statistical service (GSS), 2018). The region is rated the 8th most populated region in Ghana, and also as the 8th in terms of land area (GSS, 2018). The main economic activities of the

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people of Central Region are dominated by services followed by small scale mining and fishing (GSS, 2018). Apart from the main economic activities mentioned earlier, the local folks also engage in farming; notably, maize farming, and bee-keeping. The region also boasts of offshore crude oil resources at Saltpond. The Offshore Producing Company Limited and two joint venture partners operate this oil field.

The Central Region is referred to as the hub of education in Ghana. The region has some of the best schools in the country. Notable among the institutions of higher learning include the University of Cape Coast, University of Education Winneba, Cape Coast Technical University, OLA College of Education, Foso College of Education and Komenda College Education. With regard to Senior High Schools, the region has over sixty public senior high schools some of which are known by the international community. The notable Senior High Schools are Adisadel College, Saint Augustine's College, Wesley Girls' High School, Holy Child School, Ghana National College, Mfantsipim School and Aggrey Memorial Senior High School. There are about 4,188 public Basic Schools in the Central region of Ghana: 95 Creche/Nursery, 1,416 kindergarten, 1,438 are primary and 1,239 are junior high schools (GSS), 2018).

Every year, the Government of Ghana, through the Ministry of Education (MoE) and the Ghana Education Service (GES), posts trained and certified fresh graduate teachers to the various regions in the country. Among the teachers posted every year are those from the Colleges of Education. The crop of newly trained teachers (class of 2019 and 2020) constituted the last group of trained teachers for

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the three-year regular Diploma in Basic Education (DBE) programme. These fresh Diploma in Basic Education teachers who have been posted to Basic Schools were the focus of the study. Figure 4 is the map of Central Region showing its districts.

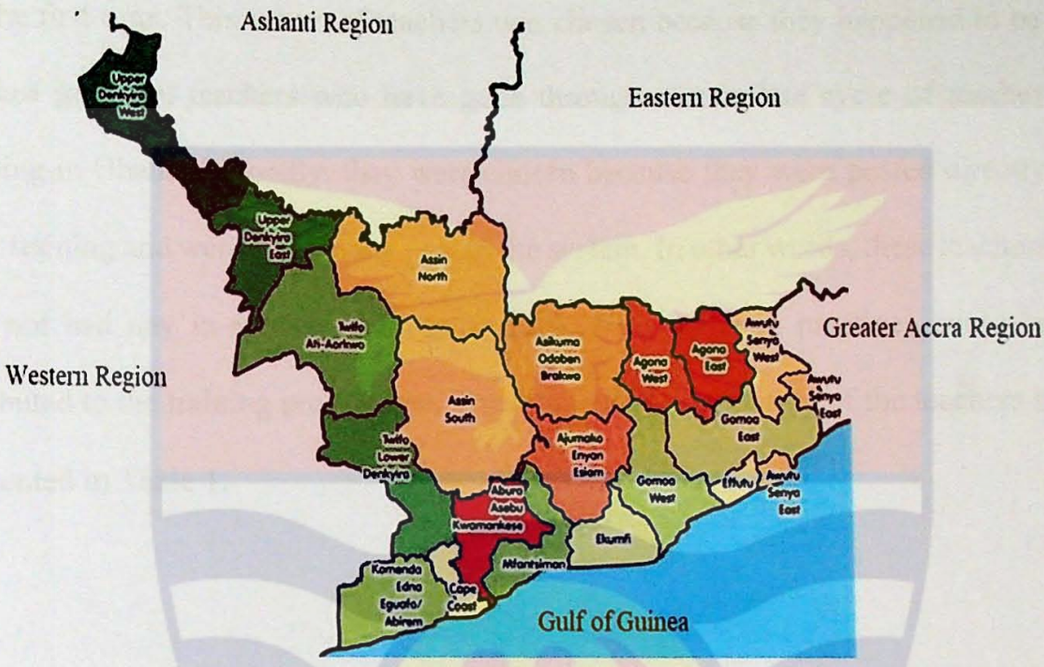


Figure 4: Districts of Central Region of Ghana

Population

The population of the study comprised all beginning teachers who have completed College of Education and are at post in Basic Schools in the Central Region of Ghana. A total of 1718 prospective Basic School teachers were posted to the 22 districts in the Central Region to teach at the Basic Schools. This comprised 451 beginning female and 1,267 beginning male teachers. All the beginning teachers were products of the 3-year regular Diploma in Basic Education (DBE) programme in either of three specialisms: Early Childhood, Primary and Junior High School. All the beginning teachers had been certified as trained teachers.

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The cohort of teachers used comprised two-year groups – those who completed college in 2018/2019 and 2019/2020 academic years, and have since been posted to assume the role of permanent classroom teachers at the Basic School for the first time. This cohort of teachers was chosen because they happened to be the last group of teachers who have gone through a complete cycle of teacher training in Ghana. Secondly, they were chosen because they were posted directly after training and were completely new to the system. In other words, these teachers had not had any in-service training; as such, their teaching practices could be attributed to the training programme. The population distribution of the teachers is presented in Table 1.

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Table 1: Beginning Basic School Teachers Population Distribution

SN	Districts	Population
1	A	107
2	B	81
3	C	76
4	D	103
5	E	105
6	F	77
7	G	114
8	H	80
9	I	39
10	J	80
11	K	42
12	L	48
13	M	57
14	N	51
15	O	55
16	P	93
17	Q	93
18	R	102
19	S	61
20	T	96
21	U	102
22	W	58
Total		1718

Source: Ghana Education Service (2020)

Sampling Procedure

The sample size for the study comprised 104 beginning and 80 in-service Basic School mathematics teachers from three districts in the Central Region of

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Ghana. A multi-stage sampling technique was employed to select sample for the study. First, the 22 districts were assigned numbers as shown in Table 1, and computer-generated random numbers were used to select three districts: L, Q and R districts. These three districts represents 14% of the total number of districts in the region. This choice was deemed representative as researchers proposed 10% of the total items being considered, taking into consideration cost elements and time constraints as far as research activities are concerned (Sarstedt, Bengart, Shaltoni, & Lehmann, 2018).

As shown in Table 1, ninety-three (93) teachers were posted to district Q, one-hundred and two teachers (102) to district R and forty-eight (48) to district L, making a total of 243 beginning teachers. Out the 243 beginning teachers, 140 teach mathematics. From the table of finite population proposed by Krejcie and Morgan (1970) (See Appendix A), a population of 140 teachers of mathematics corresponds to a sample of 104 teachers. This sample size represents 74% of the population and this is representative. According to Krejcie and Morgan, with a probability of committing error less than 5% and a confidence level of 95%, the sample size of 104 is appropriate for the finite target population.

Further, since the number of beginning teachers in each of the three selected districts were different, it was necessary to obtain a sample that was representative of each district relative to the entire population. As a result, proportionate sampling technique was employed. This sampling technique ensured an evenly spread of the sampling units over the study region. At the end, 39 teachers were selected from district Q, 44 teachers from district R and 21 teachers from district L, making 104

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beginning teachers as the sample size for the study. Table 2 presents the proportions and the sample distributions.

Table 2: Sample Size Distribution

SN	Districts	Population	Proportion computations	Sample size
1	Q	53	(53/140)*104	39
2	R	59	(59/140)*104	44
3	L	28	(28/140)*104	21
	Total	140		104

Source: Ghana Education Service (2020)

There are several Basic Schools in each of the selected districts. Some of the schools did not have any beginning teacher while some have a maximum of five teachers. Since the focus of the study was on beginning mathematics teachers, it became necessary to purposively select schools that had at least two beginning mathematics teachers in order to obtain the required number (104) of teachers in each district for the study. Finally, for a fair comparison between beginning teachers and in-service teachers, the same number (104) of in-service teachers was purposively selected. The purposive sampling technique was used because only in-service teachers who were found in schools where beginning teachers were posted and were teaching at the same grade bound were made to participate in the study. Only in-service teachers who were available and willing to participate in the study were included. This exercise was repeated in all the Basic Schools in the three selected districts and 80 in-service teachers took part in the study.

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Data Collection Instruments

Three different instruments were used to collect data for the study: An observation schedule, questionnaire and a semi-structured interview guide. The first instrument, a standard observation schedule, was adopted from the Centre for Teacher Professional Development, University of Cape Coast, Teaching Practice Unit (UCC, 2021). The instrument focused on four thematic characteristics of teachers' teaching practices: Lesson plan, teaching methodology and delivery, classroom organization and management and professional commitment. In all, there were twenty (20) items on the observation schedule: five items under lesson plan, eleven items under teaching methodology and delivery, two items under classroom organisation and management and two items under teacher professional commitment. The instrument assessed teachers specifically in the following areas of classroom teaching: planning of lesson, introduction of lesson, use of teaching aids, communication skills, teaching strategies employed, pupil's involvement, strategies for assessing pupils learning, questioning skills, mastery of subject matter, classroom management skills and general classroom organization. However, most (55%) of the items on the observation schedule were centred on teaching methodology and delivery; that is, the techniques and strategies teachers employed in teaching mathematics. The instrument was based on a five-point Likert scale: 5 = Very good, 4 = Good, 3 = Satisfactory, 2 = Unsatisfactory and 1 = Poor. In addition, the instrument provided spaces for overall comments on each of the four thematic areas observed and a space for any emerging issue (See Appendix A).

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The second instrument was a questionnaire made up of 37 items of which 20 items were adapted from Schackow (2005) and Davis (2004) and the rest constructed by the researcher. The instrument was divided into two parts. The first part investigated the attitude of beginning teachers towards the teaching of mathematics at the Basic School. This part of the questionnaire had 22 closed ended items with two sub-scales: beliefs and feelings. The beliefs sub-scale had eight (8) items and feeling sub-scale had 14 items. The second part examined the perception (reported experiences) of beginning teachers about the effect of their method of teaching mathematics course on their teaching practices. It consisted of one (1) open-ended and 14 closed-ended items. The items on both first and the second parts of the questionnaire were rated on a 5-point Likert scale – from strongest agreement (5) to weakest agreement (1) (See Appendix B).

The third instrument was a semi-structured interview guide consisting of six main questions with sub questions. Some of the questions on the semi-structured interview guide were adapted from Centre for Teaching Support and Innovation, University of Toronto (2017), and the rest developed by the researcher. The questions on the interview guide were constructed to solicit the opinion of the beginning teachers, generally, about the influence of their preparation programme on their teaching practices in mathematics. Specifically, the questions were targeted at beginning teachers' knowledge of: lesson objectives, the use of appropriate TLMs, engagement of pupils in mathematics class, the influence of methods of teaching mathematics course on attitudes towards teaching mathematics, influence of methods of teaching mathematics course on competencies in teaching

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mathematics, and the influence of the training programme on teaching practices. It also contained follow-up questions that explained how beginning teachers obtained and make use of the ideas and skills they employed in teaching mathematics at the Basic School (See Appendix B).

Instrument validity and reliability

Validity is the degree to which an instrument accurately measures what it is intended to measure (Sarstedt, et al., 2018). To ensure validity of the study in its entirety, the researcher made sure data collected were quality and devoid of dishonesty. The observation schedule was an adopted instrument that had been validated and standardised by University of Cape Coast. The instrument had been used over the years to assess teachers teaching practices during on-campus and off-campus. No further validation was done before using it since it has been used to assess teachers in Ghana and the study was also conducted on teachers in Ghana.

While preparing the interview guide, attention was on clarity and coherence of the questions to the respondents. The completed interview guide was submitted on three occasions to two experienced senior lecturers who are experts in the subject of study for face and content validation. Questions that were not clear were reconstructed and those that were ambiguous were corrected before the final guide was obtained. Initially, there were nine (9) main questions on the interview guide. A preliminary application of the prepared interview guide was conducted using fifteen beginning teachers in three Basic Schools that had similar characteristics as schools in the three districts selected for the study. After the preliminary application, the questions on the interview guide were reduced to six.

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Further, the questionnaire adapted by the researcher to solicit participants' responses about their attitude towards teaching mathematics and their perception about the influence of their preparation programme on their teaching practices also went through a similar process of validation as the interview guide. Again the content and face validity were analysed with the help of two senior lecturers. A preliminary application of the prepared questionnaire conducted, using fifteen (15) Basic Schools, reduced the initial 48 items to 37 items.

Next, the survey instrument was checked for reliability and internal consistency using the Cronbach alpha. Cronbach alpha-coefficient ranges from 0.0 to 1.0. A scale is termed reliable and internally consistent if its Cronbach alpha-coefficient score is not less than 0.70 (Connelly, 2011; Heo, Kim, & Faith, 2015). Cronbach alpha coefficients for beliefs and feelings sub-scales were 0.987 and 0.891, respectively. After the analysis, the initial 24 items on the attitude scale reduced to 22 items. The Cronbach alpha value for the combined attitude scale was 0.894. According to the Cronbach alpha value, the 22 closed ended items on the combined attitude scale were all consistent (Bruton, et al., 2000; Connelly, 2011). Also, the Cronbach alpha value for perception was 0.837. Summary of the reliability coefficients is presented in Table 3.

Table 3: Reliability

Variable	Number of items	Cronbach alpha
Attitude	22	0.894
Believes	08	0.987
Feelings	14	0.891
Perception	14	0.837

Source: Field survey (2021) N = 104

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Ethical considerations

Ethics is crucial in research; thus, every researcher is to adhere to ethics of research. As part of the requirements for conducting research involving human beings, the researcher obtained an ethical clearance from the Institutional Review Board (IRB), University of Cape Coast, before embarking on the study. To ensure the safety of every participant, all ethical issues concerning the study were addressed before the IRB gave the final approval for the study to be conducted. Each instrument for the study was assigned an informed consent form for which participants were made to sign as evidence of their voluntary participation in the study.

Data Collection Procedures

A visit was made to the selected Basic Schools to meet with teachers who teach mathematics. During this visit, beginning teachers (defined as teachers with at most two years prior teaching experience) as well as in-service mathematics teachers were pre-informed about the purpose of the study and they were also assured of the confidentiality of the data that were to be gathered. Two groups of beginning teachers were identified during the visit. They were teachers who had just completed college and those who were done with a one-year national service after completing college. Nonetheless, the two groups of teachers were all included in the study as beginning teachers. All the teacher participants were also given opportunity to read the ethical clearance letter issued to the researcher to affirm their willingness to participate freely in the study. Also, to protect the anonymity of the participants, they were assured that all names associated with the study would

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be pseudonym. The teachers were made to understand that participation in the study was voluntary and that they had the right to participate or not to participate. Participants were also informed that they had the right to withdraw from participating in the study without any consequences, and if any participant decided to stop somewhere along the line, they would not be side-lined in any form. Those teachers who agreed to participate in the study were then given a consent form to sign and a check list to complete. The check list comprised topics from methods of teaching mathematics course of which the beginning teachers were asked to indicate by ticking as many topics as they were taught while in college. The resulting checklist provided information about the coverage of the method course instruction at the college. Finally, the teaching time table and personal contacts of the beginning teachers were taken.

The study began by collecting information on the Diploma in Basic Education programme that prepared the beginning teachers who were the main participants of the study. First, the curriculum for the methods of teaching mathematics course was thoroughly inspected to identify areas that are commonly taught at the Basic School and could influence beginning teachers' practices. This made it possible to connect with topics that beginning teachers taught during the classroom observations.

Data collections for the study were carried out in two phases at the Basic Schools. The first phase combined the collection of the survey data and the classroom observations. The classroom observation included both the beginning and the in-service mathematics teachers while the survey included only the 104

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beginning teachers. The survey consisted of two parts to be completed together in 20 minutes averagely. Part one was on attitude of beginning teachers towards teaching mathematics and part two was on perception of the beginning teachers on influence of the method of teaching mathematics course component of their training programme on their teaching practices.

The classroom observations were carried out with the assistance of nine other expert observers all of whom have been trained and engaged by the University of Cape Coast Teaching Practice Unit to assess pre-service teachers on off-campus teaching practices. Consequently, all the observers were conversant with the adopted observation tool. However, before the entire data collection exercise began, the researcher met with the team to discuss how to go about the observation, scoring, and specific comments on each of the thematic areas.

The first classroom observation of mathematics lesson was carried out simultaneously with the survey on the second visit to the schools. The observation was done in the classroom when the beginning teacher was having mathematics lesson as indicated on the normal school timetable. The full lesson duration (60 minutes) of mathematics for each participant was observed. This exercise was carried out in each of the Basic Schools visited. The observation data were mainly on teaching practices of both beginning and in-service teachers who freely participated in the study.

Each teacher was observed three times within three weeks on different days by two observers at a sitting. The two observers rated the lesson independently and then recorded the average score after each observed lesson. At the end of the third

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observation of a participant, the average of the three averages were then calculated and recorded. Since the three observations per participant were not done consecutively, there was a five-minute debriefing at the end of each observation. During this time, the beginning teacher was granted a short interaction based on the lesson delivery. In addition to the observation, and with the consent of the beginning teachers, some lessons were videoed to get in-depth information concerning the teaching practices of the teachers. In order to minimise the distortion of participants' behaviours related to handheld devices, the video camera was mounted on the wall of the classroom (Bottorff, 1994 as cited in Lotzkar, & Bottorff, 2001). The period of data collection for the first phase spanned over twelve weeks.

The second phase of data collection was a semi-structured interview, which was a follow up on the classroom observations, aimed at ascertaining the influence of the training programme on the teachers' practices. The researcher conducted it with one experienced mathematics educator from the expert observers. The interview lasted 20 minutes on average for each participant. The interview for each participant was scheduled to take place shortly (within a week) after the third observation has been carried out. The participants for the interviews were chosen purposively to include teachers whose teaching practices scores were exceptionally high (>90%) as well as those whose teaching practices scores were low (<50%) as rated by the observation instrument. In all, fifteen beginning teachers, five each for early childhood education, primary education and JHS education, took part in the interview. This post-observation interview further explained the beginning

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teachers' actions and inactions in the classroom. What the teacher did, why he/she took that action and where that skill or idea was learned.

In summary, all participants were fully informed about the purpose of the study, and were assured of confidentiality, and that their responses would be used for academic purposes only. The study relied on observations of participants' mathematics instructions supplemented with questionnaires and interviews. Some classroom lessons were also videotaped, and field notes were taken. Questionnaire was used to gather information on attitude of beginning teachers towards the teaching of mathematics as well as their perceptions about the influence of their training programme on their teaching practices. Semi-structured interview guide was used to further gather information from the beginning teachers about the influence of the training programme on their teaching practices and attitude towards teaching mathematics. To protect the data gathered, the audio and video recordings were safely stored on a CD-ROM and kept by the researcher. Before the interview data was used in the final work, participants had access to their transcript to confirm that it was a true reflection of their own responses. In all, the data collection period spanned over four months – from March, 2021 to June, 2021.

Data Processing and Analysis

To answer the first research question, quantitative data gathered using the observation schedule was used. The beginning teachers were rated based on their teaching practices. The overall average score obtained by each beginning teacher was rated on a scale of "5 = very good", "4 = good", "3 = satisfactory", "2 = unsatisfactory" and "1 = poor". There were 20 items on the observation tool which

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gave a minimum raw score of 20 and a maximum score of 100. Out of the 100 scores, lesson plan was 25 marks, methodology and delivery was 55 marks, classroom management and organisation was 10 marks and the teacher professional commitment was 10 marks.

A score less than 50 shows very poor influence, 50 – 54 poor influence, 55 – 59 satisfactory influence, 60 – 64 fair influence, 65 – 69 average influence, 70 – 74 good influence, 75 – 79 very good influence and 80 – 100 excellent influence, based on the University of Cape Coast, teaching practice grading system. Further, percentages were used to group the number of beginning teachers obtaining a particular total score on the rating and the results discussed based on Valsiner's zone theory. Finally, the results were re-grouped into three categories (weak influence, moderate influence and high influence) for discussion.

The second research question was on the perception of beginning teachers about the influence of the methods of teaching mathematics course taken at the college on their teaching practices. This research question was addressed using quantitative data collected from the questionnaire on perception. The questionnaire was rated on a 5 point Likert scale; 5 = strongly agree, 4 = agree, 3 = undecided, 2 = disagree and 1 = strongly disagree. The data was analysed using the mean, standard deviation and percentages. A mean score of above 3.5 indicates positive opinion about the influence of methods of teaching mathematics course on beginning teachers teaching practices; otherwise, negative opinion. The responses were then grouped, under positive and negative perceived influence, using percentages to show the number of beginning teachers who perceived the methods

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of teaching mathematics course to have had positive influence on their teaching practices and those who perceived otherwise.

For the third research question, which assessed the influence of methods of teaching mathematics course on beginning teachers' attitudes towards teaching, quantitative data, collected using the questionnaire on attitude was used. The responses from the beginning teachers were rated as follows: "5 = strongly agree", "4 = agree", "3 = neutral", "2 = disagree", and "1 = strongly disagree". The question was analysed using mean, standard deviation, frequencies and percentages. A mean score of 3.5 and above indicated favourable influence of methods of teaching mathematics course on beginning teachers' attitudes towards teaching. However, mean scores below 3.5 indicated unfavourable influence of the methods course. The number of beginning teachers were then grouped under "influence" and "no influence" using frequencies and percentages. The results were then discussed in the perspective of Valsiner's zones.

Further, to test the research hypotheses, quantitative data were employed. The first and second hypotheses were analysed using the one-way Analysis of Variance (ANOVA), while the two-way independent sample t-test was employed to analyse the third hypothesis.

The interview data were analysed qualitatively using NVivo (release 1.0) to address research questions one and three. The main themes (constructs) were organised under three zones (categories). The qualitative analysis was conducted to give further explanation to the results obtained from the quantitative data. A

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summary of the zones with their corresponding constructs, which guided the study, are indicated in Table 4.

Table 4: Zones with Constructs

Zones	Constructs/indicators
Zone of Proximal Development (ZPD)	• Mathematics content knowledge, • Pedagogical knowledge, • Confidence in teaching mathematics, • Attitude toward teaching mathematics
Zone of Free Movement (ZFM) (Classroom/learning environment)	• Pupils behaviour in class • Pupils motivation • Pupils engagement/participation • Availability of resources to support teaching • Support from colleague teachers • Classroom organisation • Culture of the pupils
Zone of Promoted Action (ZPA)	• Access to TLMs • Support from colleague teachers • Good classroom organisation • Attitude towards teaching mathematics • Teaching approaches that support conceptual understanding • Teachers stimulus/motivation

Source: Adapted from Goos (2005)

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The Zone of Proximal Development was conceived as a set of possibilities (the 'what' and 'how' of teaching) that the training programme offers the beginning teachers under the guidance of their tutors and other experience peers. The Zone of Free Movement (ZFM) was conceived as the freedom at the disposal of the individual to act within the learning environmental while the Zone of Promoted Action (ZPA) was conceived as the practices within the learning environment that promote the teaching actions of the individual teacher.

Chapter Summary

The study relied on both quantitative and qualitative data. The study needed a paradigm that could combine the beliefs of both postpositivist and the interpretivists, as such, the pragmatics paradigm was employed. The pragmatist asserts that whether there exists a single or multiple realities, every individual has his/her own interpretation of the world. Since the results of the quantitative data informed the collection of the qualitative data to give further explanation or contextualise the quantitative data, sequential explanatory mixed methods design was employed. The study was conducted in the Central Region of Ghana, made up of 22 districts. A sample of 104 beginning and 80 in-service teachers were selected from three of the districts using multiple sampling technique. Observation schedule, questionnaires and semi-structured interview guide were used to collect data for the study. The quantitative data were analysed using descriptive and inferential statistics while the qualitative data were analysed narratively based on Valsiner's zone theory; ZFM, ZPD and ZPA. Names of participants' school of practice and

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College of Education attended were pseudonymised to ensure anonymity and confidentiality.

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CHAPTER FOUR

RESULTS AND DISCUSSION

Overview

The purpose of this study was to examine the influence of the regular Diploma in Basic Education programme run by Colleges of Education on beginning teachers' teaching efficiency in mathematics, using the sequential explanatory mixed method design. This chapter presents the results and discussion in relation to the research questions and the hypotheses formulated in Chapter One. The analysis of the quantitative data precedes the qualitative data. The analysis and the discussions were done in the perspective of Valsiner's zones theory (zone of proximal development, ZPD, zone of free movement, ZFM, and zone of promoted action, ZPA). For clarity, the chapter was organised in such a way that all the analysis, corresponding results and the inferences that could be drawn from them, have been presented for the first research question before directing attention to the next question or hypothesis in that order. The chapter begins with the demographic information on the study participants, descriptive statistics and continued with the analyses of the research questions and the research hypotheses. Finally, chapter summary has also been presented.

Demographic Information

This section of the chapter covers the participants' gender, teacher type – beginning teacher or in-service teacher, and specialties – early childhood, primary and Junior high school. These pieces of information were important as the researcher sought to assess whether specialties have significant effect on teaching

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practices and attitudes of teachers towards teaching of mathematics, and whether being a beginning teacher or an in-service teacher has significant effect on teaching practices. To analyse these pieces of information, frequencies and percentages were used. The results are presented in Table 5.

Table 5: Socio-demographic Information of Participants

Variable		Frequency	Percentage (%)
Gender	Female	128	69.6
	Male	56	30.4
Teacher Type	Beginning teacher	104	56.5
	In-service teacher	80	43.5
Specialty	Early childhood	31	29.8
	Primary	41	39.4
	Junior high school	32	30.8

Source: Field survey (2021)

Note: Specialties were computed as percentage of total beginning teachers

Table 5 shows the socio-demographic information of teachers who participated in the study. In all, 184 Basic School teachers participated in the study. Out of the total, 128 (69.6%) of the teachers were females whilst 56 (30.4%) were males. Though the female participants outnumbered their male counterparts, the males were fairly represented. Also, this difference was not surprising as female teachers are mostly found in Basic Schools, compared to male teachers. The focus of the study was on beginning teachers, as such, 104 beginning teachers representing 56.5% of the total number of teachers who participated in the study

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against 80 in-service teachers, representing (43.5%) of the total participants was representative.

The in-service teachers were also well represented, as they were more than 50% of the total beginning teachers considered. Finally, Table 5 showed that out of the 104 beginning teachers, 31 (29.8%) were early childhood education teachers, 41 (39.4%) were primary education teachers and 32 (30.8%) were Junior High school teachers.

Influence of Diploma in Basic Education Programme on Beginning Teachers' Teaching Efficiency

The first research question sought to examine the influence of Diploma in Basic Education (DBE) programme on beginning Basic School teachers' teaching practices. Essentially, this question was set to determine whether the DBE programme taken by beginning teachers at the Colleges of Education had influence on their overall teaching practices in mathematics at the Basic School level. To respond to this research question, the teaching practice scores obtained by the beginning teachers were classified – from "no influence" (<50%) to "excellent influence" (80%-100%), according to the University of Cape Coast teaching practice scores classification – and analysed using frequencies and percentages. The scores were further grouped into three categories – no influence (weak impact), moderate influence (average impact), and high influence (good impact).

For coherent discussions on the influence of the DBE programme on beginning teachers teaching practices, the researcher presents the analysis by considering each of the four aspects of teaching practices (lesson plan, teaching

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methodology and delivery, classroom organisation and management and professional commitment) one after the other and then finally combined them to understand the effect. The results of the analysis are presented in Tables 6, 7, 8 and 9 for lesson plan, teaching methodology and delivery, classroom organisation and management, and professional commitment, respectively. In the tables, "Poor" indicates a score of "1"; "Unsatisfactory" represents a score of "2"; "Satisfactory" indicates a score of "3"; "Good" represents a score of "4"; and "Very good" stands for a score of "5". Descriptive statistics of the first thematic area under the teaching practice (lesson plan) is presented in Table 6.

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Table 6: Descriptive Statistics of Beginning Teachers' Lesson Plan

	Poor	Unsatisfactory	Satisfactory	Good	Very good
	F (%)	F (%)	F (%)	F (%)	F (%)
Objectives	3 (2.9)	0 (0.0)	3 (2.9)	35 (33.7)	63 (60.6)
Summaries/core points	1 (1.0)	0 (0.0)	3 (2.9)	64 (61.5)	36 (43.6)
Teaching and learning activities	0 (0.0)	1 (1.0)	22 (21.2)	42 (40.4)	39 (37.5)
TLRs	0 (0.0)	0 (0.0)	17 (16.3)	35 (33.7)	52 (50.0)
Subject and pedagogical knowledge	0 (0.0)	1 (1.0)	6 (5.8)	66 (63.5)	31 (29.9)

F = Frequency

N = 104

Source: Field survey (2021)

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The results from Table 6 suggest that 63 representing 60.6% of the beginning teachers stated very good objectives for their lessons. In other words, 60.6% of the teachers stated specific, measurable and achievable objectives, which were linked to their classroom activities. Together, 98 (94.3%) of the teachers stated acceptable (good and very good) objectives for the lessons observed. This indicates that the teachers received substantial knowledge on lesson objectives (i.e. belonging to the zone of proximal development, ZPD). However, considering the number of beginning teachers who enacted their teaching and learning activities coherently, out of the five areas under the lesson plan, sequencing of learning activities was rated the least with 81(77.9%) respondents.

It could also be seen from Table 6 that no participant was scored "poor" or "unsatisfactory" in terms of stating TLRs, indicating that all the beginning teachers stated teaching learning resources and indicated where they would be used in their lessons. With respect to subject matter and pedagogical knowledge, only one out of the 104 beginning teachers deviated from the concept taught. The rest of the teachers demonstrated good command of the subject matter during their lesson delivery. Again, it can be said that within the ZPD, the teachers received good knowledge of the use of TLMs and subject matter.

The second thematic area that was considered during the observation was teaching methodology and delivery. The strategies and the techniques that the teachers employed during lesson delivery as well as the pace of the lesson. All the strategies were mapped on to the ZPD. The teaching practice observation results are displayed in Table 7.

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Table 7: Descriptive Statistics of Beginning Teachers' Teaching Methodology and Delivery

	Poor	Unsatisfactory	Satisfactory	Good	Very good
	F (%)	F (%)	F (%)	F (%)	F (%)
Introduction to the lesson	0(0.0)	9(8.7)	12(11.5)	79(76.0)	4(3.8)
Presentation – teaching and learning activities	3(2.9)	3(2.9)	3(2.9)	39(37.5)	56(53.8)
Pace of lesson and audibility of voice	0(0.0)	4(3.8)	1(1.0)	60(57.7)	39(37.5)
Questioning and feedback	0(0.0)	1(1.0)	4(3.8)	60(57.7)	39(37.5)
Use of chalkboard	0(0.0)	1(1.0)	4(3.8)	60(57.7)	39(37.5)
Use of teaching resources (TLRs)	0(0.0)	1(1.0)	4(3.8)	60(57.7)	39(37.5)
Communication/use of language	0(0.0)	1(1.0)	4(3.8)	60(57.7)	39(37.5)
Student participation	0(0.0)	1(1.0)	4(3.8)	60(57.7)	39(37.5)
Mastery of subject matter	0(0.0)	4(3.8)	1(1.0)	60(57.7)	39(37.5)
Assessment of student learning	0(0.0)	4(3.8)	1(1.0)	60(57.7)	39(37.5)
Closure	0(0.0)	4(3.8)	1(1.0)	60(57.7)	39(37.5)

F = Frequency

Source: Field survey (2021)

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From Table 7, it could be seen that except for one teacher, all the beginning teachers were rated very high (each teacher received a score of more than 90%) in terms of teaching methodology and delivery. Specifically, in terms of the number of teachers who were rated "very good", presentation of learning activities was rated the highest while "introduction of lesson" was rated the least. Together, 95 (91.3%) out of the 104 beginning teachers were able to present or organise their teaching and learning activities sequentially and logically in their lesson delivery. However, 6 (5.8%) of the teachers could not present or organise their lessons properly. It could also be observed that 99 (95.2%) were able to engage pupils during their lessons, indicating active participation of pupils. In terms of subject matter, although no beginning teacher was rated "poor", five (5) of them representing (4.8%), could not demonstrate that they have command of what they were teaching.

Nevertheless, a great number (103 out of 104) of the teachers had mastery of the subject matter and could give precise information to their pupils in class. Also, majority (99) of the teachers could use simple and correct mathematical language in class to the understanding of almost every pupil. Further, the assessment of pupils' understanding in class by majority (99) of the teachers was encouraging. About ninety-five percent (95.2%) of the teachers employed variety of assessment techniques to check the level of understanding of pupils. No teacher was rated "poor" with respect to assessment of pupils in mathematics. In the course of teaching, (95.2%) of the teachers also did very well by drawing pupils' attention to the end of their lessons by way of summarizing the lesson, giving out exercises

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or informing the class about what to expect in the next lesson. In most cases, learners could tell that the lesson had ended as a good characteristic of teaching. This implies that the teachers possess good knowledge of teaching methodology and delivery which might be obtained within their ZPD. The next section presents the descriptive statistics of the third thematic area, classroom organisation and management skills as displayed in Table 8.

Table 8: Descriptive Statistics of Beginning Teachers' Classroom Organisation

	Poor	Unsatisfactory	Satisfactory	Good	Very good
	F (%)	F (%)	F (%)	F (%)	F (%)
Management of the learning environment	0(0.0)	4(3.8)	1(1.0)	60(57.7)	39(37.5)
Management of students' behaviour	3(2.9)	1(1.0)	1(1.0)	60(57.7)	39(37.5)

F = Frequency

Source: Field survey (2021)

From Table 8, it could be observed that 99 out of the 104 beginning teachers were able to manage both the learning environment and students' behaviour in class. This suggest that the teachers were in control of their classroom. It is also worth mentioning that no beginning teacher was scored "poor" in terms of management of the learning environment. However, 4(3.8%) of the teachers could not manage both the learning environment and students' behaviour in class.

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The next aspect of the teaching practice is the teachers' professional commitment. This determines how the teacher behaves in class in terms of the way they relate with their pupils, their dressing, record keeping and their attitude towards teaching and learning of mathematics. The descriptive statistics of beginning teachers' professional commitment is displayed in Table 9.

Table 9: Descriptive Statistics of Beginning Teachers' Professional Commitment

	Poor	Unsatisfactory	Satisfactory	Good	Very good
	F (%)	F (%)	F (%)	F (%)	F (%)
Teacher behaviour	3(2.9)	1(1.0)	1(1.0)	60(57.7)	39(37.5)
Record keeping and attitude to teaching	3(2.9)	1(1.0)	1(1.0)	60(57.7)	39(37.5)

F = Frequency

Source: Field survey (2021)

From Table 9, it could be seen that 99, representing 95.2% of the beginning teachers exhibited good behaviour and good record keeping in class. On the other hand, 3 (2.9%) of them could not exhibit acceptable teacher behaviour and habit of record keeping in class. One teacher (1.0%) each was also rated "unsatisfactory "on both teachers' behaviour and teachers record keeping and attitude towards teaching mathematics.

In order to have a good sense of the influence of the DBE programme on the teachers' teaching practices, the range of scores were further classified into three main categories based on the University of Cape Coast grading. Teaching

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practice score less than 50% by the University standard is considered "failed" hence classified as "weak influence". Scores from 50% to 69% by the standard are good, as such they were classified as "moderate influence" and scores from 70% to 100% are considered very good and thus classified as "high influence" of the training programme on teachers' practices. The influence of the DBE programme on beginning teachers teaching practices is displayed in Table 10.

Table 10: Diploma in Basic Education Programme on Teaching Practice

Impact classification	Score range	Frequency (%)	Influence
Weak impact	<50%	3 (2.9)	Weak influence
Poor impact	50%-54%	2 (1.9)	Moderate influence
Satisfactory impact	55%-59%	7 (6.7)	
Fair impact	60%-64%	19 (18.3)	
Average impact	65%-69%	10 (9.6)	
Good impact	70%-74%	24 (23.1)	High influence
Very good impact	75%-79%	10 (9.6)	
Excellent impact	80%-100%	29 (27.9)	

Source: Field survey (2021) N = 104

From the results presented in Table 10, it could be inferred that the DBE programme taken at the College by the beginning teachers had influence, from "weak impact" to "excellent impact", on the teaching practices of beginning Basic School mathematics teachers. The results showed that the DBE programme had weak impact (<50%) on the teaching practices of 3(2.9%) of the beginning Basic School mathematics teachers. That is, the DBE programme can be said to have weak influence on 2.9% of beginning teachers teaching practices in mathematics at the Basic School.

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Also, from Table 10, it could be seen that the DBE programme had weak impact (50%-54%) on the teaching practices of two 2(1.9%) teachers, satisfactory impact (55%-59%) on 7 (6.7%), fair impact (60%-64%) on 19 (18%) and average impact (65%-69%) on 10(9.6%) of the teaching practices of the beginning teachers. Cumulatively, the DBE programme can be said to have moderate influence on 38 representing 36.5% of the beginning teachers who participated in the study.

The results further showed that the programme had good impact (70%-74%) on the teaching practices of 24(23.1%), very good impact (75%-79%) on 10 (9.6%) and excellent impact (80%-100%) on 29 (27.9) of the teaching practices of the beginning Basic School mathematics teachers. This accumulates to the DBE programme having high influence on 63 representing 60.6% of the total number of beginning teachers who participated in the study.

The mean and the standard deviation for the four aspects of the teaching practices were then computed in order to have a general interpretation of the influence the DBE programme on teachers teaching practices. Table 11 presents the mean score and the standard deviations.

Table 11: Performance of Beginning Teachers in Teaching Practice

Teaching practice areas	Highest possible score	Mean score	Standard Deviation
Lesson Plan	25	21.48	2.10
Teaching Methodology and Delivery	55	46.86	6.18
Classroom Management and Organisation	10	8.55	1.46
Professional Commitment	10	8.52	1.58

Source: Field survey (2021) N = 104

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From Table 11, it could be seen that almost all the beginning teachers did well in each of the four aspects of the teaching practice since the mean scores were close to the highest scores. Considering the overall men score, it was concluded that the DBE programme had influence on beginning teachers' teaching practices. The next section presents the analysis of related qualitative data.

Qualitative results

The aim of the qualitative aspect of this study was to gain more insights into how the DBE programme influenced beginning teachers' teaching efficiency in mathematics at the Basic School. To achieve this aim, 15 beginning teachers involved in the study were interviewed after they had been observed teaching various topics in mathematics. The data collected were mapped onto the teacher's Zone of Proximal Development (ZPD), Zone of Free Movement (ZFM) and Zone of Promoted Action (ZPA).

Beginning teachers' zone of proximal development

The constructs that were considered under the ZPD were the teacher's mathematics content knowledge, pedagogical knowledge, and confidence in teaching mathematics. To find out what beginning teachers learned during their training concerning teaching practice in mathematics, they were asked specific questions on knowledge of lesson objectives, knowledge of engagement of pupils, and teacher professionalism as well as competences in teaching mathematics. When they were asked where and how they acquired the skills for teaching mathematics, majority (13 out of 15) of them attributed it to their training programme (DBE).

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However, two of them claimed they got their content knowledge from their senior high schools and some other reading materials.

Particularly, with regards to beginning teachers' awareness of lesson objectives, majority of them asserted that the DBE programme had helped them get better understanding of lesson objectives and how to state them. The interview conducted revealed that majority (13 out of the 15) of the beginning teachers were aware of characteristics of good lesson objectives. Specifically, the teachers explained that they learned a lot about the characteristics of good lesson objectives from the training programme. According to the interviewees, every good mathematics lesson should have clearly stated objectives that are specific, measurable and achievable within a given period.

> *"The setting of objectives should be specific, measurable, attainable, relevant and time bound."* (BT008).
>
> *"Objectives should be achievable, it should be time bound, objectives should be reasonable enough... it will not be appropriate for you to set objectives that at the end of the lesson you cannot achieve. So, once you're setting objectives, you have to look at the time frame of the lesson and you set the objectives. And you make sure that at all cost you achieve it; ... oh okay. So, one of the objectives was, at the end of the lesson, the student should be able to identify the... of a mapping and what is the most important. Once you know the rule then... like what we were doing this morning; finding the values when we have the domain*

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and so you can only do that when the rule of mapping is known. So, our main focus was writing the rule of mapping... so that was my main objective.ie, writing the rule of mapping" (BT005).

They also said good objectives should be stated in behavioural terms such that by the end of a lesson, pupils can demonstrate that they have indeed acquired such behaviours. Some of the behavioural terms the teachers used in stating their lesson objectives when they were asked to state some of the objectives for their previous lessons were: construct, list, write, draw, count, identify, sort, arrange, match and group, just to mention but few.

"My objectives were that, at end of the lesson, the learners will be able construct a table for data collection and be able to draw a graph (this teacher taught the class Bar graph). Before you can make a graph, you have to collect your data, make a tally of the data you've collected before you can use it to draw your graph" (BT004).

Further, they explained that they learned from the programme how to track one's own objectives during mathematics lesson to be certain whether the objectives have been achieved or not by the end of a particular mathematics lesson. As a follow-up question to find out whether the teachers had idea about how to track lesson objectives, they were asked specifically "How did you know you had (or had not) achieved your lesson objectives, based on what you were taught in the DBE programme?" Majority of the teachers came up with interesting responses, indicating that the DBE programme has lent them a big deal of experience on lesson

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objectives. Class exercises were the main objective-tracking tool used by the teachers.

> *"I am having 60 pupils in my class and almost about half of them were able to get everything clear when I assessed them. So if you want to know that you have achieved your objectives, give the learners exercise to do or ask questions that will help you to know that you have achieved what you taught or they have understood everything"* (BT004).
>
> *"I gave the learners exercise, and through the exercise, I got to know that I had achieved my objectives"* (BT011).
>
> *". . . pupils were given exercises and they came out with appropriate responses; they were asked questions and they came out with correct answers. These made me know my objectives have been achieved"* (BT010).
>
> *". . . through the responses to the exercises and group works I gave to them, I was convinced that I have achieved my objectives"* (BT014).

From the foregoing responses, it appears the beginning teachers had learnt a lot from their training programme concerning lesson objectives. This made it easy for them to set appropriate objectives for their lessons and also employ variety of techniques to assess whether these objectives have been achieved.

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Concerning knowledge about the engagement of pupils in class, whether the teachers had any knowledge about how to actively engage pupils during mathematics lessons, the teachers explained that every mathematics teacher should be concerned about the involvement/engagement of pupils in their classroom, and that when pupils are actively involved in mathematics lesson, they get deeper understanding of the concept being taught.

> "*What I know as a maths teacher is, pupils should be actively engaged during maths classes, and every maths teacher should be concerned about this. . .*" (BT001)
>
> "*. . .involvement of pupils in maths lessons is one of the most important ways of ensuring that pupils get in-depth understanding of what is being taught*" (BT008).

Enquiring about where they learnt the idea of pupils' engagement in mathematics lesson from, all the beginning teachers interviewed attributed their success in engaging pupils in class to their training programme.

> "*I was taught during my training programme how to engage students . . .*" (BT006).
>
> "*Like I mentioned earlier, we were taught at the college, and that is what I am applying now to successfully engage my pupils*" (BT005).

The teachers further explained that they learnt a number of strategies from college as to how to get every pupil involved in a mathematics lesson. They cited strategies such as setting classroom rules that bind everyone; assigning roles in the

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class – by putting them into small cooperative groups, and by calling individuals at random to perform specific tasks in the classroom through questioning; by linking the lesson to previous lessons – that is teaching from familiar to unfamiliar, from known to unknown, and from concrete to abstract; as well as using the student-centered approach to engage pupils. The researcher recorded the following specific responses:

> *"I set rules in the classroom and involve them in pair work and discussion"* (BT006).
>
> "*I put the children into small groups, and this engaged and draws their attention to what is being taught*" (BT002).
>
> *"I asked questions and then they answer . . . then I give them activities to do. So when teaching 'Addition' for example, I asked them to count the objects by themselves, 'count this, and then put them together'. That is how I get them to interact and get them involved"* (BT003).
>
> *". . . By asking questions . . . when you ask them questions, they get involved in the lesson; because if you don't ask questions in the class, they will just be sitting idle. So, when you ask questions, they get involved"* (BT001).
>
> *". . . you teach from the known to the unknown – so you always start with what the pupils know, then you move on to what you're coming to give them that they don't know. I use this approach to make the lesson interesting and get them involved in my lesson"* (BT005).

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"To ensure that my students are involved in my lesson, I always employ the student-centered approach. You know, students' involvement in a lesson should be key in a lesson because if you use the lecture approach where you only go and talk and talk and talk till the lesson comes to an end, students will not get involved in the lesson. Therefore, to get my students involved throughout – from the beginning to the end of the lesson, I use the student-centered approach to achieve it" (BT015).

"Nowadays, we use learner centered approach to get students engaged in lessons; so you, the facilitator, have to let the students come out with their views. That is why I made them sit in groups. So lesson was first discussed among the children in groups before you, the facilitator, add up" (BT011).

On classroom management skills, the beginning teachers explained that the training programme had been helpful to them. They stated that the programme had given them more insights into how to organise their classroom and how to control pupils' behaviour. The researcher asked them specifically, "How do you make use of what you learnt at college, in terms of how to manage your class and pupils' behaviour?" The following are excerpts from the responses given by the beginning teachers:

"If someone is misbehaving I was taught how to handle it, and I make sure they sit in rows and columns. I bring the stubborn

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students to the front seats to keep eyes on them so they can pay attention to what I am saying" (BT011).

"I mobilise them; put them in groups so that they will work together. I also appoint leaders among them so there is leadership role to check behaviour" (BT012).

"Formerly, two students would sit on each desk, but now, in order to manage their behaviour and ensure good classroom organisation, we learn to put them in groups. The groups are usually mixed with individuals who are good as well as those who are average" (BT005).

Additionally, in terms of competence in teaching mathematics at the Basic School, the beginning teachers claimed that the programme had prepared them so well that they always go to class fully prepared. This was evident through the classroom observations conducted – the teachers demonstrated good knowledge of the subject matter and organised their classroom activities coherently. These could be substantiated by the responses the beginning teachers gave when they were asked, "How do you feel when you are teaching mathematics in terms of your lesson delivery?"

"I feel well-prepared because before I come to class I have much knowledge about what I'm going to deliver and then I'm ready for the feedback that will come; yes, so I am ok teaching maths" (BT003).

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"When you know what you're going to teach, you become confident . . . that's why every teacher has to prepare before the lesson starts" (BT001).

"I always feel confident when teaching mathematics due to the fact that I'm always fully prepared" (BT002).

"I feel really prepared during mathematics lessons. In fact, I enjoy every bit of my lessons" (BT008).

In terms of demonstrating professionalism in all aspects of the teaching career, many of the beginning teachers claimed they are doing exactly what they were taught at the college, and they specifically mentioned appropriate dressing, preparing for class before the lesson starts (punctuality), among others.

"I prepare my lesson notes, and gather my TLMs far ahead of my lesson . . . so I dress neatly. That's how committed I am to my profession" (BT014).

"I was taught at college how to do all these things, yes. So I do exactly what I was taught, that I should be committed and professional in everything; for example, punctuality and timeliness to class" (BT002).

"Before I come to the class I must consider my pupils interest first, I have to prepare my lesson notes, and based on the lesson, I have to know the TLMs and the teaching methods or the strategy that I have to use in teaching and not just to deliver

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anything to the learners. I'm very much committed. I don't play with my profession" (BT004).

"I have a routine that I follow – I read, prepare notes for class, and get TLMs in place well ahead of time before my lesson begins. These show my level of commitment and professionalism towards the teaching profession" (BT013).

They also admitted that their pupils are always looking up to them as role models.

"..., I see myself as a role model to the pupils in the classroom; so, as a professional, I put up positive behaviours that the children will be able to copy or imitate at the end of the day" (BT009).

"I also know that I am a role model to them, and my pupils look up to me" (BT014).

These responses were not different from what was observed during the classroom observation conducted. Per the training programme, all the beginning teachers who participated in the study received training in all the subjects at the Basic School and were expected to demonstrate competencies in teaching all the subjects including mathematics. However, two of the beginning teachers whose teaching practices were below standard attributed their failure to either the fact that it is obligatory for them to teach mathematics or they are not comfortable teaching the subject.

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"You know, I didn't like mathematics in school but it is compulsory to teach it, so I do my best in teaching it" (BT09).

"I don't feel all that comfortable anytime I had to teach mathematics. Honestly, I feel more comfortable teaching other subjects rather than mathematics. I don't just like to teach mathematics" (BT007).

In summary, based on the responses obtained, it could be stated that the beginning teachers have substantial knowledge of the Basic School content and the pedagogies of enactment. Also, the training programme could be said to have, to a large extent, inculcate in the beginning teachers the knowledge and skills required to teach mathematics efficiently, and with the right attitudes towards teaching of mathematics at the Basic School.

Zone of free movement experienced by beginning teachers

The ZFM was conceived as the constraints that beginning teachers experience in the teaching and learning environment that limited their instructional decisions. To ascertain the beginning teachers' experiences with regards to how the teaching environment could possibly constrain their teaching actions, the teacher participants were asked questions specifically related to pupils' behaviour in class, pupils' motivation, pupils' engagement or participation, organisational structure of the school, classroom organisation, and how the culture of the pupils affects their instructional decisions. The responses indicated that the beginning teachers were constrained in some aspects of their practices; however, majority of them seemed to have control over the constraints as a result of their training programme.

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In particular, with regard to pupils' behaviour in class, majority (14) of the beginning teacher interviewees stated that they were able to manage their pupils' behaviours and that did not affect their lesson delivery. The beginning teachers were of the view that, though some of the pupils were difficult to control, the training programme afforded them the knowledge and ideas to employ to get around such difficult behaviours. One key thing most of the beginning teachers mentioned that they learned from their training programme which has helped them to handle their pupils behaviour was demonstration of professionalism.

"My pupils' behaviour in class has never been an issue for me." (BT013).

"In college, we were doing on-campus teaching practice and had to teach in front of our colleagues but when you come to the field, things are slightly different. There are behaviours that we were not exposed to back at college but we are experiencing them now. I think if we were taught back there, things would have been better; but I don't think my pupils' behaviours affect my teaching practices here because I as a professional teacher, I am able to handle different kinds of behaviours" (BT015).

Others also stated that setting of classroom rules and regulations was the magic. These, according to the beginning teachers, worked for them that they did not have any major issues concerning pupils' behaviour; and these behaviours did not hamper their lesson deliveries. The following were captured during the

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interview when the beginning teachers were asked about their pupils' behaviour in class and how they dealt with them.

> *"For me, my pupils' behaviours do not have any serious adverse impact on my lessons; I always try to contain them and maintain order in class by setting rules and making sure that their behaviours are not affecting my classroom management or lesson"* (BT001).
>
> *"I always ensure that I let the learners know behaviours I don't tolerate during my lesson, and this has helped me in many ways that I don't have any issues with children's behaviours, as far as my teaching activities are concerned. At times, I group them and assign roles to them in that they will not distract one another"* (BT011).

Additionally, they explained that another strategy that has helped them to manage negative behaviours in class is motivating and engaging pupils on tasks throughout the lesson. The beginning teachers explained that the teaching strategies they learned from their training programme had equipped them with appropriate techniques to keep pupils motivated and engaged at all times. For instance, some of the beginning teachers mentioned that they used various materials that the children are familiar with, making them pay more attention as they could relate to the activities the materials were being used to demonstrate. The following responses were gathered from the beginning teachers when they were asked about their pupils' motivation and engagement in their mathematics lessons.

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"My pupils are always motivated. They enjoy my class; especially when I use bottle tops for demonstration. Their level of motivation positively influences my teaching activities" (BT002).

"My teaching practices are always on point as my pupils are always motivated and engaged in my maths lessons all the time" (BT007).

"You don't have to call only those who know to talk. You have to let everyone in the class talk . . . this makes the learners stay motivated and engaged in the lesson. I can say they are always motivated and I don't have any issues with them concerning their motivation in mathematics class" (BT008).

"My children stay motivated all the time; and they participate in maths lessons as well" (BT010).

"Majority of the pupils appear motivated, and this positively influences my teaching practices" (BT012).

Furthermore, with respect to organisational structure of the school, the beginning teachers claimed that the schools they were posted to had their own ways of doing things, and they had no option than to adjust to the arrangements in their respective schools. For instance, in some of the schools, beginning teachers claimed they were allowed to teach mathematics only at the lower primary level, though most of the beginning teachers interviewed seemed all right with this arrangements. They also mentioned that the schools had experienced mathematics teachers who

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performed oversight duties by ensuring that the new teachers are doing what they had been assigned to do, and report same to the head teacher of the school. Majority of the beginning teachers appeared to accept this arrangement as they were of the view that it made them focus more on their overall teaching practices due to the feeling that someone was keeping records on them. They also believed that this was not a restriction to their teaching practices. The following are some of the responses obtained when the beginning teachers were asked about the organisational structure of their schools and how this influences their teaching practices.

> *"This school has its own principles, and I think I like it. You don't just come and they give you a higher class to teach without spending at least a year here. This is to ensure that you get used to the school and its system first before they assign a higher class to you. For now, I am comfortable with the class three I teach . . . it is even making me learn more things to improve the knowledge I have already acquired from my training programme at the college"* (BT001).
>
> *"I think the school's organisational structure is okay for me. In a way I feel I have learnt and still learning a lot here; especially from the assistant headteacher who also teaches mathematics here"* (BT003).
>
> *"The arrangements in the school are fine for me. No stressful moments here."* (BT011).

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On classroom organisation and management, majority of the beginning teachers revealed that their classrooms were well-organised, and that the number of pupils in each class is manageable. They stated that how their classrooms were organised was not a restriction to them; they felt the classrooms were spacious enough to enable them deliver their lessons successfully. The following are some of the responses when they were asked whether their classroom organisation restrict their teaching delivery.

> *"As you can see, this classroom is well-organised and very conducive for teaching and learning. I enjoy teaching in here. I always feel like standing in here to demonstrate the knowledge I have acquired from my training programme"* (BT003).
>
> *"In terms of management, I would say my class is manageable and well-organised for that matter. I have only 20 pupils in my class. I am able to teach and teach well"* (BT004).
>
> *"Yeah, sometimes . . . under normal circumstance, having a manageable class is effective and helps lesson delivery . . . it makes you flow and deliver whatever you want to deliver, based on the time that you have been allotted. I will say the classroom organisation here is not bad, and will help improve my abilities"* (BT005).
>
> *"Over here, all the students are females; thus, controlling them becomes a bit difficult. So in order to ensure proper management, after my presentation of content, I ask them to*

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pause the writing and follow my explanation. Moreover, I sometimes pause during my presentation to inquire from them my last statement, which helps to keep their attention and behaviour in check throughout the lesson" (BT015)

In addition, in terms of culture of the pupils, majority of the beginning teachers did not have any major issues as it did not serve as a barrier to lesson deliveries. This, according to the beginning teachers, was due to the fact that majority of them speak similar local language as the pupils they teach. This made it easier for them to interact easily with the pupils; especially, pupils who found it difficult to express themselves in English language. When the beginning teachers were asked how they were influenced by the culture of the pupils, the following responses were ascertained:

"I think I don't have any issues with the children's culture. I am from around so I understand how things are done here. It has rather given a different perspective to the knowledge I acquired from the training programme" (BT002).

"I have found this useful; especially the language aspect. Most of the children cannot speak English, neither do they understand when you speak it. However, I understand the local language spoken here so it's not an issue at all . . . I just feel I am learning more from here" (BT006).

"I do not have any problem here. Their culture is not a restriction to my teaching practices. That is all I can say now" (BT007).

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". . . I don't have any difficulty with the culture here. I'm familiar with everything here . . . I know how these children understand things and behave here. These cannot affect my lessons" (BT011).

Nevertheless, there was an exceptional case where one teacher, BT003, from outside the Central Region, had issues interacting with the pupils due to language barrier. This teacher could not speak or understand the dominant local language of the pupils. In fact, this teacher was one of the three teachers who did not perform well during the classroom observations. When he was interviewed, he explained that the language barrier had affected his lesson delivery. He claimed that he sometimes finds it difficult to determine the level of understanding of his own pupils in class. When he was asked a follow up question on how the culture of the pupils in his school affected his delivery, the following was what he had to say:

"I come from the Volta Region but they posted me to the Central Region. I don't understand and cannot speak the children's language (Fante). Secondly, the children have problem with English language. This has affected my teaching approaches, and even the good things I learnt from the college I couldn't put them into full use due to this language thing. At least, if I could speak their language, I would try and explain for them to understand" (BT003).

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Zone of promoted action experienced by beginning teachers

The zone of promoted actions was conceived as constructs experienced by beginning teachers in the teaching and learning environment that tend to promote their instructional decisions. It includes how the teachers manage the constraints encountered in the teaching and learning environment to maximise student learning. To assess teachers under this zone, they were asked questions about the kind of supports they get from other colleagues that promote the knowledge and skills they acquired from college. They were also asked how classroom management and organisation as well as pupils' behaviour and teacher stimulus or motivation has promoted their teaching actions. Further, the beginning teachers were asked how they managed the constraints they encountered to maximize pupils learning. They explained that they had access to support from their colleagues, which helped them to demonstrate the knowledge acquired from their training programme. The following excerpts support this assertion:

> *". . . as stated earlier, I have issue with the Fante language; but my colleagues who understand the language have been trying to help me understand the basics so that I can communicate effectively with my students"* (BT003).

Also, the beginning teachers were asked how they manage and organise the classroom to support the knowledge and skills acquired from the training programme. From their responses, it appeared that majority of them did not have issues with classroom organisation, as they claimed that their classrooms were conducive and well-organised enough to promote teaching and learning. Even those

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who seemed to have little issues with classroom organisation, as in the case of teacher BT008 discussed under ZFM, stated that it did not have any major negative impact on their ability to deliver. This suggests that the beginning teachers experienced good classroom organisation, in general, and issues related to classroom organisation did not impede their ability to put the knowledge acquired from the training programme into practice. The following responses were obtained when asked how classroom organisation restricted or limited their teaching actions at the Basic Schools.

> *"Yes, my classroom is good enough to promote teaching and learning. I also enjoy teaching here"* (BT001).
>
> *"I am happy about the organisation here. It supports teaching and learning"* (BT004).
>
> *". . . so far so good. I must say I don't have any problem with the classroom organisation; I never felt it had a negative impact on my lessons"* (BT012).
>
> *"The classroom organisation is ok for me . . ."* (BT014).

Further, with regards to discipline levels of pupils, the beginning teachers claimed that most of the pupils they encountered were well-disciplined. They said they never had issues with any of the pupils they taught. However, they also pointed to the fact that there were days that some of the pupils failed to adhere to instructions; but they claimed these were trivial issues and did not happen most of the time, and even that they got to understand the pupils more after further interactions with the pupils concerning their behaviour. The following were

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obtained from the interviews when the beginning teachers were asked whether the pupils' level of discipline helps their teaching activities.

"There are so many behaviours in the class, but none influenced my lessons" (BT004).

"I should say some of the children are well-behaved; though some are troublesome, I never had any experience with any of them. I think I'm really cool teaching here. The environment is good for teaching and learning promotion" (BT007).

"I never got demotivated by my pupils' behaviours. This doesn't mean they are perfect, but I believe I am able to handle them due to the knowledge I acquired from my training programme. I also see dealing with pupils as a new learning platform for me" (BT011).

"I'm very ok with the children's behaviour. It has not influenced my practices here" (BT013).

As to whether the beginning teachers get support from other colleagues concerning the teaching of mathematics, some of them explained that they get help from other mathematics teachers whenever they consulted them. Some also claimed that their school had support system in place for all beginning teachers. When they were asked whether the relationship with other colleagues limited or promoted their teaching actions, they gave the following responses:

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"..., I have a friend here too; we came from the same college; he teaches maths and he's very good and has been of help to me" (BT007).

"Okay, so one thing that I would say has actually helped my teaching in this school is that I have two of my college friends posted here, and both of them teach mathematics just like me. You know we have some people who are better in a particular area or topic than others. For instance, my friend called ... (name withheld) *is very good at algebra so I always get support from him when things get tougher for me, and this has had good impact on my teaching activities* (BT014).

"When I arrived here, the head had a meeting with me. He explained how things are done in the school. He introduced me to one of the old mathematics teachers and told me to address any issue affecting my teaching to him to assist me. I realised that is how their arrangement is, and it has been helpful to my teaching career as the old teacher has been of great help so far" (BT006).

In addition, it is obvious that everyone has a reason for doing one thing or the other. The beginning teachers, just like any other individuals, could be influenced by motivation or stimulus. The level of motivation a teacher experiences could either positively or adversely influence their teaching practices. According to majority of the beginning teachers, they are always motivated to teach their pupils, as they have resolved to stick to the teaching profession. Majority (12 out of 15) of

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the beginning teachers claimed that they were motivated to teach mathematics at the Basic School level, and their motivation came from the fact that they were in the position that they could impart knowledge to others. This means that motivation is not an issue for the beginning teachers and that their level of motivation has not denied them the ability to impart knowledge and demonstrate the teaching skills acquired from the training programme. The following are some of the responses they gave when asked about how motivated they are in terms of teaching of mathematics and how motivation has helped them to work through any challenges encountered.

> *"I am self-motivated. This feeling inside me always pushes me to do more for others; that is why I love teaching mathematics.* (BT001).
>
> *"My focus has always been making people successful, and I believe one of the ways to make one successful is to give them knowledge. This has been my motivation as through teaching, I believe I will be able to help others get somewhere"* (BT007).
>
> *"I don't think I am influenced by level of motivation I get. I believe in intrinsic motivation than extrinsic motivation, so it is just my desire to teach mathematics and teach it and this has helped promote my skills in teaching mathematics"* (BT010).
>
> *"I have always loved to teach mathematics at the Basic School. The feeling that I am teaching other people has been my*

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motivation leading to taking up the training programme so that I could get the chance to teach mathematics" (BT012).

From the discussion so far, it appears majority of the beginning teachers believed that they have the right environment needed to make their work less difficult and less challenging, implying that they do not have any major issues when it comes to teaching of mathematics at the Basic School. Above all, they are intrinsically motivated to teach at the Basic School. Overall, 14 out of 15 teachers stated that the DBE programme was useful in building their teaching practices.

Discussion related to research question one

From the result above, it appeared the DBE programme had positive influence on the teaching practices of the beginning Basic School mathematics teachers. The quantitative result indicated that the programme had high influence (60.6%) on the beginning teachers teaching practices. Further, considering the quantitative results in the light of the qualitative findings, the DBE programme could be said to have positively influenced the beginning teachers teaching practices in mathematics. This result is not surprising as the DBE programme was designed to equip preservice teachers with the necessary teaching skills that would make them perform efficiently in the classroom. The interview responses confirmed that the teachers acquired substantial knowledge and skills of teaching from their training programme.

Furthermore, the products of the DBE programme were exposed to on-campus teaching practices followed by a one-year off-campus teaching practice, which equipped them with practical skills to fit into the real classroom (ZPD). This

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exposure to practicum might also have contributed to the high performance in teaching practices. The teachers' high teaching practices performance could also be as a result of the continuous capacity building workshops, organised by the Institute of Education, University of Cape Coast, for all tutors at the Colleges of Education. Besides, the DBE curriculum had been reviewed a couple of times by the same University to improve the programme. It is therefore not surprising that most of beginning teachers proved that the DBE programme had had satisfactory (55%-59%) to excellent impact (80%-100%) on their teaching practices. Above all, the intervention by the Transforming Teacher Education and Learning (T-TEL) such as teacher professional development programmes for tutors in the Colleges of Education could also have contributed to the high performance of the teachers who participated in the study.

In addition to the programme requirements, all teachers who had completed the programme had to do a one-year mandatory national service teaching before their postings were regularised. Most of the beginning teachers who participated in this study were in their second year of teaching at the Basic School, as such, the national service experiences could also account for the high teaching practice performance in mathematics.

Another inference that could be drawn from the high performance of the teachers in terms of their teaching practice is that the teachers completed college not long (a year or two ago) and could easily apply the knowledge and skills they received to shape their practices. The teachers demonstrated high level of pedagogy and competences for teaching mathematics, suggesting that they had acquired some

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special knowledge or training from the DBE programme. The implication is that the DBE programme has remarkable influence on the beginning teachers' teaching practices, and thus, to become an efficient mathematics teacher, the DBE programme cannot be underrated.

The beginning teachers demonstrated very high level of competences in teaching mathematics at the Basic School. The qualitative results were in support of the high quantitative outputs. The teachers showed good knowledge in lesson objectives, good classroom organisation and management skills, appreciable knowledge of how to engage and relate with pupils in class during mathematics lessons.

Nevertheless, it should be pointed out that the DBE programme had no impact on the teaching practices of some of the beginning teachers. This outcome is not surprising either, as it is possible some of the beginning teachers did not really pay attention to the contents of the DBE programme while in the College. Thus, this outcome is just a reflection of the level of efforts these beginning teachers put into reading the DBE programme. Another possibility is that the tutors handling the courses under the DBE programme at the College could not pay attention to preservice teachers with special needs; thereby, causing these preservice teachers to carry low knowledge in teaching practices to the classrooms.

Perhaps the training programme could not help some of the beginning teachers to unlearn or change their attitude towards teaching mathematics. It also appeared during the classroom observation that some of the beginning teachers had

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low confidence in teaching mathematics, and this might have influenced their delivery and teaching practices as a whole.

The results discussed, thus far, indicate that the DBE programme has influence on the beginning teachers' teaching practices. This positive influence reflected in the teaching practices of the beginning teachers during the data collection exercise as majority of them exhibited good knowledge of teaching practices in almost all the necessary thematic areas: *lesson plan preparation*, *teaching methodology and delivery*, *classroom organisation and management*, and *professional commitment*. It should also be mentioned that as majority of the beginning Basic School mathematics teachers demonstrated appreciable knowledge in almost all the thematic areas of teaching practices, few of them, however, performed abysmally and this could be inferred from Table 6.

Particularly, with regards to lesson plan, as observed by the researcher, some of the beginning Basic School mathematics teachers presented logical and comprehensive lesson plans. Few others either brought a piece of paper containing a list of topics to class or a lesson note whose contents were different from what the teacher taught his/her class; however, this phenomenon was not found to be common. That notwithstanding, the researcher realised that, in general, the DBE programme had positively influenced how the beginning teachers prepare their lesson plans, as majority stated specific, measurable and achievable objectives, core points, teaching and learning activities, teaching-learning resources, and demonstrated subject and pedagogical knowledge as presented in Table 7.

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Concerning teaching methodology and delivery, the beginning teachers demonstrated that the DBE programme had had good influence on their teaching practices. The results from the observation showed that most of the beginning teachers introduced their lessons well, organised teaching and learning activities sequentially, appropriately paced their lessons with audible voice, encouraged questioning and feedback, managed whiteboards, used appropriate teaching/learning resources, used correct language, engaged all pupils and encouraged cooperative peer-tutoring. Above all, the teachers demonstrated mastery of subject matter knowledge, appropriately assessed pupils learning, and consistently drew pupils' attention to the closure of their lessons.

Also, the DBE programme had shown to have good influence on the teaching practices of beginning teachers regarding classroom organisation and management. The researcher observed that the beginning teachers were able to manage their learning environment very well and the behaviour of pupils were also well-managed. All these indications go to state that the DBE programme, in its entirety, had really shaped the organisation and management skills of the beginning Basic School mathematics teachers. Nonetheless, some of the beginning teachers had challenges controlling their students' behaviour in class.

Furthermore, considering professionalism, majority of the beginning teachers showed that the DBE programme had influenced them positively. This reflected in the teachers' behaviour as they showed zeal and enthusiasm throughout their lessons. Aside the show of enthusiasm, they demonstrated good record-keeping habits. The teachers were smartly dressed for class, and they had good

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interpersonal relationship with their pupils in class. The qualitative results also indicated that the teachers acquired professionalism from their training programme. It could, therefore, be concluded that the DBE programme taken at the College has shaped the beginning teachers' teaching practices in terms of their professional commitment.

This finding shows consistency with the findings of some prior studies, as well as inconsistency with some other prior related studies. For instance, the current findings support the findings of Akyeampong et al. (2013) who examined the impact of teacher training programme on early primary grade teachers in mathematics. They found that initial teacher preparation had a strong influence on newly qualified teachers' classroom performance. Nevertheless, just as found in this study, Akyeampong et al. averred that some of the newly trained teachers' classroom activities were not connected to the concepts learned in mathematics. This only goes to confirm that despite the fact that teacher preparation programme has good impact on the teaching practices of newly trained or beginning teachers, there is still the situation where this impact is not witnessed in some of the beginning teachers. Perhaps it is time authorities and tutors in the Colleges paid attention to individual preservice teachers in order to take care of their special needs.

Also, this finding shows consistency with Quadhi et al.'s (2020) finding which showed that through preparation programme, professional teaching competences of teachers are improved. They further opined that there should be conscious efforts to bridge the gap between teacher preparation programmes and

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practices at the schools, as most aspects of the preparation programmes do not really focus on the actual happenings in the classrooms. The stance of Quadhi et al. is not surprising as the current researcher also realised that most of the beginning teachers get overwhelmed during their real classroom practices as they claim the practices they undergo during their College years seem insufficient for actual classroom practices.

Further, Ali and Hamza (2018) affirmed that teacher training programme has positive impact on performance of teachers in the classroom, and this culminates in organisational improvement. They proceeded to state that teacher' training programmes also influence the learning of students the teachers are teaching. This implies that teacher preparation programmes are impactful as far as beginning teachers' teaching practices are concerned. This stance by Ali and Hamza (2018) is confirmed by Barr and Carolyn (2012) who also found that teachers who had undergone preservice training demonstrated positive and improved teaching practices in the classroom; thereby, improving students' achievements. Barr and Carolyn compared the teaching practices of trained teachers and that of teachers who had not undergone any preservice training, and the latter were found to have low impact on the achievements of students, as these teachers demonstrated poor teaching practices in the classroom.

This finding also correlates with the finding of Kajander (2010). Kajander found that apart from the high impact the training programme had on the teaching practices of teachers teaching mathematics at the elementary schools, procedural and conceptual knowledge of the teachers were improved. This means that devoting

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more time to prepare mathematics teachers for Basic Schools is worth it, just as opined by López and Assaf (2014) who also revealed that teacher training programme augmented with field experiences influence classroom instructional practices of the teachers. These outcomes are not different from the results obtained by Ünal (2017) who found that preservice teacher training programmes help improve teachers' teaching efficiency which in turn lead to improvement in performance of the students taught by these trained teachers.

The current finding also shows correlation with the finding of Ensor (2001). Ensor states that methods course influences the teaching practices of beginning teachers, as the beginning teachers' ways of talking about the learning of mathematics in the classroom have improved. In similar manner, Good et al. (2006) averred that teacher preparation programmes really matter, as they found teacher preparation to have encouraging impact on teaching practices of beginning teachers teaching at the elementary, middle and high school levels. Darling-Hammond et al. (2002) also held forth that teachers prepared in teacher education programmes felt better prepared and performed well in their teaching practices, compared to teachers who entered the teaching profession through alternative programmes.

However, on the flipside, Kılıç (2011) argued that teacher preparation programmes do not really have any obvious influence on teaching practices of beginning teachers. Kılıç (2011) found in his study that teachers who had undergone preparation programmes found it difficult managing students' behaviour, and were also unsuccessful recognising students' sources of misconceptions and common errors. As unusual as this finding may appear, it is not

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far from possibility as Borko et al. (1992) also observed that teachers who had had teacher education could not provide conceptual explanation for standard division of fraction algorithm. Specifically, Borko et al. realised that the prospective teachers could not explain to their students why in division of fractions, the operation sign changes to multiplication sign and then the next number is flipped or inverted. Also, from the qualitative results, it was revealed that few beginning teachers though have acquired the necessary knowledge and skills, were constrained by language and overcrowded classrooms that limited their performance.

Collectively, from the outcome of most studies on teacher preparation programmes, there seems to be some evidence to indicate that teacher-training programmes have influence on teachers teaching practices. These findings are not entirely different from the current finding as majority of the beginning teachers who participated in this study have proved that the DBE programme had, on the average, an appreciable influence on their teaching practices. Nevertheless, the impact was not felt on the teaching practices of some of the beginning teachers, and this was expected as individuals learn differently.

DBE trained teachers' Perception about the Influence of Methods of teaching Mathematics course on their Teaching Practices

The second research question was to determine DBE trained teachers' perceptions about the influence of methods of teaching mathematics course taken at the college on their teaching practices. This question was analysed using mean, standard deviation, frequencies and percentages. A mean score of ($\geq$3.5) indicates

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positive perception about the influence of methods of teaching mathematics course on beginning teachers' teaching practices, and a mean score of (<3.5) indicates negative or poor perception about the items used to define the influence of methods of teaching mathematics course on beginning teachers' teaching practices. The results are presented in Table 12.



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Table 12: Perception of Beginning Teachers on the Influence of Methods of Teaching on Teaching Practices

Statements	Strongly disagree F (%)	Disagree F (%)	Neutral F (%)	Agree F (%)	Strongly agree F (%)	Mean	Standard deviation	Positive perception F (%)	Negative perception F (%)
1. Methods of teaching mathematics course has prepared me well for teaching mathematics at the Basic School	4 (3.8)	14 (13.5)	12 (11.5)	62 (59.6)	12 (11.5)	3.62	0.99	74 (71.15)	30 (28.85)
2. Methods of teaching mathematics course has equipped me with adequate skills on lesson note preparation	4 (3.8)	12 (11.5)	8 (7.7)	68 (65.4)	12 (11.5)	3.69	0.96	80 (76.92)	24 (23.08)
3. I have learnt how to state specific, relevant and achievable objectives for my lesson	0 (0.0)	6 (5.8)	0 (0.0)	86 (82.7)	12 (11.5)	4.00	0.59	98 (94.23)	6 (5.77)
4. Methods of teaching mathematics course has prepared me adequately on how to introduce mathematics lesson	0 (0.0)	6 (5.8)	0 (0.0)	84 (80.8)	14 (13.5)	4.02	0.61	98 (94.23)	6 (5.77)

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Table 12, Continued

Statements	Strongly disagree F (%)	Disagree F (%)	Neutral F (%)	Agree F (%)	Strongly agree F (%)	Mean	Standard deviation	Positive perception F (%)	Negative perception F (%)
5. Methods of teaching mathematics course has prepared me adequately on how to manage learners' behaviour in class.	0 (0.0)	6 (5.8)	0 (0.0)	84 (80.8)	14 (13.5)	4.02	0.61	98 (94.23)	6 (5.77)
6. Methods of teaching mathematics course has equipped me with good questioning skills.	0 (0.0)	7 (6.7)	3 (2.9)	82 (78.8)	12 (11.5)	3.95	0.64	94 (90.38)	10 (9.62)
7. Methods of teaching mathematics course has provided me with skills on how to involve all learners in my lessons.	0 (0.0)	6 (5.8)	0 (0.0)	86 (82.7)	12 (11.5)	4.00	0.59	98 (94.23)	6 (5.77)

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Table 12, Continued

Statements	Strongly disagree F (%)	Disagree F (%)	Neutral F (%)	Agree F (%)	Strongly agree F (%)	Mean	Standard deviation	Positive perception F (%)	Negative perception F (%)
8. Methods of teaching mathematics course has taught me how to take learners' prior knowledge into account when planning my instruction.	0 (0.0)	6 (5.8)	0 (0.0)	84 (80.8)	14 (13.5)	4.02	0.61	98 (94.23)	6 (5.77)
9. I have learnt how to actively engage all learners in mathematics lesson from my method of teaching mathematics course.	0 (0.0)	1 (1.0)	0 (0.0%)	91 (87.5)	12 (11.5)	4.10	0.38	103 (99.04)	1 (0.96)
10. I have learnt how to organize teaching and learning activities sequentially from method of teaching mathematics course.	0 (0.0)	1 (1.0)	0 (0.0)	91 (87.5)	12 (11.5)	4.10	0.38	103 (99.04)	1 (0.96)

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Table 12, Continued

Statements	Strongly disagree F (%)	Disagree F (%)	Neutral F (%)	Agree F (%)	Strongly agree F (%)	Mean	Standard deviation	Positive perception F (%)	Negative perception F (%)
11. I have learnt how to pace mathematics lesson to benefit all learners in class.	0 (0.0)	4 (3.8)	5 (4.8)	89 (85.6)	6 (5.8)	3.93	0.51	95 (91.35)	9 (8.65)
12. I have learnt to show enthusiasm any time I am teaching mathematics.	0 (0.0)	1 (1.0)	0 (0.0)	97 (93.3)	6 (5.8)	4.04	0.31	103 (99.04)	1 (0.96)
13. I have learnt to listen to all learners in class from method of teaching course.	0 (0.0)	1 (1.0)	0 (0.0)	91 (87.5)	12 (11.5)	4.10	0.38	103 (99.04)	1 (0.96)
14. From methods of teaching mathematics course, I learnt how to use variety of techniques to determine understanding of learners.	0 (0.0)	8 (7.7)	8 (7.7)	77 (74.0)	11 (10.6)	3.88	0.69	88 (84.62)	16 (15.38)
Overall perception						4.01	0.60		

N = 104

Source: Field survey (2021)

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From Table 12, it can be seen that the beginning teachers rated their methods of teaching mathematics course very high (each item had a mean of more than 3.6 on a scale of 1 to 5). From the overall mean score (4.01> 3.5), it could be said that the beginning teachers, generally, perceived the method course as having positive influence on their teaching practices. Areas which the teachers rated very high and hence perceived to have made great impact on their teaching practices were their ability to actively engage all learners in their class (item 9, M = 4.10, SD = .38), and their ability to organise teaching and learning activities sequentially to cater for all learners (item 10, M = 4.10, SD = .38).

In terms of pupils' engagement in class, with the exception of one teacher, the rest of the teachers (103), representing 99.04% felt their method course had positively influence their skills on how to engage pupils in class. It was evident during the observation that most of the beginning teachers could use a number of strategies to get pupils actively engaged in mathematics lesson. Similarly, 103(99.04%) agreed that they learned how to organise teaching and learning activities sequentially from the methods of teaching course. Again, almost all (103 out of 104) the teachers agreed that the method course had had influence on their knowledge in organising teaching and learning activities coherently in class. As such, 103(99.04%) of the beginning teachers are said to have positive perception about the influence of method of teaching course on how to organise teaching and learning activities in mathematics class.

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Other areas that the respondents perceived to have impacted most on their teaching practices were their ability to state specific, relevant and achievable objectives when planning their lessons (item 3, M = 4.00, SD = .59) as well as exhibiting passion when teaching mathematics (item 12, M = 4.04, SD = .31). In addition, the respondents perceived that their ability to introduce mathematics lessons (item 4, M = 4.02, SD = .61), consider learners' prior knowledge when planning their lessons (item 8, M = 4.02, SD = .61), get all learners involved in their lessons (item 7, M = 4.00, SD = .59) contributed immensely to their teaching practices. Moreover, the beginning teachers perceived that their skills to manage learners behaviour in class (item 5, M = 4.02, SD = .61) helped them in executing their lessons successfully.

Particularly, it can be seen from Table 14 that while 98 (94.3%) out of the 104 beginning teachers felt that methods of teaching mathematics course had prepared them adequately on how to manage learners' behaviour in class, only 6(5.8%) of the teachers disagreed that methods of teaching course prepared them adequately in terms of managing learners behaviour in class. This implies that, overall, beginning teachers have positive perception about the influence of methods of teaching mathematics course on how to manage learners' behaviour in class.

Areas beginning teachers comparatively rated low were ability to employ variety of techniques to determine pupils' understanding when teaching mathematics (item 14, M = 3.88, SD = .69). Most 88(84.62%) of the teachers felt that their method of teaching course had taught them how to employ variety of techniques to determine pupils' understanding in mathematics class. This means

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eleven (11) out of every thirteen (13) beginning teachers have positive perception about the influence of method course on their ability to use variety of techniques to check pupils' understanding. On the flipside, 16(15.38%) of the respondents have negative perception about the influence of method course on their ability to apply variety of techniques to check pupils' understanding. Item on whether method course had prepared them well for teaching mathematics at the Basic School level (item 1, M = 3.62, SD = .99) was also rated low followed by item on skills for lesson preparation (item 2, M = 3.69, SD = .96).

Specifically, 74(71.15%) of the teachers agreed that method of teaching mathematics course had prepared them adequately for teaching mathematics at the Basic School. Drawing from this, it can be said that nearly three-fourth of the teachers felt their methods of teaching course had prepared them adequately for teaching mathematics. Although majority (71.15%) of the beginning teachers felt well prepared, 30 teachers, representing (28.85%), felt they were not adequately prepared by their method course.

Further, 80(76.92%) of the beginning teachers felt their methods of teaching course had equipped them with the kills of preparing notes for their mathematics lessons. It could be said that majority of the teachers have positive perception about the influence the method course had on their skills in terms of lesson note preparation. On the other hand, 16 of the teachers felt that their method of teaching course had not equipped them with adequate skills on lesson note preparation; eight of the teachers could not state whether or not their method had prepared them well on lesson preparation. Thus, it can be said that 24(23.08%) out of the 104 beginning

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teachers have negative perception about the influence of method course on their skills in preparing lesson note.

Discussion related to research question two

From the results, it became evident that, overall, the beginning teachers felt that the methods of teaching mathematic course had had influence on their teaching practices. Nevertheless, some of the beginning teachers seemed not to have felt the positive influence of the methods of teaching mathematics course on their teaching practices. In particular, They were of the view that the methods of teaching mathematics course did not prepare them well or equipped them with adequate skills, especially on lesson notes preparation and ability to employ variety of techniques to check pupils understanding.

This outcome of some beginning teachers not feeling or believing the impact of their preparation programme may be due to a number of factors, such as, inability of some beginning teachers to pay attention to contents of the method course during the training programme. Hence making them have negative perception about the influence of the method of teaching course on their teaching practices. Perhaps the training programme could not meet specific needs of some of the individual beginning teachers as a result, they find it difficult to associate their success in the classroom to their initial preparation programme. This finding is in line with Ham (2011) who reported that some beginning teachers claimed that their success in the classroom was as a result of their experiences before and after their preparation programme, and not the main preparation programme.

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It could also be argued that some of the beginning teachers could not get support from their tutors and their peers to overcome the challenges associated with teaching mathematics at the Basic School; hence, making them have negative perception about the influence of the method course on their teaching practices at the Basic School. Some of the beginning teachers might have unresolved challenges that make them perceived that their preparation programme was not useful to their teaching practices at the Basic School.

Another inference that could be drawn from the result is that the training programme might have equipped the beginning teachers with the necessary skills and techniques for teaching mathematics at the Basic School; however, the school or classroom context could not support the actions of the teachers. For instance, during the classroom observations, it was evident that most of the beginning teachers had substantial content and pedagogical knowledge (belonging to ZPD) for teaching mathematics. However, the classroom context they find themselves could not support some of the knowledge and teaching skills they gained from their method course. Classrooms organisations, behaviour of pupils in the classroom as well as large class sizes either hindered the teachers teaching methodology and delivery in the classroom. It was also observed that some of the teachers had low confidence in teaching and others did not show passion for teaching mathematics (belonging to ZFM). These limited the instructional decisions of some of the teachers as they could not apply their knowledge fully and thereby performing below the minimum mark of 50%.

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On the other hand, most of the beginning teachers perceived the preparation programme to have had positive influence on their teaching practices. A number of inferences could also be drawn from this result. First, the topics in the Basic School syllabi, which the beginning teachers were teaching at the time of data collection, were not different from the topics in the method of teaching mathematics course they were exposed to during training. This makes it easy for them to establish a link between the content of the training programme and the actual practices in the classroom. Second, the beginning teachers might have had their challenges, as far as the teaching of mathematics at the Basic School is concerned, resolved during the training programme. Once the training programme meets the challenges and the expectations of the individual teachers, they are likely to perceive the programme to be useful and relevant to their practices.

The foregoing result supports the finding of Durkee (2019) in which he investigated how first-year elementary teachers felt their method of teaching courseork had influenced their attitude, content and pedagogical knoledge. The finding revealed that most of the teachers perceive their method coursework had much influence on their attitude towards mathematics, although they reported that their content knowledge was not much influenced by the method coursework. Again, Isikoglu (2008) reported that beginning teachers had a change – negative to positive – in perception about the influence of method course, after going through a-15 week training course on methods. Similary, the result of this study is also in line with the finding of Wasserman and Ham (2013) that beginning teachers felt their success was the result of the practical skills and the theory that their teacher

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education programme provided. Specifically, the beginning teachers explained that the instructional strategies modeled by their educators and the field experience that the training programme provided helped them to link theory to practice on the field.

In general, it could be argued that beginning teachers percieve the Diploma in Basic Education (DBE) programme to have positive influenc on their teaching practices as other studeies have also confirmed the positive influence of initial teacher preparation programme.

Influence of Methods of Teaching Mathematics Course on Beginning Teachers' Attitude towards teaching

The third research question was to examine whether methods of teaching mathematics course had influence on beginning teachers' attitude towards teaching mathematics. This question was answered using mean, standard deviation, frequencies and percentages. The scale used contained both 13 positive and eight negative worded items to ensure that the responses were devoid of common methods bias. For the positive worded items, a mean score of ($\geq$ 3.5) indicates that the methods of teaching course has influence (positive) on the beginning teachers' attitudes towards teaching, and a mean score of ($<$3.5) indicates low influence of methods of teaching course on the attitudes of beginning teachers. With respect to the negative worded items, an average score of ($<$ 3.5) means positive influence, and ($\geq$ 3.5) indicates negative influence. The results are then presented in Table 13.

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Table 13: Attitude of Beginning Teachers towards Teaching of Mathematics

Statements	Strongly disagree F (%)	Disagree F (%)	Neutral F (%)	Agree F (%)	Strongly agree F (%)	Mean	Standard deviation
1. I like encouraging students' questions and answers when teaching mathematics	4(3.8)	14(13.5)	12(11.5)	62(59.6)	12(11.5)	3.62	0.99
2. I don't like preparing teaching aids in mathematics	39(37.5)	49(47.1)	6(5.8)	6(5.8)	4(3.8)	1.91	1.01
3. I like summarizing all core points for all activities that relate to my lesson	4(3.8)	12(11.5)	8(7.7)	68(65.4)	12(11.5)	3.69	0.96
4. I like to maintain learners' attention throughout my mathematics lesson.	4(3.8)	14(13.5)	12(11.5)	66(63.5)	8(7.7)	3.58	0.95
5. I enjoy using materials and examples from daily life when teaching mathematics.	4(3.8)	14(13.5)	12(11.5)	62(59.6)	12(11.5)	3.62	0.99

N = 104

Source: Field survey (2021)

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Table 13, Continued

Statements	Strongly disagree F (%)	Disagree F (%)	Neutral F (%)	Agree F (%)	Strongly agree F (%)	Mean	Standard deviation
6. I am not confident in teaching mathematics	46(44.2)	48(46.2)	7(6.7)	2(1.9)	1(1.0)	1.69	0.76
7. I like taking learners prior understanding into account when planning my mathematics lesson	4(3.8)	12(11.5)	8(7.7)	68(65.4)	12(11.5)	3.69	0.96
8. I enjoy using variety of assessment techniques to check for students' understanding in mathematics class	4(3.8)	14(13.5)	12(11.5)	66(63.5)	8(7.7)	3.58	0.95
9. I enjoy monitoring learning activities in mathematics class	4(3.8)	12(11.5)	8(7.7)	48(46.2)	32(30.8)	3.88	1.09

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Table 13, Continued

Statements	Strongly disagree F (%)	Disagree F (%)	Neutral F (%)	Agree F (%)	Strongly agree F (%)	Mean	Standard deviation
10. I enjoy teaching mathematics when every learner is actively involved in my lesson.	4(3.8)	12(11.5)	8(7.7)	48(46.2)	32(30.8)	3.88	1.09
11. I hate to re-teach a topic in mathematics because not every learner can do well in mathematics.	46(44.2)	45(43.3)	10(9.6)	2(1.9)	1(1.0)	1.72	0.79
12. I enjoy marking learners' exercises when teaching mathematics	4(3.8)	12(11.5)	8(7.7)	48(46.2)	32(30.8)	3.88	1.09
13. I enjoy linking content of mathematics to learners experiences when teaching	4(3.8)	14(13.5)	12(11.5)	62(59.6)	12(11.5)	3.62	0.99

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Table 13, Continued

Statements	Strongly disagree F (%)	Disagree F (%)	Neutral F (%)	Agree F (%)	Strongly agree F (%)	Mean	Standard deviation
14. I hate to teach learners two or more ways of solving a particular mathematics problem when teaching mathematics	38(36.5)	43(41.3)	22(21.2)	1(1.0)	0(0.0)	1.87	0.78
16. I hate to relate concepts to learners experience when teaching mathematics.	38(36.5)	48(46.2)	14(13.5)	3(2.9)	1(1.0)	1.86	0.83
17. I like asking both lower and high-order questions when teaching mathematics.	4(3.8)	14(13.5)	12(11.5)	62(59.6)	12(11.5)	3.62	0.99
18. I like paying attention to only learners who ask questions in my class because the rest are not interested in the lesson.	4(3.8)	12(11.5)	8(7.7)	68(65.4)	12(11.5)	3.69	0.96

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Table 13, Continued

Statements	Strongly disagree F (%)	Disagree F (%)	Neutral F (%)	Agree F (%)	Strongly agree F (%)	Mean	Standard deviation
19. I hate to provide feedback to learners if they do not do well on an exercise.	32(30.8)	54(51.9)	18(17.3)	0(0.0)	0(0.0)	1.87	0.68
20. I like using variety of instructional strategies when teaching mathematics.	4(3.8)	12(11.5)	8(7.7)	68(65.4)	12(11.5)	3.69	0.96
21. I hate giving learners time to think after I have asked questions in class.	41(39.4)	54(51.9)	9(8.7)	0(0.0)	0(0.0)	1.69	0.62
22. I hate to ask learners to explain their solutions to a problem in mathematics class.	44(42.3)	47(45.2)	13(12.5)	0(0.0)	0(0.0)	1.70	0.68
Overall attitude						3.68	0.94
						N = 104	

Source: Field survey (2021)

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Overall, from the results displayed in Table 13, all the items had high average scores. All the positive worded items had mean of more than 3.5, whereas, all negative worded items has mean of less than 3.5. This implies that the attitude of the beginning teachers toward teaching mathematics was positive. Among the positive responses, teachers' likeness for summarizing core points for all activities that relate to their lesson had the highest mean score (item 3, M = 3.69, SD = .96), with teachers showing likeness in maintaining learners' attention throughout mathematics lesson receiving the least mean score (item 4, M = 3.58, SD = 3.95).

Further, the negative statements, "I am not confident in teaching mathematics" and "I hate giving learners time to think after I have asked question in class" had the highest mean scores (items 6 and 21, M = 1.69, SD = .62). Negative statements of "I hate to teach learners two or more ways of solving a particular mathematics problem" and "I hate to provide feedback to learners if they do not do well on an exercise" had the lowest mean scores (items 14 and 19, Mean = 1.87, SD = .68).

It could be observed from Table 15 that 74(71.1%) of the beginning teachers reported that they like encouraging pupils to ask questions and answer questions in mathematics class. Thus, 37 out of every 52 beginning teachers like encouraging pupils to ask questions in class. On the other hand, 18(17.3%) of the teachers did not like encouraging pupils to ask questions in mathematics class. In addition, 12(11.5%) of the teachers could not tell whether they like encouraging pupils to ask questions in class or not. This suggests that 30 teachers, representing 28.8%, may not give pupils opportunity to express themselves in class.

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Further, 88(84.6%) out of the 104 beginning teachers professed that they like preparing teaching aids for mathematics lessons. However, out of the 104 teachers, 10(9.6%) of them agreed that they do not like preparing teaching aids for their lessons in mathematics. Also, 6(5.8%) of the respondents remain neutral as they could not tell whether they like preparing teaching aids or not. This brings the number of teachers who do not like preparing teaching aid for mathematics lessons to sixteen (16) representing 15.4% of the total number of participants for the study.

From Table 13, it could also be observed that 94 of the beginning teachers felt they are confident in teaching mathematics whereas ten (10) of them felt they were not confident in teaching mathematics. In terms of active engagement of pupils in class,80(77.0%) of the participants agreed that they enjoy teaching mathematics when every pupil is actively involved in their lessons. On the contrary, 24 of the teachers indicated that they do not enjoy teaching mathematics when every pupil is actively involved in their lessons. Interestingly, 8(7.7%) out of the 24 teachers were indifferent to pupils involvement in their mathematics class.

Furthermore, 94(87.5%) of the beginning teachers felt that it is necessary to re-teach a topic regardless of whether every pupil can do well in mathematics or not. Only three (2.9%) of the teachers agreed that it is not necessary to re-teacher a topic because not everyone can do well in mathematics. Ten (9.6%) of the teachers, however, could not indicate whether it is important to re-topic a topic in mathematics class. Considering whether beginning teachers do connect the mathematics content they teach to pupils previous experiences, 74 teachers representing (71.1%) agreed that they enjoy linking the content of the mathematics

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they teach to learners experiences. This means that 30 teachers, representing (28.9%) do not enjoy connecting the content of mathematics to their pupils' experiences in class.

Again, it could be seen that 80 teachers representing (76.9%) reported that they like paying attention to only pupils who ask questions in their class because the rest may not be interested, indicating that the teachers do not care about every pupil in their mathematics class in terms of supporting them individually. This shows a negative attitude on the part of the teachers towards teaching of mathematics. Though most of the teachers do not pay attention to every pupils in class, 24 out of the 104 beginning teachers, representing (23.1%) disagreed that they pay attention to only pupils who ask questions in their class. Meaning 24 of the teachers do pay attention to every pupils in their class when teaching mathematics.

Furthermore, with regards to whether the teachers expose pupils to a number of ways of solving a particular problem, 81(77.8%) of the participants indicated that they like to teach learners two or more ways of solving a particular mathematics problem. No teacher indicated that he/she hates to teach multiple (two or more) solutions to a particular problem in mathematics while one teacher agreed that he/she does. However, 22(21.3%) of the participants were not sure if they teach pupils two or more solutions to a particular mathematics problem.

Examining whether teachers felt that it is right to give pupils ample time to think before answering questions posed in class, no teacher agreed (0, 0.00%) that they hate to give learners enough time to think before answering questions in class;

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instead, 95(91.3%) disagreed to the statement. What it is means is that majority of the respondents felt it is worth giving pupils time to think before answering questions posed in class. Nonetheless, nine(8.7%) of the beginning teachers were indecisive on the same statement.

With regards to the nature of questions teachers posed in class to assess pupils mathematical abilities, majority (74 out of 104) of the beginning teachers agreed that they like asking both lower and higher order questions when teaching mathematics. In contrast, 18(17.3%) of the teachers, said they do not ask both lower and higher order questions in mathematics class. Similarly, 86(82.7%) said they liked to provide feedback to pupils in mathematics class even if the pupils do not do well on an exercise. No teacher agreed that he/she hate to give pupils feedback if they do not do well on a given exercise. This shows a positive attitude of the teachers towards questioning and feedback in mathematics class. However, 18(17.3%) of the teachers could not decide whether they provide feedback to pupils in mathematics class or not.

As to whether the beginning teachers believe in the use of variety of techniques to explain concepts to pupils in mathematics class, a good number of them 80(76.9%) agreed that they employ different techniques in class when teaching mathematics. However, few (16) teachers indicated that they used a particular technique in teaching mathematics. Nonetheless, 8(7.7%) of the participants could not tell whether they used different techniques in teaching mathematics or not.

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Finally, as to whether the beginning teachers give opportunity to pupils to verbalise the mathematics they learn or explain their solutions, out of the 104 teachers, 91 representing (87.5%) outright disagreed with the statement that "I hate to ask learners to explain their solution to a problem in mathematics class". This suggest that majority of the teachers do give pupils opportunity to explain their solutions to a given problem in class. Absolutely no beginning teacher agreed that they hate to ask learners to explain their answers in class. Nevertheless, 13(12.5%) remained indifferent to the above statement. The next section presents the analysis of the qualitative data.

Qualitative results

The qualitative data collected were mapped onto the teacher's Zone of Proximal Development (ZPD), Zone of Free Movement (ZFM) and Zone of Promoted Action (ZPA). Specifically, the qualitative data was gathered on how methods of teaching course component of the training programme influenced teachers' attitude towards teaching mathematics.

Beginning teachers' zone of proximal development

With respect to knowledge about the use of TLMs (belongs to ZPD), the beginning teachers claimed that they learned a lot from their methods course which formed part of their course requirements in the DBE programme. Most of the teachers explained that teaching mathematics concepts using TLMs is the right way to go. Pupils understand mathematics concepts better when they are given the opportunity to manipulate the materials themselves. When the teachers were asked how they got the knowledge about the use of TLMs, all the 15 teacher interviewees

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attributed their knowledge to their training programme. For instance, some of the responses from the teachers are as follows:

> *"I knew about TLMs when I was in college. We were taught during methods class how to prepare TLMs for every lesson and so that's how I came to know about it"* (BT001).
>
> *"At the college, we were taught how to use TLMs; so I got the knowledge from there* (BT003).
>
> *"When I was in the Training College, when we were doing methods of teaching, you couldn't prepare a lesson note without including TLMs. It's stated in the lesson notes. I learnt all this from my training programme"* (BT006).
>
> *". . . I was taught in my methods course at college that lessons are prepared with TLMs. I picked the knowledge up and use it today in my lessons"* (BT011).
>
> *"I was taught in my methods class at the college. I was taught to use TLMs to facilitate understanding, as its usage help students to learn by observing and seeing"* (BT009).

The beginning teachers were also asked to express, in their own view, whether the materials they used in teaching a named topic were appropriate. A number of them again admitted that the materials they selected for their mathematics lessons were appropriate and relevant to the topic that they taught. If it were not so, they would not have achieved their lesson objectives for the given period.

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"I feel my TLMs were appropriate for the topic, Subtraction of Single Digit Numbers, I just taught as pupils' understanding seemed to have been enhanced after I introduced the materials" (BT013).

"I think my TLMs were appropriate for all lessons involving counting, numbering and the likes" (BT009).

"You cannot do away with TLMs when you are teaching a concept that involves Addition and Subtraction, as it is easy to practicalise the concepts, and enhance pupils' understanding with the use of TLMs" (BT011).

Attitude is very crucial in all careers and the teaching of mathematics is no exception. It could be inferred from the interview responses that methods of teaching mathematics course has influenced the attitude of the beginning teachers towards teaching of mathematics as well as how the teachers feel generally towards the teaching of mathematics. The researcher asked the beginning teachers whether the methods course has contributed to their present attitude towards teaching mathematics. The beginning teachers claimed they feel confident in teaching mathematics at the Basic School, and that the methods of teaching mathematics course that they took at the college has contributed meaningfully to their attitudes towards mathematics teaching. The following responses corroborate this assertion:

"I feel very confident. Initially, back in school, I was not so good because of anxiety in maths, but after doing methods of teaching maths and other maths courses, I realised that I have overcome

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all those anxieties and I am very confident when teaching maths now, because I know I understand what I am teaching and therefore I will be able to impart to my learners and they will get it very well. This is a typical representation of the influence of the training programme – transforming mathematics-phobic person to mathematics-loving teacher. So, generally, I will say my attitude towards teaching mathematics is superb" (BT012).

". . . as I said earlier, I was taught maths activities, so per what I was taught back in college, it has helped mould my attitude towards teaching the subject, and I enjoy it" (BT001).

"I would describe my attitude towards teaching mathematics as positive" (BT011).

"I like teaching mathematics, and would say the training programme has really prepared me well to become a great mathematics teacher" (BT009).

Concerning adequacy of knowledge about specific strategies or techniques that the beginning teachers learned from their methods of teaching course, they were asked whether their methods of teaching course adequately prepared them for teaching mathematics at the Basic School and why they think so. Most of them said the programme has prepared them adequately.

"Yes, the methods course has adequately prepared me. This is because I have learnt a lot from the college concerning the

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importance of using teaching and learning materials to teach a concept in mathematics" (BT004).

"*Yes, mathematics activities have prepared me adequately. All that I was thought in college as early childhood teacher were not different from what I am teaching on the field. So, I feel the methods course has prepared me well*" (BT012).

"*Yes, because all the methods that I am using here I acquire them from the college*" (BT014).

The lesson that caught the attention of the observers during the classroom observations was on the topic "Multiplication of Two Digit Whole Numbers Using "Halving and Doubling Method". The presentation of the lesson was sequential and logical as most of the pupils in the class grasped, with ease, the concept that was being taught. The following represents the method the teacher used:

To multiply two numbers using the halving and double method, simply halve one of the numbers and double the other

He then gave the following example:

i) $12 \times 25 = 6 \times 50 = 300$ *(that is, halve the 12 and double the 25)*

ii) $16 \times 50 = 8 \times 100 = 800$ *(Halve the 16 and double the 50)*

iii) $4 \times 44 = 2 \times 88 = 176$ *(Halve the 4 and double the 44)*

He further explained to the pupils that for easy multiplication, the process of halving and doubling can continue until one of the numbers becomes a single digit. For instance, to find the answer to 24×32.

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First, halve 24 and double 32; that is, $24 \times 32 = 12 \times 64$. *Since both numbers are still two digits, the process of halving and doubling continues. That is, half 12 and double 64, which gives* 6×128.

With that, one of the numbers is single (6) and it will be easier to multiply. Pupils are therefore comfortable to multiply the two numbers and give the answer.

Hence, $24 \times 32 = 12 \times 64 = 6 \times 128 = 768$

This method (halving and doubling) made it easy for the pupils to multiply two-digit whole numbers without difficulty. Most of the pupils in the class were eager to try more examples using the method. When the teacher's lesson note was inspected, it was clearly stated, under the relevant previous knowledge, that pupils were taught multiplication of single digit whole numbers and multiplication of single digits with double-digit whole numbers using the traditional approach. The pupils grasped the concept of multiplying two digits numbers with ease not only because of the method employed in teaching it but also the fact that the teacher linked the lesson to their previous knowledge.

Interestingly, unlike other teachers who would use a technique to teach without letting pupils know why the technique worked, BT008 did not end there but went ahead to explain to the class why the halving and doubling strategy worked. He first posed the simple question 6×7 and then asked the pupils to arrange bottle tops in rows to represent 6×7 as shown in Figures 5. This demonstration was done on the teacher's table which was positioned in front of the

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class. The teacher then asked the pupils to count the number of bottle tops in all (i.e., 42), as the product of the two numbers.

The teacher asked one of the pupils to come forward and divide the number of rows into two. He then guided them to arrange one-half of the bottle tops such that it has the same number of rows in the other half as shown in Figure 5.

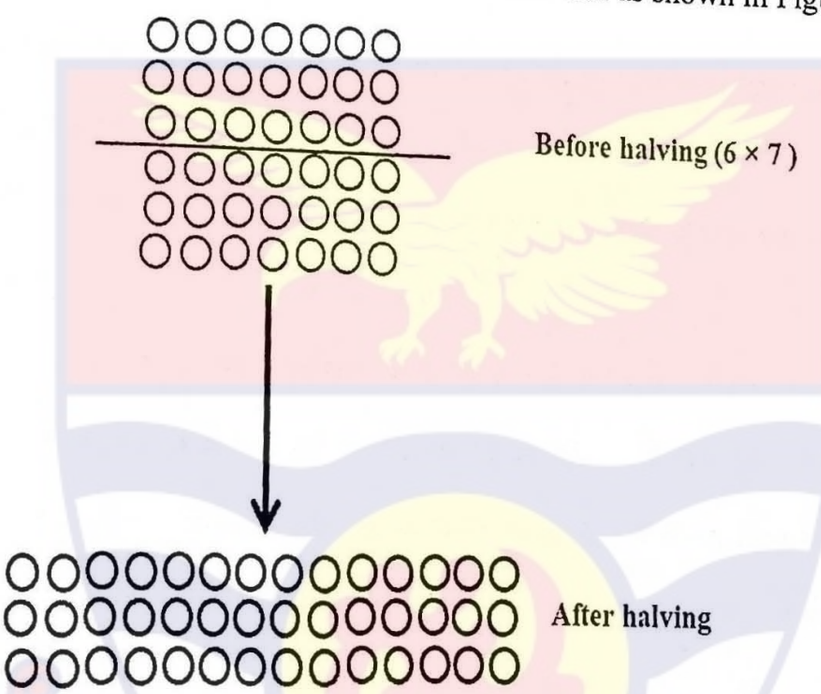


Figure 5: Arrangement of bottle tops

Source: Author's construct (2021)

The pupils counted the bottle tops again and realised they were still 42 in number. Pupils observed that the bottle tops were just arranged differently. That is, half the number of rows and double the number of objects in each row will not change the number of objects. The teacher gave two more examples to the class to try. It was so interesting that within a short time, most of the pupils could explain why the halving and doubling strategy worked for multiplication of numbers. This

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teacher consistently scored above (90%) in all his mathematics lessons observed, consequently he was selected for the interview session.

In respect of teaching approaches that support conceptual understanding, majority of the beginning teachers claimed that they had the necessary skills that enabled them to teach to the understanding of their pupils. The beginning teachers stated that they have knowledge in the use of many teaching approaches, and that if one approach did not work with their pupils, they could quickly employ alternative approaches to ensure that the pupils understand the concept being taught.

> *"I don't use one approach in my teaching. The approach I use each day is informed by the needs of my students. Sometimes, improvise some means just to make sure the children grasp what I am teaching, and that is the most important thing to me"* (BT009).

One other lesson that attracted the researcher's attention during the classroom observations was this teacher who was found using an algorithm other than the traditional approach to teach subtraction of whole numbers. The approach the teacher used, I believe has the potential of developing the critical thinking ability of pupils at the Basic School level. In the class, the pupils were not just giving answers by rote means but were made to verbalise the mathematics they were learning. The algorithm employed by teacher was '**How Much More Do I Add**' shortened to 'HMMDIA' to teach subtraction of whole numbers. The lesson was connected to previous lessons on addition of whole numbers where pupils

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could add two digit whole numbers with ease. Pupils were answering subtraction questions using the "counting on principle" of addition. The following were some of the examples the teacher gave in the class.

First example: 24 – 11

Teacher: How much more do I add to 11 to get 15?

Pupils (reasoning): Wrote down 4

Teacher: How much more do I add to 15 to 20?

Pupils (reasoning): Wrote down 5

Teacher: How much more do I add to 20 to get 24?

Pupils (reasoning): Wrote down 4

Teacher: Now add all the numbers recorded as the answer

Pupils (adding): $4 + 5 + 4 = 13$

Hence, $24 - 11 = 13$

Second example: 46 – 13

Teacher: How much more do I add to 13 to get 20?

Pupils (reasoning): Recorded 7

Teacher: How much more do I add to 20 to get 30?

Pupils (reasoning): Recorded 10

Teacher: How much more do I add to 30 to 40?

Pupils (reasoning): Recorded 10

Teacher: How much more do I add to 40 to get 46?

Pupils (reasoning): Recorded 6

Teacher: Next, add all the numbers recorded as the answer

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That is $7 + 10 + 10 + 6 = 33$

Hence, $43 - 13 = 33$

Pupils were so excited about the approach the teacher employed in teaching subtraction. Most of them were calling for more questions to answer when it was even time for them to go for break. These teaching approaches showed that the beginning teachers learned a lot from the training programme concerning the teaching of mathematics at the Basic School.

Zone of free movement experienced by beginning teachers

To ascertain the beginning teachers' experiences with regards to how the teaching environment could possibly constrain their teaching actions, the participating teachers were asked questions specifically related to availability of teaching resources, teaching methodologies and strategies that could promote learning of mathematics.

Concerning availability of teaching resources (belongs to ZFM), majority of the beginning teachers stated that their schools had the requisite resources available. For instance, the beginning teachers mentioned that there were writing materials and other teaching and learning materials available in their schools to select for smooth lesson delivery. This suggests that the teachers had the freedom of selecting from available materials to support the teaching of mathematics. The researcher recorded the following specific responses:

"My school has most of the materials I need to do my teaching,. .

. " (BT007).

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"I have never faced any challenges since I came to this school, with regards to materials and resources needed to ensure smooth impartation of knowledge to my pupils. This school seems to have a lot of teaching and learning resources in place. The school has a support system in place to consult in case of challenges" (BT011).

"Due to availability of teaching and learning materials, I am able to carry out my teaching activities with ease" (BT012).

Although most of the teachers admitted that there were materials available in their schools to select from, few others, however, complained of getting appropriate resources to teach some particular topics in mathematics. When one of the interviewees, who on one occasion did not use TLMs in his mathematics lesson, was asked why he could not state and use any TLM for his lesson, he explained that it was difficult to get the right materials to teach the topic for that day.

". . . with TLMs, for this topic, 'Mapping', getting a TLM for it is a problem; we have some lessons that we use TLMs – you can use real objects or you have to improvise one. But for this topic, getting a TLM for it is something that is a bit difficult so that is why I didn't include the TLMs – trying to force a TLMs for it might just make things more complicated for the children"(BT015).

The teacher who was observed using the unique method (Halving and doubling) to teach multiplication, for instance, had to demonstrate the method on a teacher's table which was positioned in front of the class due to space. Some pupils,

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especially those at back of the class, had to struggle to see what was going on. At a point, some pupils stood on their tables in order to see clearly what the teacher was demonstrating on the table. The beginning teacher, BT008, though employed an interesting method to teach mathematics, was however constrained by congested and poorly organised classroom, which made him unable to fully demonstrate his method to the benefit of each and every pupil in his class. The congested classroom situation made it difficult for the teacher to attend to individual challenges during this interesting lesson, although pupils' engagement in the lesson was good as most of them were so excited about the method the teacher used.

Also, few (2 out of 15) of the beginning teachers who took junior high education option, complained about the difficulty level of some of the mathematics content they were taught back at college. According to these teachers, some of the mathematics contents (topics) they had learned were higher than the grade-bound they were trained to teach. When they were asked specifically what they wished the programme had taught them that they are experiencing in the classroom, they attributed it to mismatched content knowledge.

> *"We were taught some topics that demand higher level of thinking and understanding than what is expected at the junior high school. I wish these higher topics could be replaced with topics that are related to the Basic School cur"* (BT008).

Zone of promoted action experienced by beginning teachers

To assess teachers under this zone, they were asked questions on accessibility of appropriate TLMs, use of particular strategy or method, teachers'

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own positive attitude towards teaching mathematics, and specific teaching approaches that support conceptual understanding. The beginning teachers were asked whether they had access to any resources or supports that promoted their teaching actions. They explained that they had access to appropriate TLMs and teaching resources that support the methods and approaches they employed in teaching mathematics. The following excerpts were recorded:

> *"... I have full access to many materials and resources that I can rely on here to ensure smooth teaching and learning. This has already made me feel I am the best teacher ever – considering how I am able to use these materials to demonstrate for the pupils to understand* (BT004).
>
> *"I have access to support from my colleague teachers, especially those with whom I came from same school. We are two here from . . . (college's name withheld). We support each other in terms of teaching methodologies and others"* (BT006).

Furthermore, majority of the beginning teachers believed that their own positive attitude towards teaching mathematics has helped them put into work the knowledge acquired from the training programme. This implies that majority of the beginning teachers had positive attitudes towards mathematics and this reflected in their lesson deliveries. Many of the teachers expressed how they loved mathematics even before they started the training programme. They said they believed in their abilities and always had positive mind-sets about mathematics and this made them enjoy mathematics periods all the time. This means that with regards to the

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beginning teachers' attitudes towards teaching mathematics, they believed that their attitudes were positive and thus helped promote the knowledge acquired from the college. The following were captured when they were asked to describe their general attitude towards teaching mathematics.

> *"It's lovely when you understand what you're supposed to be teaching. My attitude towards teaching mathematics has been positive and I can say I have really improved"* (BT004).
>
> *"My attitude towards mathematics is positive. So, I always encourage my students, as I am already aware of the mindset and the feelings students have about mathematics. I keep telling them mathematics is not difficult. Moreover I am guided by the saying that an hour in each day is more useful than 7 hours in one day. So mathematics should be studied on daily basis and continuous"* (BT010).
>
> *"I think my attitude towards teaching mathematics is very good as I have the patience to use many methods in one lesson just to ensure that the students understand the concepts I am trying to teach. This has also helped me develop in many ways as a professional teacher"* (BT014).
>
> *"Teaching mathematics is a fun for me, so I feel ok teaching it. This has made me put the knowledge I acquired from the training college into good use here"* (BT005).

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"I feel happy teaching mathematics; because how the children engage themselves throughout the lesson makes me happy. It always makes me to teach more and impart more knowledge to the children" (BT008).

Further, the responses from the beginning teachers suggest that they were not limited by teaching approaches; thus, teaching approaches that support conceptual understanding could not be said to have impeded lesson deliveries based on the knowledge obtained from their training programme. The following were recorded from the interviews when they were asked about teaching approaches that support conceptual understanding and how these influence their teaching practices.

"Because I already have the idea about teaching maths, it's not that difficult when delivering it. I use several teaching approaches based on the needs of the students I am teaching" (BT001).

"Before going to the training college, of course we knew the content from school. But how to blend this content with the methodology was the problem so from there you're told that if you're teaching this student you have to use this approach or that approach. That has helped me. Because I've added that methodology to the content that I already knew and now I'm able to have a successful lesson delivery. So, I'm able to blend the 2 i.e., the methodology and the content to teach for conceptual understanding of the students" (BT005).

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"I don't use one approach in my teaching. The approach I use each day is informed by the needs of my students. Sometimes, I improvise some means just to make sure the children grasp what I am teaching, and that is the most important thing to me" (BT009).

In summary, it could be stated that the methods of teaching mathematics course under the DBE programme at the Colleges of Education has positively influenced the beginning teachers' attitude towards teaching mathematics.

Discussion related to research question three

From Table 15, the overall mean score was 3.68 (SD = 0.94) which indicates that the participants had positive attitudes towards teaching mathematics. The result showed that teachers appreciate the need to give pupils ample time to think before answering questions in mathematics class, appreciate the use of variety of approaches to teach a concept in mathematics, and pay attention to all learners. Based on this result, the assertion by Agyei and Voogt (2016) that teachers dictate to pupils in the mathematics classroom may no longer be the case, as pupils are given opportunity to learn mathematics at their own pace.

Although few, 4 out of 104, of the beginning teachers acknowledged that they do not like using variety of strategies to teach mathematics and same number also alluded that they do not enjoy teaching mathematics when every learner is actively involved in the class, the general attitude of the beginning teachers towards teaching mathematics could be described as positive. This result was not surprising because during the classroom observation most of the beginning teachers were up

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to the task. The teachers made good use of the instructional time – they were regular and punctual to class and also delivered their lesson within the stipulated time.

The teachers also showed enthusiasm and decorum whenever they were teaching mathematics. The responses the teachers provided to the items on the attitude scale were not different from what the researcher observed during the classroom observation. It could be said that the method course had shaped their attitude towards teaching mathematics, as they were found using variety of approaches to teach, for instance, subtraction of whole numbers (e.g., smallest being 4 – 1) which Early Grade Mathematics Assessment Report argued that Ghanaian primary two pupils find most challenging (USAID, 2016).

The result is similar to that of Tabuk (2018) who examined the attitude of prospective primary school teachers towards teaching mathematics and found that the prospective primary school teachers have positive attitude towards teaching mathematics. In addition, in terms of their specialties, the attitudes of the prospective teachers towards teaching mathematics were found to be the same. The result is also in line with a longitudinal study conducted by Kesicioğlu (2015) to determine the effects of preschool preparation programme on preservice teachers' attitudes towards early mathematics education. Therefore, it can be contended that methods of teaching mathematics course had positively influenced the teachers' attitude towards teaching mathematics. The result was not different from an earlier study by Macnab and Payne (2003) which indicated that teachers understanding, confidence and their liking for mathematics are enhanced by their teacher education programme.

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From the forgoing discussions, it has been shown that the method of teaching mathematics course, which forms an integral component of the training programme (DBE), largely influenced the feelings and believes of the participating teachers towards teaching mathematics. It was therefore concluded that the DBE programme positively influenced the attitude of beginning teachers towards teaching mathematics at the Basic School.

Effect of Methods of Teaching Mathematics Course on Teachers' Teaching Practices Across Specialty

This first hypothesis tested whether training by specialties has significant effect on influence of methods course on teaching practices of beginning teachers. Essentially, the hypothesis compares the teaching practice score (dependent variable) of the beginning teachers across the three specialties (independent variables) – early childhood, primary education and Junior high school. As such, to test the hypothesis, the one-way analysis of variance (ANOVA) was employed. Before performing the ANOVA, the performance of beginning teachers in the four indicators of teaching practice across the three specialties were explored and the results displayed in Figures 6, 7, 8 and 9. The mean teaching practice scores of beginning teachers by specialties are displayed in Tables 14.

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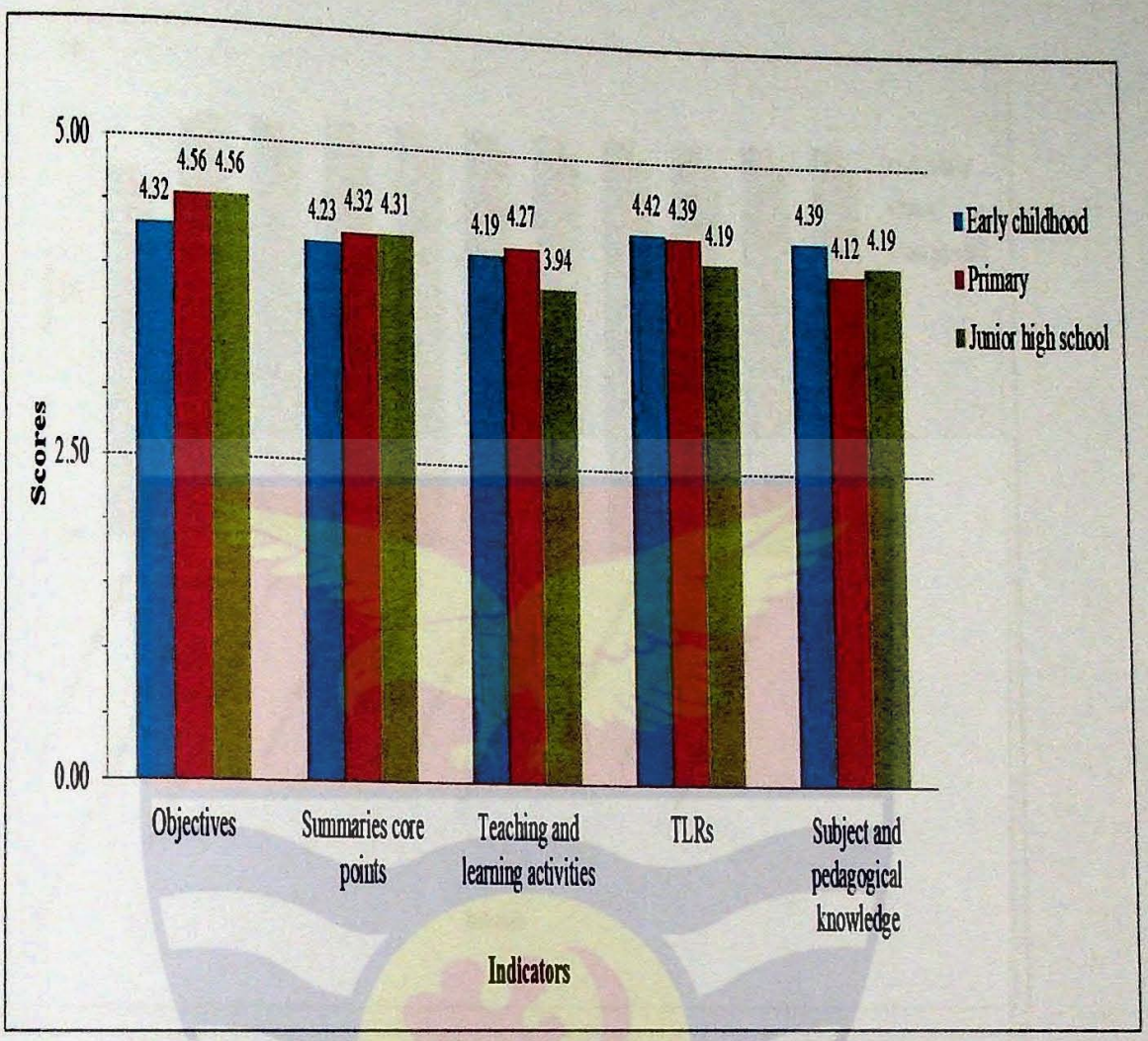


Figure 6: Lesson Plan

It could be observed that no beginning teacher, irrespective of the specialty, scored less than the average score in each of the items under the lesson plan. Although all the specialties performed well in each item, stating lesson objectives appeared to be the best score item. The least scored item was the sequencing of teaching and learning activities in the lesson plan. Scores on teaching methodology and delivery are presented in Figure 7.

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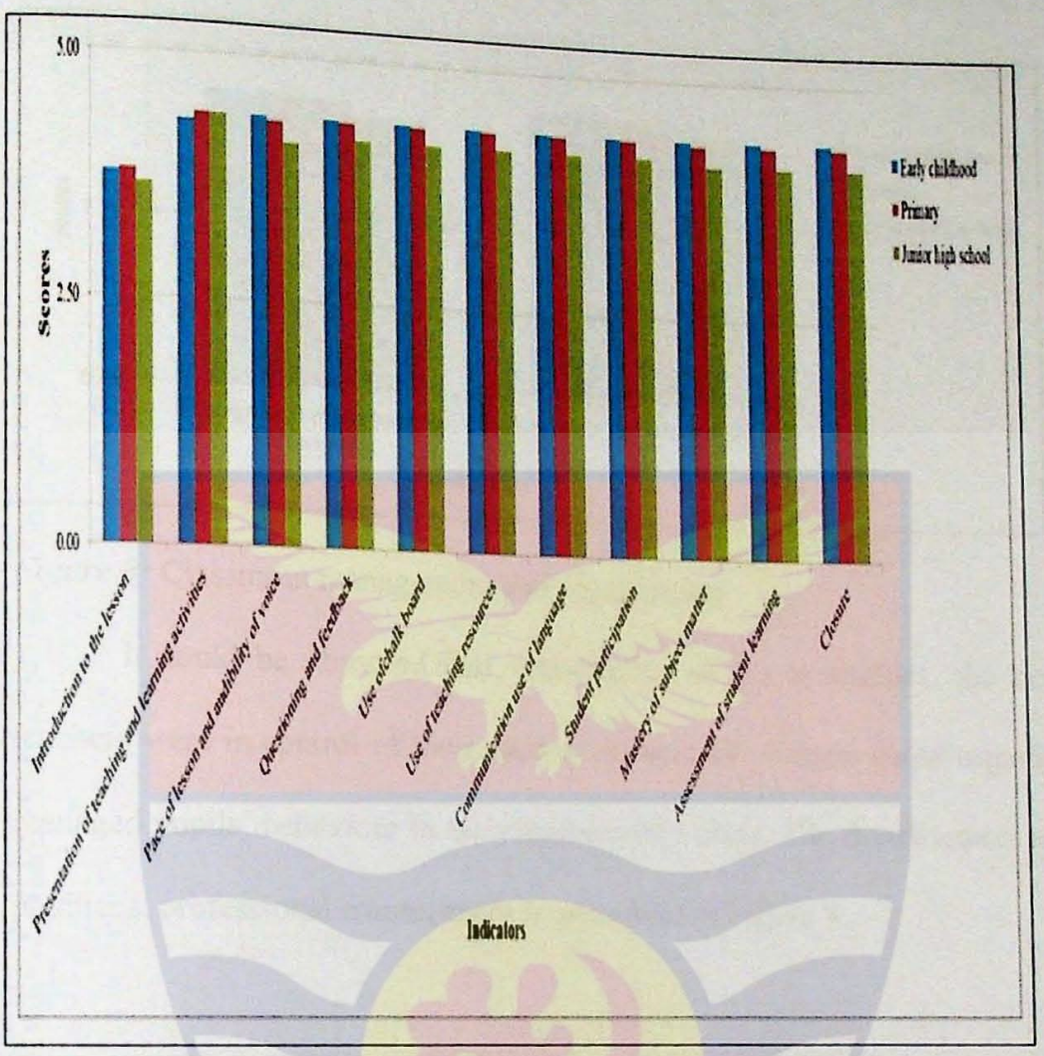


Figure 7: Methodology and Delivery

Concerning teaching methodology and delivery of mathematics lessons, the least scored item was on lesson introduction, with early childhood and primary teachers scoring the highest on the same item (Figure 4). Beginning teachers performed very well in the presentation of teaching and learning activities. Figure 8 presents the third aspect of teaching practices, classroom organisation and management.

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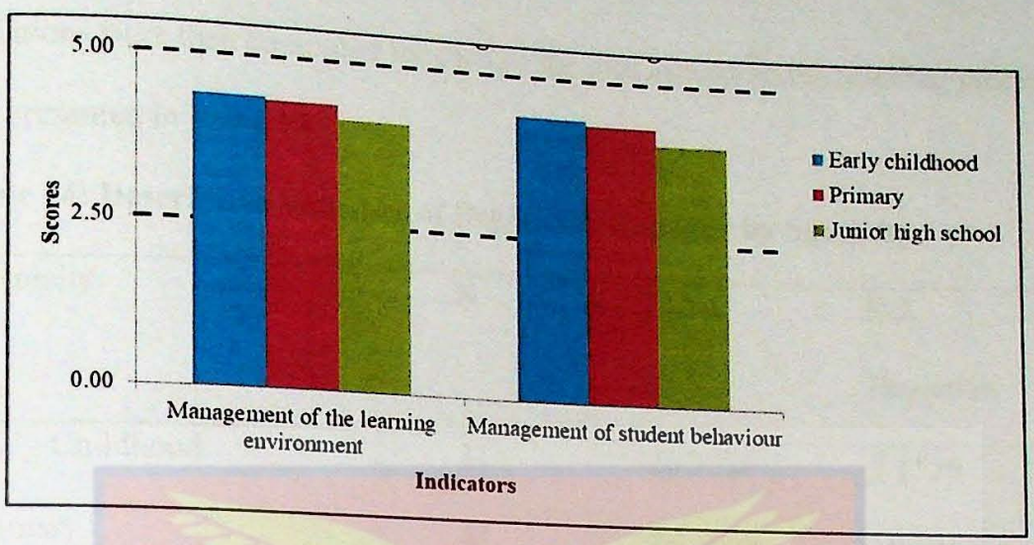


Figure 8: Classroom management and organisation

It could be observed that, irrespective of the specialties, the beginning teachers were in control of their classes. Almost all of them could organised and managed pupils' behaviour in their mathematics class. The fourth aspect teachers' practices, professional commitment is presented in Figure 9.

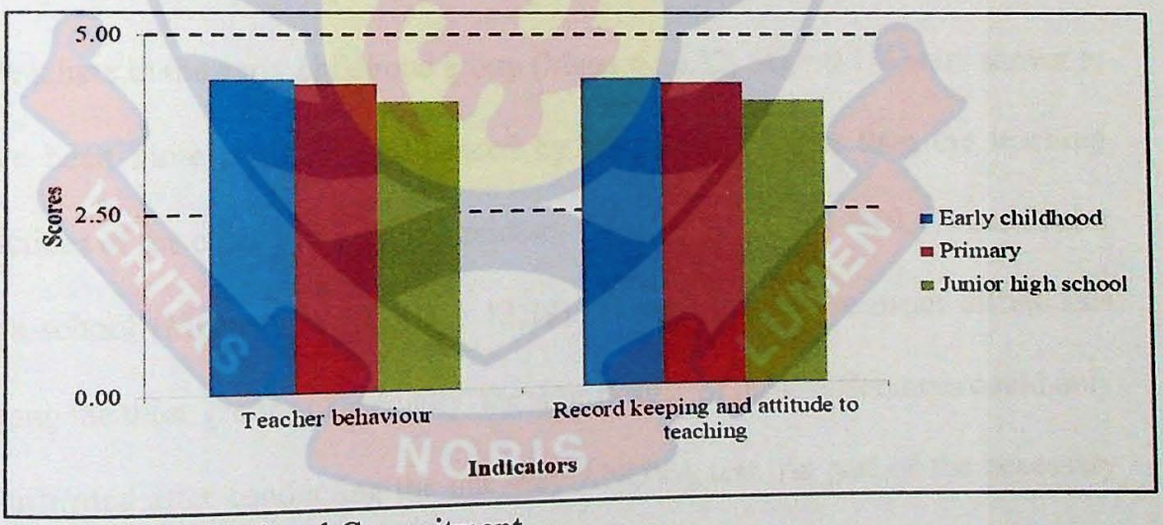


Figure 9: Professional Commitment

Junior high school teachers who participated in the study scored the least mark on teacher behaviour and attitude to teaching mathematics. Early childhood teachers recorded the highest scores on both items. Mean scores and standard

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deviations were then computed for each of the four aspects of the teaching practice and presented in Table 14.

Table 14: Descriptive Statistics of Beginning Teachers by Specialty

Specialty	N	Mean	Std. Deviation
Early Childhood	31	86.3226	9.1556
Primary	41	80.6098	10.4663
Junior High school	32	70.4375	12.2420
Total	104	79.1827	12.3279

Source: Field survey (2021)

A look at the descriptive results presented in Table 14 showed the sample data to have produced differences in the mean scores of the three specialty variables – early childhood, primary and Junior high school. Specifically, teaching practices of teachers in the early childhood group (Mean = 86.32, SD = 9.16) were shown to have been more positively influenced by the method course than the teaching practices of the other two groups – primary (Mean = 80.61, SD = 10.47) and Junior high school (Mean = 70.44, SD = 12.24). Though there were mean differences among the three groups of specialty, the significance of these differences could only be affirmed after conducting the one-way ANOVA test. As part of the necessary requirements to conduct ANOVA test, the data was checked for any possible outlier using boxplots as shown in Figure 10.

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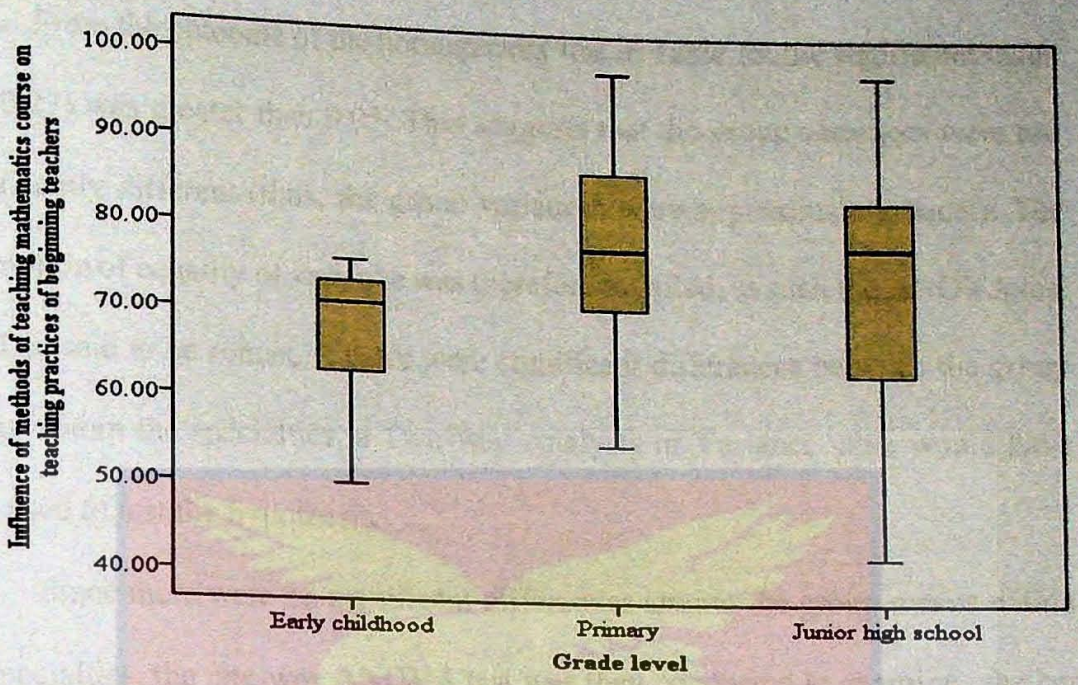


Figure 10: Boxplot for specialties (grade levels)

There were no outliers in the data, as examined by inspection of the boxplot in Figure 8. Next, the homogeneity of variance between the specialties was checked using the Levene's test for equality of variance. Generally, if the significant value in the output table of the Levene's test is less than 0.05 then an inference is made that the group variances are significantly different at 0.05 level (that is the group variances are not equal), and therefore the assumption of homogeneity of variance is violated. On the other hand, if the significance value obtained is greater than 0.05, it suggests that variances for the two groups are equal. The result of the Levene's test for homogeneity of variance is presented in Table 15.

Table 15: Test of Homogeneity of Variance in Specialty

Levene Statistic	df1	df2	Sig.
1.341	2	101	0.27

Source: Field survey (2021)

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From the outcome of the homogeneity test in Table 15, the significant value (P = 0.27) was greater than 0.05. This suggests that the group variances were not significantly different (thus, the group variances were approximately equal). The assumption of equality of variance was therefore satisfied, as such the ANOVA test could be said to be robust. If there were significant differences between the group means within the specialties, a Two-way Analysis of Variance table would have been used to test the hypothesis.

Since there were no significant differences among the group means within the specialties, the one-way ANOVA test was then conducted to examine whether the group mean scores (see Table 15) of the specialties were significantly different or not. Table 16 presents the results of the ANOVA test.

Table 16: ANOVA Table for Mean Difference in Specialty

	Sum of square	df	Mean square	F	Sig.
Between Groups	4.12	2	1.77	17.987	0.001
Within Groups	39.23	101	0.41		
Total	43.35	103			

Source: Field survey (2021)

It could be observed from Table 16 that the significant value (P < 0.01) is less than 0.05 significance level indicating that there is a significant difference in the mean scores across the specialties. This led to the conclusion that there is a significant difference in the means scores for at least one pair of specialties. However, the ANOVA test does not reveal exactly where the differences among

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the groups occur. Tukey's HSD Test was then employed to investigate which pairs of specialties have significant difference between group means at the 0.05 level of significance. The Tukey's HSD was appropriate because it presents results of multiple comparisons among all the different pairings, in this case, of the three specialties. Table 17 presents the result of the multiple comparisons.

Table 17: Tukey's HSD Multiple Comparison of Differences in Specialties

(I) Specialism	(J) Specialism	Mean Difference (I-J)	Sig.
Early Childhood	Primary Education	5.71282	0.069
	Junior High school	15.88508*	0.000
Primary Education	Early Childhood	-5.71282	0.069
	Junior High school	10.17226*	0.000
Junior High School	Early Childhood	-15.88508*	0.000
	Primary Education	-10.17226*	0.000

*The mean difference is significant at the 0.05 level.

From Table 17, it could be seen that the result of the Tukey post hoc test conducted showed a statistically significant difference between early childhood teachers and Junior high school teachers ($P < 0.01$), with respect to the influence of methods of teaching mathematics course on their teaching practices. The post hoc test indicates that the mean scores of early childhood ($M = 86.33$, $DS = 9.16$ was significantly higher than the mean score of Junior high school ($M = 70.44$, $SD = 12.24$). Also, a statistically significant difference was found between Junior high school teachers and primary education teachers ($P < 0.01$). This also indicates that the mean score for primary education teachers ($M= 80.61$, $SD = 10.47$) was higher than the mean score for Junior high school teachers ($M = 70.44$, $SD = 12.24$).

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Nevertheless, there was no statistically significant difference between early childhood education teachers and primary education teachers ($P > 0.05$), concerning the effect of methods course on their teaching practices.

Results, thus far, have revealed that specialty had significant effect on the influence of method course on teaching practices of beginning teachers. This suggested a rejection of the null hypothesis, "*There is no significant effect of specialties (early childhood, primary and Junior high school) on the influence of method course on teaching practices of beginning teachers.*" This result was further subjected to a post hot test to affirm the between-subjects effects. Table 18 showed the variance in the influence of method course on teaching practices accounted for by specialties of beginning mathematics teachers.

Table 18: Specialty on Influence of Method Course on Teaching Practices

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	3987.658[a]	1	3987.658	34.866	.000	.255
Intercept	294856.129	1	294856.129	2578.061	.000	.962
Specialty	3987.658	1	3987.658	34.866	.000	.255
Error	11665.871	102	114.371			
Total	667723.000	104				
Corrected Total	15653.529	103				

a. R Squared = .255 (Adjusted R Squared = .247)

Dependent variable: Influence of method course on teaching practices

Source: Field survey (2021)

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The results in Table 18 showed a significant statistics – $F(1, 102) = 34.87$, $P < 0.01$. The R-squared value of 0.255 indicates a moderate effect (Cohen, 1992) of specialty on influence of methods course on teaching practices. The partial eta squared and the R-Squared values revealed that specialty accounted for 25.5% of all the changes in the influence of methods of teaching course on beginning teachers' teaching practices. The implication is that method of teaching mathematics course was critical in shaping the beginning teachers teaching practices although it was not the only determining factor. The remaining 74.5% variation in the influence of method course on teaching practices of beginning teachers could be explained by other variables not considered in this study. From these results, the researcher rejected the null hypothesis and concluded that there was a statistically significant effect of specialty on the influence of method course on teaching practices of beginning teachers.

Discussion related to hypothesis one

The result supported the first hypothesis – that methods of teaching mathematics influenced the teaching practices of beginning teachers across specialties. As already explained in the background, the training of teachers under the DBE programme was based on specialties: early childhood, primary and junior high education. Irrespective of the specialty, the same instrument was used to assess the beginning teachers teaching practices. The beginning teachers were expected to exhibit same degree of competencies in the classroom. However, from the result, the mean teaching practice scores were different across the specialties with early childhood teachers scoring the highest followed by the primary education teachers,

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and the least was Junior high education teachers. The statistical result showed that at least a pair of specialty difference existed and it was significant.

The result suggested that, in terms of teaching practice, the performance of the beginning teachers in the classroom varied by specialties. Specifically, there was difference in performance between early childhood teachers and JHS education teachers. Further, there existed differences between the teaching practices of Primary education and JHS education teachers. However, there was no difference between the performance of early childhood and Primary education teachers. The expectation was that irrespective of the specialty, any beginning teacher who has successfully completed the DBE programme should be able to teach mathematics efficiently at the Basic School level since they were handling pupils at the same grade-bound that they have been trained to teach.

One inference that could be drawn from these differences is that, early childhood and primary education teachers were given general training whereas the JHS education teachers received specific training in their chosen programmes at the college. As such, the early childhood and Primary education teachers should be performing at the same level, in terms of their teaching practices, as against the JHS education teachers at a different level as confirmed by the result. This result was evident during the classroom observations as most of the beginning teachers came to class well prepared for their mathematics lessons and used appropriate teaching and learning materials that were consistently linked to the grade-bound they have been trained to teach. They also employed variety of teaching techniques to engage almost every pupil in their classrooms. Quite a number of the beginning teachers

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also demonstrated appreciable subject knowledge and could give relevant examples at the grade-bound they taught.

Effect of Specialty on the Attitude of Beginning Teachers Towards Teaching

This hypothesis tests whether specialty has significant effect on the attitude of beginning teachers towards teaching mathematics. Again, this hypothesis essentially compares the attitude of beginning teachers across three specialties – early childhood, primary education and junior high school. To test this hypothesis, the one-way analysis of variance (ANOVA) was employed. The results are displayed in Tables 19, 20, 21, 22 and 23.

Table 19: Descriptive Statistics of Beginning Teachers Attitude for Teaching

Specialty	N	Mean	Std. Deviation
Early Childhood	31	3.4119	1.14964
Primary Education	41	3.8253	0.79107
Junior High School	32	3.7511	0.87895
Total	104	3.6793	0.94451

Source: Field survey (2021)

A look at the descriptive results presented in Table 19 showed the sample data to have produced differences in the mean scores of the three specialty groups – early childhood, primary education and junior high school. On the average, primary education teachers' attitudes towards teaching of mathematics (Mean = 3.83, SD = 0.79) were shown to have been more positively influenced by the preparation programme than the attitudes of early childhood teachers (Mean = 3.41, SD = 1.15) and junior high school teachers (Mean = 3.75, SD = 0.88). However, as to whether these differences are significant between the groups, this has not yet been established as further analyses are required to establish this.

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Therefore, the test of homogeneity of variance, analysis of variance, Tukey's multiple comparisons, and effect sizes are computed. The test of homogeneity of variance, which produces Levene's statistics, is to check for the assumption of homogeneity of variance among the three specialties, as this assumption needs to be met to ensure that the statistical model being used to test the hypothesis is robust enough. The result on the test of homogeneity of variance is thus shown in Table 20.

Table 20: Test of Homogeneity of Variance in Attitude

Levene's statistic	df1	df2	Sig.
1.793	14	89	.052

Source: Field survey (2021)

From the test of homogeneity of variance table, Table 20, it could be observed that the p-value (P = 0.052) is greater than the alpha value of 0.05; indicating that the group variances were not significantly different. This means that the assumption of homogeneity of variance among the specialties has been satisfied; as such, the one-way analysis of variance test will be robust. Table 21, therefore, presents the result of the one-way analysis of variance of specialty.

Table 21: ANOVA of Specialty

	Sum of squares	Df	Mean square	F	Sig.
Between groups	3.273	2	1.636	4.557	.013
Within groups	36.271	101	0.359		
Total	39.544	103			

N = 104

Source: Field survey (2021)

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From Table 21, the p-value produced was (P = 0.013), which is less than alpha value of 0.05. This means that there is a statistically significant difference in the attitude of beginning teachers, between at least one pair of specialties. However, since the analysis of variance alone could not show between which pair of groups the differences existed, a multiple comparison test was performed using Tukey post hoc and the result are displayed in Table 22.

Table 22: Tukey's HSD Multiple Comparison of Specialty Means

(I) Specialty	(J) Specialty	Mean difference (I-J)	Sig.
Early childhood	Primary	-.40684*	.014
	Junior high school	-.35754	.051
Primary	Early childhood	0.40684*	.014
	Junior high school	0.04930	.935
Junior high school	Early childhood	0.35754	.051
	Primary	-0.04930	0.935

Dependent variable: Attitude towards teaching

Source: Field survey (2021) **The mean difference is significant at 0.05 level*

The results from the Tukey post hoc multiple comparison test in Table 22 showed a statistically significant difference between early childhood teachers and primary school teachers (P = 0.014), with respect to attitudes towards teaching mathematics. There was no statistical difference between the attitude of early childhood teachers and junior high school teacher (P = 0.051), though between their mean scores, a slight difference was reported (Mean difference = 0.35754). Also, a

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marginal mean difference (Mean difference = 0.049) was reported between junior high school education teachers and primary education teachers, with respect to attitude towards teaching mathematics at the Basic School; nevertheless, this difference was not statistically significant (P = 0.935).

Ultimately, the results have shown that specialty had significant effect on beginning teachers' attitudes towards teaching mathematics at the Basic School. The researcher therefore rejected the null hypothesis that "*There is no significant effect of specialty (early childhood, primary and Junior high school) on the attitudes of beginning teachers towards teaching*", and concluded that there is a statistically significant effect of specialty on beginning teachers' attitudes towards teaching mathematics at the Basic School. However, to determine the size of the effect of specialty on the teachers' attitudes towards teaching, a further analysis was conducted, and the results displayed in Table 23.

Table 23: Specialty on Beginning Teachers' Attitudes towards Teaching

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	3.273	2	1.636	4.557	0.013	0.083
Intercept	1406.590	1	1406.590	3916.806	0.000	0.975
Specialty	3.273	2	1.636	4.557	0.013	0.083
Error	36.271	101	0.359			
Total	1480.295	104				
Corrected Total	39.544	103				

R Squared = 0.083 (Adjusted R Squared = 0.065)

Dependent variable: Beginning teachers' attitudes towards teaching

Source: Field survey (2021)

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The results from Table 23 show that there is a statistically significant effect of specialty on beginning teachers' attitudes towards teaching ($F(2, 103) = 4.557$, $P < 0.05$), and this confirms the results in the Table 24 that there exists differences among specialties of beginning teachers with regard to attitude towards teaching of mathematics at the Basic School. Though not all the differences identified were statistically significant, it is in the right direction to determine the effect size of the influence specialty has on the attitude of beginning teachers towards teaching of mathematics. This will help understand whether specialty is the only determinant of the differences in attitudes of beginning teachers towards teaching of mathematics or not.

Thus, to quantify the differences in beginning teachers' attitudes towards teaching of mathematics by specialty, the eta square values (effect size) were computed. Based on Cohen (1977), the interpretation of this index refers to the magnitude of the mean difference between variables; an effect size of $d = 0.2$ is considered small, $d = 0.5$ medium and $d = 0.8$ to 1 as large effect size. For beginning teachers' attitudes towards the teaching of mathematics, an effect size of ($\eta^2 = 0.083$) is obtained, as shown in Table 25. This indicates that the effect size of beginning teachers' attitudes towards teaching of mathematics by specialty is small. This result indicates that specialty alone cannot explain the observed differences.

Discussion related to hypothesis two

The results revealed that the attitude of the beginning teachers towards the teaching of mathematics differs across the three grade-bounds (specialties). The attitude of the primary education teachers towards teaching appeared to be more

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positive than the attitude of early childhood education teachers and junior high school education teachers, as shown in Table 23. Also, the attitude of the junior high school education teachers toward teaching of mathematics was found to be more positive than that of the early childhood education teachers. However, these differences were not significant, except for the difference between primary education teachers and early childhood education teachers, with respect to attitude towards teaching mathematics.

The differences found between attitudes of teachers across the specialties were not unexpected as prior studies argued that teachers' specialty is a possible factor that influences attitudes of teachers towards teaching of mathematics (Ernest, 1988; Okyere, 2013). A number of factors could explain these variations in attitude of beginning teachers toward the teaching of mathematics. First, the difference between the attitude of early childhood education teachers and primary education teachers could be because early childhood education teachers seem to exercise more patience compared to the primary education teachers, as early childhood education teachers are to attend to younger children compared to primary education teachers who attend to relatively older children. Considering this, on the average, it is possible that early childhood teachers would demonstrate a more relaxed attitude than primary education teachers. The primary teachers, on the other hand, would have to do a lot of work when it comes to assessment of their pupils, and thus, might be encouraged to engage in more classroom activities.

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Also, with regards to primary education and junior high school education teachers, there was no significant difference in their attitudes towards teaching mathematics due to the fact that both might be considering their pupils as older, compared to early childhood pupils; therefore, their approach to teaching was expected to be similar. However, with regards to the insignificant difference between the attitude of early childhood and junior high school teachers towards teaching mathematics, it could be explained that the junior high school education teachers are relaxed in the classroom as they consider their pupils to be mature enough to take responsibilities of their own actions. Similarly, the early childhood teachers are also relaxed because they do not need to do much of assessments of their pupils, as these teachers may not see it relevant to ask their pupils to, for instance, explain solutions to problems or provide feedback to them.

This finding correlates with the findings of earlier studies that considered grade-bounds and attitudes of teachers towards teaching. For instance, Ernest's (1988) study examined the attitudes and practices of student teachers of primary school mathematics, and found that student teachers have positive attitude towards mathematics and its teaching but have varied approaches and attitudes to the teaching of mathematics, based on the grade level they belong to. This is to say that, though all beginning teachers could demonstrate positive attitudes towards teaching mathematics, these attitudes, to a considerable extent, are influenced by the teacher's specialty.

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Also, Okyere (2013), after reporting that attitudes towards teaching mathematics is influenced by the level the teacher teaches, posits that, generally, the positive attitudes of teachers boost the confidence of their students; thereby, making them develop positive attitude towards the learning of mathematics. Okyere's finding suggests that grade levels taught by teachers should be paid attention to in order to achieve leverage across all specialties, as far as attitude towards teaching is concerned.

In summary, it could be said that specialty significantly influences attitudes of beginning teachers towards mathematics teaching in Basic Schools. Beginning teachers of primary education specialty showed more positive attitudes towards teaching of mathematics, followed by beginning teachers of junior high school education specialty and then beginning teachers of early childhood education specialty. However, only the difference between early childhood and primary education teachers, as far as attitude towards teaching mathematics is concerned, was found to be significant; thus, deserves some level of attention.

Difference Between Teaching Practices of Beginning and In-service Teachers

This hypothesis sought to assess whether there is difference in teaching practices of beginning teachers and in-service teachers. To test this hypothesis, the researcher carried out a two-independent samples t-test. This test produced the group statistics, and the independent samples test (the hypothesis test). These are presented in Table 24 and Table 25, respectively.

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Table 24: Group Statistics of Beginning and In-service Teachers

Variable	Teacher type	Mean	SD
Teaching practices	Beginning teachers	72.5481	12.36785
	In-service teachers	72.8188	10.03230

Source: Field survey (2021) $n_{bt} = 104$ $n_{it} = 80$

The group statistics, as shown in Table 24, is a part of the main analysis leading to the hypothesis test analysis. This result summarises, statistically, the overall descriptive results on teaching practices and teacher type (beginning teachers and in-service teachers). The results presented in the Table 24 were the basic information about the group comparisons; these included the sample size (n), mean (M), standard deviation (SD), and the standard error teaching practices as far as teacher type was concerned. Below the table are the number of beginning teachers ($n_{bt} = 104$) and the number of in-service teachers ($n_{it} = 80$) who made up the total sample ($N = 184$) for this analysis.

The mean score for the beginning teachers was ($M = 72.55$, SD = 12.37) and that for in-service teachers was ($M = 72.82$, SD = 10.03). From these results, it could be inferred that there was a slight difference between beginning teachers and in-service teachers, with respect to teaching practices or influence of the preparation programme on teaching practices. Nonetheless, the significance of this difference could only be confirmed by the results on the hypothesis test presented in Table 25 – independent samples test.

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Table 25: Independent Samples Test

		Levene's Test for Equality of Variances		T-test for Equality of Means						
		F	Sig.	T	Df	Sig. (2-tailed)	Mean Diff.	Std. E. Diff.	95% CI of the Diff. Lower	95% CI of the Diff. Upper
Teaching practices	Equal variances assumed	1.306	.255	-.159	182	.873	-.27067	1.69724	-3.61948	3.07813
	Equal variances not assumed			-.164	181.463	.873	-.27067	1.65194	-3.53015	2.98880

Source: Field survey (2021) $n_{bt} = 104$ $n_{it} = 80$

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Table 25 showed the results most relevant to the Independent Samples T-Test. From the table, two main parts with different pieces of information could be seen. The first part is the Levene's Test for Equality of Variances, and the second part, t-test for Equality of Means. The Levene's Test for Equality of Variances contains the test results for the Levene's Test. From the results, the Levene's Test for Equality of Variances showed a probability vale of (P = 0.255); this implies that the variability in beginning teachers and in-service teachers, with respect to teaching practices is not significantly different, as the p-value (P = 0.255) is greater than the alpha value (α = 0.05). Hence, failure to reject the hypothesis that, "*There is no significant difference between teaching practices of beginning teachers and in-service teachers at the Basic School.*"

Also, looking at the 2-tailed significant value in the first row, the result produced was $P > 0.05$. Again, this result affirmed that there was no statistically significant difference between the mean score of beginning teachers and in-service teachers, with respect to teaching practices. From these results, it could be stated that the difference between the mean scores of beginning teachers and in-service teachers were likely due to chance and not due to manipulation of the independent samples. This was also confirmed by the results in Table 5 – which, though, showed a slightly higher score in the beginning teacher group ($M = 72.55$, $SD = 12.37$) compared to the in-service teacher group ($M = 72.82$, $SD = 10.03$), a mean difference of -.27 (95% CI, -3.62 to 3.08), t(182) = -.159, $P = .873$. It could also be seen that the 95% confidence interval included a zero (0) – a range from -3.62 to

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3.08; still implying insignificant difference between the teaching practices of beginning teachers and teaching practices of in-service teachers.

Discussion related to hypothesis three

What motivated the comparison between in-service and beginning teachers was the assertion that teachers apply the knowledge and skills they acquired from preparation over time and not necessarily in the first year of their teaching career (Jordan et al., 2018). This literature suggests that in-service teachers who have taught for more years could perform better than their counterpart beginning teachers who are in their early years of teaching mathematics. This means with their experiences and exposure, one would have expected that the in-service teachers would do better. Though the result from this study showed that the in-service teachers slightly outperformed the beginning teachers, in terms of teaching practices, the difference was not significant.

A number of reasons might have accounted for the insignificant difference between the teaching practices of beginning and in-service teachers. One, it could be that the in-service teachers had not received enough support in terms of professional learning; thereby, putting them at the same level as the beginning teachers in terms of teaching practices. This was evident from the very few or no workshops attended by the in-service teacher participants, as recorded in a follow-up interview. Two, the professional learning that the in-service teachers have received might be related to characteristics of the teachers other than their teaching practices.

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Drawing from all the results presented for this hypothesis thus far, it could be seen that with regards to influence of the DBE programme on teaching practices, in-service teachers demonstrated to have been fairly highly influenced than their beginning teacher counterparts, as this was evident in their average score presented in Table 24. Nevertheless, this difference was only due to chance as the subsequent test conducted revealed that this difference was not significant (see Table 25). This is to say that both in-service and beginning teachers who had undergone the DBE programme are not different when it comes to the influence the preparation programme on their teaching practices, in terms of lesson plan preparation, teaching methodology and delivery, classroom organisation and management, and professional commitment. In other words, being an in-service teacher or beginning teacher has no significant effect on the influence of the preparation programme on their teaching practices.

This finding is surprising as both beginning and in-service teachers involved in the study were taught using different curriculum materials due to the consistent curriculum reviews. Interestingly, in terms of teaching practices, both groups of teachers were observed using similar teaching approaches which suggested that they had similar competences. The teachers follow the same lesson note preparation, professionalism, classroom organisation and management, as well as delivery of lessons. It could be said that both the beginning and in-service teachers' have studied and mastered similar techniques needed to teach mathematics at the Basic School level.

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Interestingly, this finding shows consistency with the Valsiner's zone theory (Valsiner, 1987) which posits that teachers are expected to demonstrate practices that are consistent with their beliefs and goals as well as the experiences they received within the ZPD during their training programme, and Goos (2008) also supported this position. Inferring from this, both beginning teachers and in-service teachers are not expected to be different in terms of their teaching practices, as far as the influence of preparation programme on teaching practices is concerned. It could also be said that attitudes formed by both the beginning and in-service teachers from their training programmes were positive towards teaching mathematics; thus, closing the gap between the two groups, in terms of influence the preparation programme had on their teaching practices.

Similarly, the finding showed consistency with the assertions of Jordan et al. (2018) who were of the view that teachers – irrespective of being beginning or in-service – apply the knowledge and skills acquired from their preparation programme over time and not necessarily in the first year of their teaching carrier. This implies that teachers in their beginning years of their teaching career, to large extent, apply similar skills and techniques in their teaching practices as teachers who have been in the teaching career for long. Thus, in a way, no significant difference is expected between beginning teachers and in-service teachers, as far as their teaching practices are concerned.

Juxtaposing Jordan et al.'s (2018) assertion to the current finding, it could easily be inferred that slight differences are expected when comparing these groups – beginning teachers and in-service teachers – only that these differences are mostly

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not significant or anything that needs further investigation to unravel what the causes of the differences are. Apparently, one group may show a higher performance in a particular thematic area of teaching practices; thus, resulting in the slight difference that is possible to be noticed between the practices of beginning and in-service teachers, as far as the influence of methods of teaching mathematics course or preparation programme is concerned.

On the contrary, this finding did not show corroboration with the findings of some prior studies. For instance, Akyeampong et al. (2013) found a significant difference between mathematics teachers in their initial years of teaching career and those in their advanced years of teaching mathematics. However, they pointed out that the difference was occasioned by the teachers' performances in the various aspects of teaching practices as some did well in some aspects – such as classroom management and organisation – of teaching practices than others. Their findings, according to this researcher, might have been influenced by the setting of their study, as it was a cross-country study unlike this study which focused on part of Ghana.

Further, this finding shows inconsistency with the findings of van Heerden and Ruedin (2019) who found initial teacher preparation programme to have mixed influence on the teaching practices of beginning teachers and in-service teachers; thereby, culminating in a significant difference between the teaching practices of beginning teachers and the teaching practices of in-service teachers. van Heerden and Ruedin reported that as beginning teachers outperformed their counterpart in-service teachers in some aspects of teaching practices, the in-service teachers also

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outperformed the beginning teachers in some aspects of teaching practices. Ultimately, van Heerden and Ruedin's results showed a significant difference between the two groups of teachers.

Though van Heerden and Ruedin (2019) finding is not surprising, some of the factors stated to have contributed immensely to the difference in teaching and classroom practices of the two groups, – beginning and in-service teachers – as far as the influence of preparation programme is concerned, were rather surprising. Some of the contributory factors found were ability to adapt to school environment, experiences during the initial preparation such as the healthy relationships with college lecturers and mentors as well as the knowledge and skills they had acquired.

Obviously, some factors are expected to influence the effect that preparation programme has on the teaching practices of beginning teachers and in-service teachers, resulting in a difference between the two groups. However, issues such as healthy relationships with college tutors, as reported by van Heerden and Ruedin (2019), have not been expected to be a contributory factor since student teachers are expected to study and follow what they have been taught rather than concentrate on any personal-level relationships with their tutors. Perhaps van Heerden and Ruedin' (2019) study defined a different scope, thereby, resulting in the production of result inconsistent with the current finding.

All said and done, it should be mentioned that there have been diverse findings as far as significance of the difference between beginning teachers and in-service teachers, with respect to the influence the preparation programme has on their teaching practices, is concerned. As some of the prior studies found significant

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difference, others found insignificant difference between beginning teachers and in-service teachers, with regards to teaching practices. The current study showed that, statistically, there is no significant difference between beginning and in-service teachers, from the Colleges of Education Ghana as far as teaching mathematics at the Basic Schools is concerned. Hence, the researcher failed to reject the null hypothesis, and concluded that there is no statistically significant difference between beginning and in-service teachers, concerning the influence of preparation programme on their teaching practices.

Chapter Summary

The results from the analyses showed that the Diploma in Basic Education programme had positive influence on beginning teachers teaching practices in mathematics. There was no significant difference between the teaching practices of beginning and in-service teachers. The result also revealed that the beginning teachers perceive their training programme to be useful in shaping their teaching practices. In terms of attitude of the beginning teachers towards teaching mathematics, the result showed that method of teaching mathematics course had significant influence on their teaching practices. Further, there was significant effect of methods of teaching mathematics course on the teachers' teaching practices across specialties (early childhood, primary and junior high school). Finally, the attitude of the teachers towards teaching mathematics was also found to differ across the three specialties.

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CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Overview

This chapter summarises the study and presents the conclusions drawn from the analyses. The discussions have been presented with respect to each research question and hypothesis. The key findings of the study are also presented in this chapter. The chapter ends with recommendations and suggestions for further studies.

Summary

The purpose of this study was to examine the influence of the Diploma in Basic Education (DBE) programme on beginning teachers' teaching efficiency in mathematics. Teacher training programme is seen as an important avenue for improving the content knowledge and teaching skills of teachers. Ghana, over the years, has invested in quality teacher training to ensure that teachers who graduated from the Colleges of Education have at least the minimum competencies necessary to enter the teaching profession. Despite these investments, the underachievement of pupils in mathematics at the Basic Schools still lingers. It is unclear whether teachers make use of the knowledge and skills they acquired from training. This study therefore examined the influence of the DBE programme on beginning teachers' teaching efficiency in mathematics.

The specific research questions for the study were 1) What is the influence of Diploma in Basic Education programme on beginning Basic School teachers' teaching practices? 2) What are DBE trained teachers' perceptions about the

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influence of the methods of teaching mathematics course taken at the college on their teaching practices? 3) What is the influence of method of teaching course on beginning teachers' attitudes towards teaching? The study also tested whether there exist differences in teaching practices and attitude of beginning teachers across three specialties: early childhood, primary and junior high education. It also examined the relationship between the teaching practices of beginning and in-service teachers in mathematics. These research questions were analysed within the framework of Valsiner's Zone Theory – Zone of Proximal Development (ZPD), Zone of Free Movement (ZFM) and Zone of promoted Action (ZPA).

The study focused on all beginning and in-service Basic School mathematics teachers in three districts of the Central region of Ghana. All the teachers involved were products of the Diploma in Basic Education programme. Teachers in their first two years of teaching mathematics were classified as beginning teachers, otherwise they were considered as in-service teachers. In all, a sample of 104 beginning and 80 in-service teachers participated in the study.

An explanatory sequential mixed method design was employed in the study in which an observational instrument and questionnaire were used to collect the quantitative data followed by a semi-structured interview for the qualitative data. The quantitative data was analysed using frequency, percentage, mean, standard deviation, one-way Analysis of Variance (ANOVA) and independent sample t-test. The qualitative data was analysed using themes and narratives. The next section discusses the key findings from the analysis.

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Key Findings

First, the results from the analyses revealed that the Diploma in Basic Education programme had influence on beginning teachers' teaching practices in terms of lesson preparation, teaching methodology and delivery, classroom organisation and management as well as their professional obligations. The teachers demonstrated very high degree of competencies in teaching mathematics, which were attributed to the Diploma in Basic Education programme. They applied the knowledge and skills learned at school to teach mathematics with ease. The results from the qualitative data further supported the positive influence of the programme on the beginning teachers' teaching practices, as the participants explained that they could teach mathematics confidently because the training programme had equipped them with the necessary knowledge and skills to do so. Nevertheless, few of the beginning teachers' teaching practices were rated poor in terms of management of students' behaviours, presentation of teaching and learning activities, stating lesson objectives as well as teacher behaviour and attitude to teaching. The teachers attributed the poor performance to language barrier, inadequate preparation on classroom management and organisation skills, and the fact that it is obligatory to teach mathematics at the primary school, unlike JHS level where the beginning teachers were trained specially to teach mathematics. This implies that if the preparation on classroom management is given more attention at the College and Ghana Education Service (GES) addresses the language issues before posting, it is likely all the beginning teachers would teach mathematics efficiently.

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Second, with regard to the perception about the influence of the method of teaching course on teaching practices, the analysis revealed that the beginning Basic School mathematics teachers had positive perception about the influence of the method course on their teaching practices in mathematics. The beginning teachers recounted that their method of teaching mathematics course had shaped their teaching practices. They perceived the methods course to be very useful to them especially in terms of how to present mathematics lessons to actively engage pupils. Also, the teachers who were interviewed explained that the strategies and methods they employed in the classroom to teach were learnt from the method of teaching mathematics course. Taking this finding into account, the method of teaching mathematics course could be said to be very relevant to teaching efficiency; thus, improved method course should result in improved teaching efficiency.

Third, on the influence of methods of teaching mathematics course on the attitude of beginning teachers, the result revealed that the method of teaching mathematics course had positive influence on their attitude towards teaching mathematics. Specifically, the methods of teaching mathematics course positively influenced the teachers' feelings and beliefs towards the teaching of mathematics. The teachers' responses to the questionnaire were not different from what was observed being practiced by the teachers in the classrooms. Interestingly, those who had positive attitude towards teaching mathematics performed very well in the teaching practice. However, some participants felt the duration for the method course was too short, as they claimed they could not acquire all the needed skills

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within the given period. This suggests that increasing the duration of the methods course could improve the teachers' teaching efficiency in mathematics.

Fourth, concerning the effect of specialties on teaching practices, the results revealed that specialty had significant effect on the influence of method course on teaching practices of beginning teachers. In terms of teaching practices, the performance of the beginning teachers differs significantly across the three specialties. Surprisingly, the performance of primary education teachers was the highest, followed by the early childhood teachers, and then the JHS teachers. Although the result was significant, the effect size indicated that specialties were not the only factors influencing the teaching practices of beginning teachers. This means that apart from specialty, issues such as language barrier (inability to speak the dominant local language in the immediate school community) and the fact that at the primary school level, teachers are expected to teach all subjects including mathematics could possibly influence teaching efficiency especially for those teachers lacking the linguistic background and competencies in teaching mathematics.

Fifth, concerning specialties and attitude of teachers towards teaching, the results showed that specialty had significant effect on beginning teachers' attitudes towards teaching mathematics. In other words, the attitude of the beginning teachers differs across specialties. The attitude of early childhood teachers was different from the attitude of the primary teachers, and primary teachers different from junior high teachers; thus, primary teachers should be given more attention in attitude training. However, there was no difference in attitude between early

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childhood teachers and junior high school teachers. Although, generally, there was significant difference in attitude across specialties, the effect size was small indicating that specialty alone could not explain the observed differences.

Finally, with respect to the teaching practices of beginning and in-service teachers, the result revealed that the variability in beginning teachers and in-service teachers with respect to teaching practices was not significantly different. In other words, there was no significant difference between the teaching practices of beginning and in-service Basic School mathematics teachers, implying that both beginning and in-service teachers who participated in the study performed equally in terms of teaching practices in mathematics. It appears that the in-service teachers who participated in the study received either little or no professional learning on the field; thus, putting the beginning teachers at par with them. Hence, if in-service teachers are given professional learning opportunities, they may exhibit better performance in their teaching practices, compared to the beginning teachers.

Conclusions

Though majority of the beginning teachers' teaching practices were positively influenced by the training programme, few of them performed poorly due to issues of inadequate knowledge on classroom management skills, language barrier, and the fact that it was obligatory to teach mathematics at the primary level. Therefore, if the preparation on classroom management is given more attention at the College, it is likely all the beginning teachers would perform very well. Moreover, it can be said that for an individual to be efficient in teaching

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mathematics, training and preparation on methods of teaching mathematics course cannot be overemphasised.

Further, though methods of teaching mathematics course was useful to teachers' teaching practices as well as attitudes towards teaching mathematics, some of the teachers felt that the duration of the programme was not enough for them to grasp all the necessary skills for teaching. Possibly, the one semester course duration was not enough for college tutors to extensively cover the contents of the course to make the beginning teachers appreciate the course. Secondly, college tutors may possibly resort to selective (considering topics that they think are important) tutoring due to the short duration of the course. It could also mean that, the beginning teacher did not have enough time to internalise the content of the method course. Considering this, extending the duration of the methods course could improve teachers' teaching efficiency in mathematics.

Additionally, it became evident that specialty of the teachers influences their teaching practices as well as their attitude towards teaching mathematics. Therefore, it was concluded that specialty has a significant influence on beginning teachers' teaching practices and their attitudes towards teaching mathematics; hence, the rejection of the hypotheses that *"There is no significant effect of specialty (early childhood, primary and Junior high school) on the influence of method course on teaching practices of beginning teachers"* and *"There is no significant effect of specialty (early childhood, primary and junior high school) on the attitude of beginning teachers towards teaching"*. Consequently, if the individual teachers' interests in and passions for the teaching mathematics are

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considered before enrolling them into a given specialty, they may have a better perception about the influence of methods course on their teaching practices and attitudes.

Furthermore, with regards to the teaching practices of beginning teachers and in-service teachers, one would have expected some level of difference between these two groups in favour of the in-service teachers due to the fact that they had been in the service for quite some time, compared to their beginning teacher counterparts. Surprisingly, both groups demonstrated similar levels of knowledge in all spheres of teaching practices – lesson plan preparation, methodology and delivery, classroom management and organisation, and professional commitment. Therefore, the researcher concluded that there is no significant difference between the teaching practices of beginning teachers and in-service teachers at the Basic School; hence, failure to reject the hypothesis that "*There is no significant difference between teaching practices of beginning teachers and in-service teachers at the Basic School*". This suggests that the DBE programme had high influence on the teachers' teaching practices and attitude towards teaching mathematics. In other words, both groups of Basic School teachers who participated in this study could teach mathematics with efficiency.

Recommendations

1. College tutors should expose teacher trainees to specific classroom management skills since it was revealed that some of the beginning teachers attributed their poor performance to inadequate preparation on classroom management and organisation.

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2. Some of the beginning teachers who performed poorly attributed their performance to their inability to speak and understand the local language of the community they were posted to. Therefore, Ghana Education Service (GES) should assess the language background of trained teachers before posting them to ensure that issues of language barriers are averted.
3. Some of the teachers found it difficult to manage pupils' behaviour in the classroom. Thus, the mentoring Universities should encourage teacher-training institutions to prepare prospective teachers on how to teach in a multicultural classroom to curtail language and behavioural issues.
4. Ghana Education Service should consider introducing subject teaching at the primary level so that only those who have the interest and capabilities are trained to teach mathematics at the primary level.
5. Some of the beginning teachers complained that the duration for the methods of teaching mathematics course was too short for them to appreciate the contents of the course. Therefore, the Ghana Tertiary Education Commission (GTEC) should consider extending the duration of the method of teaching mathematics course from one semester to at least two semesters to give room to preservice teachers to internalise the content of the methods course.
6. Head teachers at the Basic Schools should encourage their teachers to learn more on the job, by engaging in professional learning programmes, since the result showed no difference between beginning and in-service mathematics teachers.

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7. College tutors who teach primary education teachers should regularly engage them in activities that enhance attitude towards teaching of mathematics.

Suggestions for Further Studies

From the gaps identified in the literature review and the limitations of this study, several potential research opportunities arise which could be explored for further insight on the influence of preservice teacher training programme on beginning teachers teaching efficiency in mathematics. First, the observation of participants was carried out in one term. It is suggested that a longitudinal study that will observe teachers for at least three consecutive terms is conducted on the influence of the preservice training programme on teachers teaching practices to provide further insights and explanations on the phenomenon.

Further, literature related to the effect of specialties on teachers teaching practices and their attitude towards teaching mathematics was uncommon. It is therefore, suggested that further studies are conducted on the attitude of teachers towards the teaching of mathematics across specialties. Also, the study was conducted in one region of Ghana. Similar studies should be conducted by extending the sample frame to include beginning Basic School mathematics teachers from all the sixteen regions of Ghana. Further, studies on teachers teaching efficiency in mathematics should be replicated to include the views of college tutors. Such studies would provide additional information for refinement and improvement of beginning teachers teaching practices.

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Further, it was found that specialty accounted for 25.5% of all the changes in the influence of method of teaching mathematics course on beginning teachers teaching practices. It follows that the remaining 74.5% could be other aspects of classroom practices that might possibly be linked to teachers teaching practices in mathematics. Study should be conducted to investigate other aspects of teachers practices that may possibly be related to teaching practices in mathematics.

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APPENDICES

APPENDIX A: CLASSROOM OBSERVATION CHECKLIST

BEGINNING TEACHER'S CODE……OTHER TEACHERS' CODE……

PROGRAMME……...COLLEGE CODE……

SCHOOL OF PRACTICE CODE…… FORM /CLASS……DATE……

TIME……..TOPIC……

Item and score	5 = Very good	4 = good	3 = satisfactory	2 = unsatisfactory	0/1 = poor
Lesson Plan					
1. Objective ☐	Teacher states specific, measurable and achievable objectives which are linked to classroom activities	Teacher states specific ,measurable and achievable objectives but **not** linked to classroom activities	Teacher states specific, relevant and measurable objectives but they are **not** achievable within the duration of the lesson.	Teacher states specific objectives that are relevant but **not** measurable or achievable.	Teacher states lesson objectives that are relevant but **not** specific, measurable or achievable

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2. Summaries/core points ☐	Teacher states summaries/core points for all activities which relate to lesson objectives and clarify main skills/concepts	Teacher states summaries/core points for all activities which relate to and clarify main skills and / or concepts	Teacher states summaries/core points for all activities which are related to main skills and concepts without clarifying them.	Teacher states summaries/ core points for some activities related to some of the main skills and concepts.	Teacher states summaries/ core points for activities but they are **not** related to main skills and/ or concepts.
3. Teaching and learning activities. ☐	Teacher provides varied teacher/ learner activities that are logical, sequenced and direct student learning with	Teacher/ learner activities are **not** varied but sequenced, logical and approximate time indicated.	Teacher/ learner activities have approximate time indicated but **not** logical.	Teacher/ learner activities have approximate time indicated but are **not** sequenced or logical.	Teacher/ learner activities are **not** sequential or logical and no time indicated

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

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	that facilitates student's understanding.	facilitates student's understanding.		facilitates students' understanding	

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Teaching Methodology and Delivery					
Item and score	5 = Very good	4 = good	3 = satisfactory	2 = unsatisfactory	0/1 = poor
6. Introduction to the lesson ☐	Teacher introduces the lesson, reviews student's RPK, links it up with topic and stimulates student interest. Teacher shares lesson objectives with students	Teacher introduces the lesson, reviews students' RPK, links it up with topic and stimulates student interest; lesson objectives are not shared	Teacher introduces the lesson, reviews students' RPK, and links it up with topic.	Teacher introduces the lesson, reviews students' RPK.	Teacher merely introduces the lesson by starting the topic
7.Presentation-teaching and learning activities	Teacher organizes teaching and learning activities sequentially, logically, uses varied	Teaching and learning activities are organized, sequential and	Teaching and learning activities are organized,	Teaching and learning activities are organized, and sequential.	Teaching and learning activities are disorganized

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☐	pedagogical skill, maintains balance between teacher and student activities.	logical. Teacher uses varied pedagogical skill.	sequential and logical.		
8. Pace of lesson and audibility of voice ☐	Pace is appropriate for the entire lesson and all students can hear the teacher clearly. Teacher does not shout.	Pace is appropriate most of the time and voice is audible from the back of the class. Teacher does not shout.	Pace is appropriate some of the time and voice is audible from the back of the class throughout the lesson.	Pace is appropriate some of the time but voice is not audible from the back of the class throughout the lesson.	Pace of lesson is not appropriate. Teacher speaks too fast/too slow/too loud/too low
9. Questioning and feedback ☐	Teacher ask well-balanced mixture of factual, probing high	Teacher asks a mixture of factual probing high order	Teacher asks a mixture of factual and high order	Teacher asks mostly factual questions; he /she	Teacher asks only factual questions; he/she is not

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	order and divergent questions; distributes questions fairly, always encourages students' questions and answers.	and divergent questions fairly encourages student's questions and answers most of the time.	questions; distributes questions fairly; but does not encourage students' questions and answers.	is receptive to students' questions and answers and acknowledges students' answers.	receptive to student's questions and answers.
10. Use of chalkboard	Teacher manages board effectively; date, subject and topic are written on the board; all core points are written on the board; writing is legible; gives students time to write down core points	Teacher manages board effectively; date, subject and topic are written on the board; all core points are systematically written on the board; gives student	Teacher manages board effectively; date, subject and topic are written on the board; all core points are written on the board; writing is legible.	Teacher manages board effectively; date, subject and topic are written on the board; all core points systematically are written on the	Teachers writes haphazardly on the board or hardly writes anything on the board.

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	into their books; cleans board at the end of lesson.	time to write down core points into their books.		board; writing is legible.	
11. Use of teaching resources (TLRs) ☐	Teacher uses appropriate TLRs, links them to students; previous knowledge and lessons objective (s) at key stage /s of lesson.	Teacher uses appropriate TLRs, links them to students; previous knowledge and lessons objective (s) at key stage /s of lesson.	Teacher uses appropriate TLRs, links them to students; previous knowledge and lessons objective (s).	Teacher uses appropriate TLRs, links them to students; previous knowledge.	Teacher does not have TLRs or does not use TLTRs brought to the class.
12. Communication/ use of language ☐	Teacher uses correct expressions; correct student's language errors; encourages	Teacher uses correct grammatical expressions; correct student's language	Teacher uses correct grammatical expressions; correct	Teacher uses correct grammatical expressions; does	Teacher uses incorrect grammatical expressions and

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	students to pay attention to their use of language; uses effective verbal & non-verbal communications; avoids language mannerism.	errors; uses effective verbal & non-verbal communications; avoids language mannerism.	students language errors; occasionally	not correct student's grammatical incorrect expressions; exhibit some language mannerism.	often exhibit language mannerism
13. Student participation ☐	Teacher engages all students in the lesson; facilitates problem solving among students; encourages cooperative peer-tutoring and reflective	Teacher engages all students in the lesson; facilitates problem solving among students; encourages cooperative	Teacher engages all students in the lesson; facilitates problem solving among students monitors progress	Teacher engages some students in the lesson; does not monitor progress effectively. Feedback to the	Students' participation in the lesson is low; there is virtually no monitoring and feedback

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	learning; monitors progress and provides feedback.	learning; monitors progress and provides feedback.	and provides feedback.	students is minimal	
14. Mastery of subject matter	Techer exhibits command of subject matter; gives precise information; exudes confidence, cites lots of examples; relates the content to students' experience, fosters critical thinking.	Techer has command of subject matter; gives precise information; exudes confidence, cites lots of examples; relates the content to students' experience,	Techer has command of subject matter; gives precise information; exudes confidence, cites lots of examples.	Techer has some command of subject matter; gives relevant information; cites some examples.	Teacher exhibits inaccurate subject matter knowledge and low level of confidence
15. Assessment of student learning.	Teacher uses variety of assessment techniques to determine	Teacher uses variety of assessment techniques to	Teacher uses variety of assessment techniques to check	Teacher uses only one assessment method or tool	Teacher uses only one assessment method or tool (e.g.

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☐	understanding; assessments are linked to objectives & timely; he/she encourages self-assessment and application of learning	determine understanding; encourages students' self-assessment of understanding and application of learning.	understanding; encourages self-assessment of understanding.	(e.g. oral questioning, written exercise; one-minute test, etc.) to check understanding. Assessments are linked to objectives.	oral questioning, written exercise; one-minute test, etc.) to check understanding. Assessments are not linked to objectives.
16. Closure ☐	Teacher draws attention to end of the lesson; uses question & answers, summery, practice to clarify main points along lesson	Teacher uses question & answers, summery, practice to clarify main points along lesson objectives; gives &	Teacher uses question & answers, summery, practice to clarify main points along lesson objectives.	Teacher uses question & answers, summery, and /or practice to end lesson.	Teacher finishes lesson abruptly at the sound of the bell or finishes lesson well ahead of time

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	objectives; gives & marks written exercise to evaluate learning; assigns activity for next lesson.	marks written exercise to evaluate learning.			
Classroom Organisation and Management					
17. Management of the learning environment ☐	Teacher establishes a purposeful leaning environment; interacts with students; uses student ideas; encourages cooperative learning and monitors students learning activities.	Teacher establishes a purposeful leaning environment, interacts with students; uses student ideas, and monitors students learning activities.	Teacher establishes leaning environment that is purposeful and monitors students learning.	Teacher establishes a learning environment and interactions with students are purposeful.	Teacher establishes a learning environment but interactions with students are not directed towards learning.

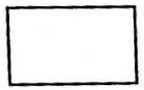
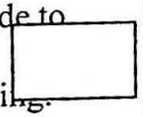
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18. Management of students behavior ☐	Teacher establishes clear parameters for student conduct, develops appropriate strategies for preventing problems, deals with misbehavior promptly. He or she is fair, firm but friendly.	Teacher establishes clear parameters for student conduct and develops appropriate strategies for preventing problems, deals with misbehavior promptly.	Teacher establishes clear parameters for student conduct and develops appropriate strategies for preventing problems; is tardy in dealing with behavior.	Teacher establishes clear parameters for student conduct and develops appropriate strategies for preventing problem.	Teacher does not establish any clear parameter for student conduct'

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Professional Commitment					
19. Teacher behaviour 	Teacher shows enthusiasm in teaching, maintains students' attention throughout the lesson, is creative and innovative, exhibits decorum in speech and behavior and is smartly dressed	Teacher shows enthusiasm in teaching, maintains students' attention throughout the lesson, models polite classroom behavior and is creative and innovative.	Teacher shows enthusiasm in teaching; focusses students' attention on the lesson and models polite classroom behavior.	Teacher shows evidence of enthusiasm in teaching and focusses students' attention on the lesson.	Teacher does not show evidence of enthusiasm in teaching and is unconcerned about the direction of the students' attention.
20. Record keeping and attitude to teaching. 	Teacher keeps records of lesson in a bound notebook for reference; accepts constructive feedback to improve	Teacher keeps records of lesson in a bound notebook for reference; accepts constructive	Teacher keeps records of lesson in a bound notebook for reference; accepts constructive	Teacher keeps records of lesson on a sheet of paper.	Teacher has no records of previous lessons; current lesson plan is on a sheet of paper.

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	teaching; reflects on teaching; shows positive attitude towards teaching.	feedback to improve teaching; reflects on teaching in REMARKS column.	feedback to improve teaching.		

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COMMENTS

1. Overall comments on Lesson Plan:

2. Overall comments on Teaching Methodology and Delivery:

2. Overall comments on Classroom Organisation and Management:

3. Overall comments on Professional Commitment:

TOTAL SCORE

AVERAGE SCORE

TOTAL AVERAGE SCORE

Observer's Code: ..... Signature: .....

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APPENDIX B

SECTION A - ATTITUDE OF BEGINNING TEACHERS TOWARDS THE TEACHING OF MATHEMATICS

***Instruction**: The statements in the table are on attitudes of beginning teachers towards the teaching of mathematics at the Basic School. Kindly indicate your level of agreement by ticking the appropriate space provided.*

No	Statements	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
	Beliefs					
1	I like encouraging students' questions and answers when teaching mathematics					
2	I **don't** like preparing teaching aids in mathematics					
3	I like summarizing all core points for all activities that relate to my lesson					
4	I like to maintain learners' attention throughout my mathematics lesson.					

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5	I enjoy using materials and examples from daily life when teaching mathematics.					
6	I am **not** confident in teaching mathematics					
7	I like taking learners prior understanding into account when planning my mathematics lesson					
8	I enjoy using variety of assessment techniques to check for learners understanding in mathematics class					
	Feeling					
9	I enjoy teaching mathematics					
10	I enjoy monitoring learning activities in mathematics class					
11	I enjoy teaching mathematics when every learner is actively involved in my lesson.					
12	I **hate** to re-teach a topic in mathematics because not every learner can do well in mathematics.					

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13	I enjoy marking learners' exercises when teaching mathematics					
14	I enjoy linking content of mathematics to learners experiences when teaching					
15	I hate to teach learners two or more ways of solving a particular mathematics problem when teaching mathematics					
16	I **hate** to relate concepts to learners experience when teaching mathematics.					
17	I like asking both lower and high-order questions when teaching mathematics.					
18	I like paying attention to only learners who ask questions in my class because the rest are not interested in the lesson.					
19	I **hate** to provide feedback to learners if they do not do well on an exercise.					

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20	I like using variety of instructional strategies when teaching mathematics.					
21	I **hate** giving learners time to think after I have asked questions in class.					
22	I **hate** to ask learners to explain their solutions to a problem in mathematics class.					

Key: strongly disagree=1; disagree=2; neutral=3; agree=4; strongly agree=5

PERCEPTION OF BEGINNING TEACHERS ON INFLUENCE OF METHODS OF TEACHING MATHEMATICS ON TEACHING PRACTICES

Instruction: *The statements in the table are on perceptions of beginning teachers about the influence of method of teaching course on their teaching practices. This questionnaire seeks to find out your experiences about the influence of your method of teaching mathematics course taken at the college on your teaching practices. Kindly indicate your level of agreement by ticking the appropriate space provided.*

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No	Statement	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1	Methods of teaching mathematics course has prepared me very well for teaching mathematics at the Basic School					
2	Methods of teaching mathematics course has equipped me with adequate skills on lesson note preparation					
3	I have learnt how to state specific, relevant and achievable objectives for my lesson					
4	Methods of teaching mathematics course has prepared me adequately on how to introduce mathematics lesson					
5	Methods of teaching mathematics course has prepared					

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	me adequately on how to manage learners' behavour in class.					
6	Methods of teaching mathematics course has equipped me with good questioning skills.					
7	Methods of teaching mathematics course has provided me with skills on how to involve all learners in my lessons.					
8	Methods of teaching mathematics course has taught me how to take learners' prior knowledge into account when planning my instruction.					
9	I have learnt how to actively engage all learners in mathematics lesson from my method of teaching mathematics course.					
10	I have learnt how to organize teaching and learning activities sequentially from method of teaching mathematics course.					

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11	I have learnt how to pace mathematics lesson to benefit all learners in class.					
12	I have learnt to show enthusiasm any time I am teaching mathematics.					
13	I have learnt to listen to all learners in class from method of teaching course.					
14	From methods of teaching mathematics course, I learnt how to use variety of techniques to determine understanding of learners.					

Key: strongly disagree=1; disagree=2; neutral=3; agree=4; strongly agree=5

Kindly write down your candid response to these four questions:

15. How well do you think your method of teaching mathematics course at the college has prepared you for teaching mathematics at the Basic School?

(i) in terms of lesson preparation

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(ii) in terms of teaching methodology and delivery

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(iii) in terms of classroom organization and management (e.g. management of the learning environment and pupils behaviour)

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(iv) in terms professional commitment (such as teacher behavior in class and record keeping)?

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APPENDIX C

SEMI-STRUCTURED INTERVIEW GUIDE FOR BEGINNING TEACHERS

POST OBSERVATION INTERVIEW

This semi-structured interview guide is a follow up to the classroom observations of beginning Basic School teachers teaching practices. The questions are to find out how well the method of teaching mathematics course had prepared beginning teachers in teaching mathematics efficiently at the Basic School. In other words, to find out how the knowledge and skills beginning teachers acquired from college had influence their teaching practices and attitudes towards teaching mathematics and whether the training programme has been useful to them.

Interview to be conducted after the beginning teacher has been observed for three times.

1. You taught (topic) on the (first, or second or third) day I visited you, am I right?
   (i) Can you share with me some of the objectives you stated for your lesson on the (first, second or third) day?
   (ii) What do you know about setting of lesson objectives? How did you get this knowledge about lesson objectives?
   (iii) Were you able to achieve all the objectives for your lesson? If YES, why? (or if No, why)

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(iv) How did you know you had (or had not) achieved your lesson objectives?

2. (i) I noticed that you did (or did not) use the TLM's you stated for your lesson. Why?

(ii) Do you think the TLM's were appropriate for the lesson? If YES, how? (If No why)

(iii) How did you know about TLM's?

3. (i) Were you happy about the level of pupils' involvement in your lesson? If No, why?

(ii) How did you get your pupils involved in the lesson?

4. How do you make use of what you learned from your method of teaching course:

- *In terms of your lesson preparation*
- *In terms of your lesson delivery (the methods and strategies you employed)*
- *In terms of classroom organization and management*
- *In terms of the engagement of learners in your class*
- *In terms of your professional commitment*

(ii) Which aspect of teaching do you think your method course did NOT adequately prepare you on? ZFM

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5. (i) Do you see much difference between what you were taught at the college and what you are experiencing in your classroom? Explain:
   - *In terms of your lesson preparation*
   - *In terms of your lesson delivery (the methods and strategies you employed)*
   - *In terms of classroom organization and management*
   - *In terms of the engagement of learners in your class*
   - *In terms of your professional commitment*

   (ii) Do you think your method course had prepared you adequately for teaching mathematics at the Basic School? If YES, why? (If No, why do you think so?

   (iii) What are some of the things you wished should have been taught in your method course that you are experiencing in the classroom?

6. (i) How do you feel when you are teaching mathematics?
   - *In terms of your lesson delivery (your methods of teaching)*
   - *In terms of your content knowledge*
   - *In terms of your competence in teaching mathematics*

   (ii) Will you describe your attitude towards teaching mathematics as positive? If YES, why? (If No, explain why)

   (iii) Will you say that your method course has contributed to your attitude towards teaching mathematics? Explain.

   (v) In conclusion, what can you say about the usefulness of your training programme? (Very useful, somehow useful, or not useful)

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APPENDIX D

ETHICAL CLEARANCE

OLA College of Education
P. O. Box 175
Cape Coast
4th January, 2021.

The Head of Department
Department of Mathematics and ICT Education
University of Cape Coast
Cape Coast.

Dear Madam

REQUEST FOR COVER LETTER

I write to apply for a cover letter to support my application for ethical clearance in order to collect data for my Ph.D. My research topic is "**INFLUENCE OF PRESERVICE TEACHERS TRAINING PROGRAMME ON BEGINNING TEACHERS TEACHING EFFICIENCY IN MATHEMATICS - CASE OF COLLEGES OF EDUCATION**".

Kindly find attached a note from my main supervisor for your consideration.

I count on your usual co-operation.

Thank you.

Yours faithfully

Signed
Japhet Kwasi Osiakwan
osikwanjaphet@yahoo.com
ET/DME/18/0003
(0244974711)

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UNIVERSITY OF CAPE COAST
COLLEGE OF EDUCATION STUDIES
FACULTY OF SCIENCE AND TECHNOLOGY EDUCATION
DEPARTMENT OF MATHEMATICS AND I.C.T EDUCATION

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Telex: 2552, UCC, GH
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Email: dmicte@ucc.edu.gh

University Post Office
Cape Coast, Ghana

Your Ref:

Our Ref: DMICTE/P.3/V.1/0114 Date: 6th January, 2021

The Chairman

Institutional Review Board

University of Cape Coast

Cape Coast

Dear Sir,

REQUEST FOR ETHICAL CLEARANCE

I write to introduce Mr. Japhet K. Osiakwan, with registration number ET/DME/18/0003 a PhD (Mathematics Education) student of the Department of Mathematics and ICT Education, College of Education Studies, University of Cape Coast.

As part of the requirement for the award of the doctorate degree, he is required to undertake a research on the topic "INFLUENCE OF PRESERVICE TEACHERS' TRAINING PROGRAMME ON BEGINNING TEACHERS' TEACHING EFFICIENCY IN MATHEMATICS - A CASE STUDY OF COLLEGE OF EDUCATION".

I would be grateful if you could give him the necessary assistance he may need.

Thanks for your usual support.

Yours faithfully,

Dr. (Mrs.) Christina Boateng

HEAD

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UNIVERSITY OF CAPE COAST
COLLEGE OF EDUCATION STUDIES
FACULTY OF SCIENCE AND TECHNOLOGY EDUCATION
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University Post Office
Cape Coast, Ghana

Your Ref:

Our Ref: DMICTE/P.3/V.1/0113

Date: 6th January, 2021

The Director

Institutional Review Board

University of Cape Coast

Cape Coast

Dear Sir,

REQUEST FOR ETHICAL CLEARANCE

I write to introduce Mr. Japhet K. Osiakwan, with registration number ET/DME/18/0003 a PhD (Mathematics Education) student of the Department of Mathematics and ICT Education, College of EducationStudies, University of Cape Coast.

Mr. Osiakwan would require ethical clearance in connection with his research topic "INFLUENCE OF PRESERVICE TEACHERS' TRAINING PROGRAMME ON BEGINNING TEACHERS' TEACHING EFFICIENCY IN MATHEMATICS - A CASE STUDY OF COLLEGE OF EDUCATION".

I would be grateful if you could give him any necessary assistance required.

Thanks for your usual support.

Yours faithfully,

Forster D. Ntow, PhD

SUPERVISOR

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