UNIVERSITY OF EDUCATION, WINNEBA

MATHEMATICS TUTORS' LEVEL OF PARTICIPATION IN T-TEL PROFESSIONAL DEVELOPMENT AND THEIR PERCEIVED SELF-EFFICACY BELIEFS TO IMPLEMENT THE B.ED. MATHEMATICS CURRICULUM

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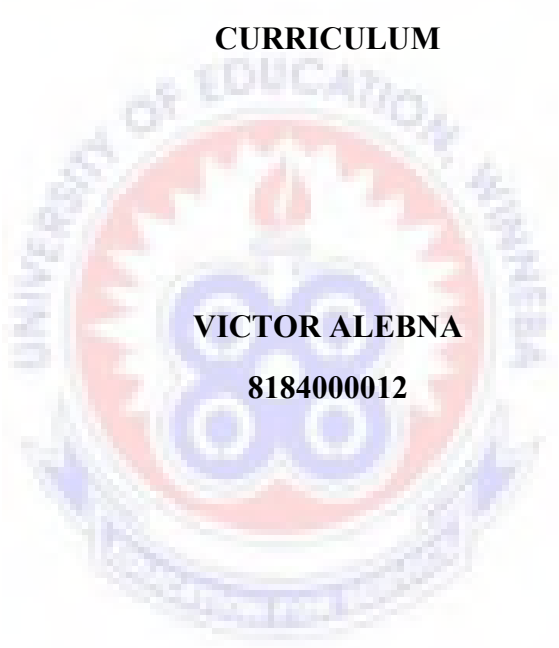

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Faculty of Science Education,
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MAY, 2019

DECLARATION

Student's Declaration

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

SIGNATURE:……

DATE:……

Supervisor's Declaration

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

NAME OF SUPERVISOR: PROF. M. J. NABIE

SIGNATURE:……

DATE:…….

DEDICATION

To my daughter Brunette Yinsongya Alebna

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ABSTRACT

The study examined the level of participation of mathematics tutors in T-TEL professional development sessions (PDS) and their perceived self-efficacy beliefs to implement the new 4-year B.Ed. mathematics curriculum in the Colleges of Education in Northern Ghana. The study adopted the mixed methods survey approach that involves concurrent triangulation of data. The sample was made up of 39 participants comprising 37 male mathematics tutors and 2 female mathematics tutors, among which 5 male tutors and 2 female tutors were selected for interviews. Convenience, purposive, and simple random sampling were used to select the sample for the study. Quantitative and qualitative data were collected using the questionnaire and semi-structured interview guide respectively. With the aid of the IBM Statistical Package for Social Sciences (SPSS) version 21, the quantitative data were analyzed using percentages, means, and standard deviations while data collected from the interview guide were analyzed using the thematic narrative approach. A Pearson product-moment correlation was run to determine the relationship between mathematics tutors' level of participation in T-TEL PDS and their perceived self-efficacy beliefs to implement the new 4-year B.Ed. mathematics curriculum. Findings from the study revealed that mathematics tutors were mostly, punctual and regular to T-TEL PDS. Besides, the study established that both female and male mathematics tutors actively participated in, think-pair-share, group discussions and presentations and whole group discussions in learning the teaching strategies of the various themes. The findings also showed that, both female and male mathematics tutors actively participated and learnt gender and inclusivity issues and are implementing these concepts in their teaching as well. The study, however, indicated that the overall level of participation of tutors in T-TEL PDS was average. Again, it emerged from the findings that, generally, mathematics tutors' perceived self-efficacy beliefs to implement the new 4-year B.Ed. mathematics curriculum were high. The study further disclosed that there was a positive statistically significant relationship between mathematics tutors' level of participation in T-TEL PDS, and their perceived self-efficacy beliefs to implement the new 4-year B.Ed. mathematics curriculum. Based on these findings, it was recommended that the Ministry of Education, National Teaching Council, National Council for Tertiary Education, T-TEL and stakeholders in teacher education should put mechanisms in place for regular assessment of mathematics tutors' implementation of the student-focused teaching methods, gender and inclusion teaching strategies and cross-cutting issues learnt during the T-TEL PDS in teaching in the new 4-year B.Ed. mathematics curriculum. Also, it was recommended that stakeholders in teacher education should assist PDCs and other mathematics tutors to organize the T-TEL PDS for existing basic school teachers to assist them acquire and use innovative student-focused teaching methods, gender and inclusion teaching strategies and cross-cutting issues in teaching mathematics in the basic schools.

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

The place of mathematics in the life of every nation cannot be overemphasized because it is linked with the development of that nation (Sunday, Akamu & Fajemidagba, 2014). Everyone needs to develop mathematical concepts and skills to understand and play a responsible role in society (Ministry of Education (MoE), 2012). Mathematics is studied across all levels of the educational ladder in Ghana. If Ghana's 15-year olds could achieve basic skills in Mathematics and Science it would expand her GDP by 38 times, over the lifetime of today's youngsters (Coughlan, 2015). This is because mathematical knowledge is linked to the socio-economic development of a country. The aims of Mathematics education in Ghanaian schools include:

- the development of mathematical knowledge and skills that pupils will require in their adult life (Mereku, 2010);
- the provision of a foundation for studies in mathematics or other subjects where mathematical concepts are essential;
- the development of a variety of problem solving strategies involving mathematics and develop the ability to think and reason logically;
- helping children to become mathematically literate in a world of information technology (IT) (Ministry of Education, 2012).
- helping children to develop the habits of diligence, perseverance, confidence and precision as a result of their mathematical training (Ministry of Education, Science and sports (MOESS), 2007).

Teacher education efforts are geared towards helping the child to achieve these aims. The current Transforming Teacher Education and Learning (T-TEL) effort in the Colleges of Education to prepare more qualified teachers is in response to increased enrolment without corresponding increase in the quality of education. This increase in enrolment is as a result of the implementation of the constitutional provision (1992) of Free Compulsory Universal Basic Education (FCUBE) for all citizens. It is also in fulfillment of the United Nation's Millennium Development Goals (MDGs) and UNESCO's Education for All (EFA) initiatives. Though these measures increased access to education and more children are going to school, their performance in literacy and numeracy is very low (Ministry of Education, 2017, p11).

The Education for all policy involve all children learning at least the basic minimum competences of literacy and numeracy that will enable them to benefit from and contribute to their society's future. However, research and reports suggest many Ghanaian children in school are not learning. While the vast majority of children in Ghana are enrolled in school, far fewer are learning (Mereku, 2017). That is, children are in school but are not learning (Mereku, 2017).

Reports from the Chief Examiners of BECE and WASSCE, according to Opoku-Agyemang (2015), indicate that the National Education Assessment (NEA), Early Grade Reading Assessment (EGRA) and Early Grade Mathematics Assessment (EGMA) show weaknesses in pupil/student performance in Mathematics and Science at all levels of education. The trend in students' weaknesses in mathematics had existed for many years. For instance, Mereku (2017) indicates that 90% of the eight year olds in Ghana failed to carry out reading and mathematics tasks which most children at this age are expected to know. Also, the National Education Assessment

results in 2013 indicates that less than 25% of the pupils met the 'proficiency' level in P3 mathematics and less than 30% of the pupils achieved 'proficiency' in P3 English, while between 30% and 40% failed to achieve the 'minimum competency' levels expected in the subjects tested. This result is not significantly different from the results of the NEA Assessment of 2011(T-TEL, 2015a).

Ghana had earlier participated in Trends in International Mathematics and Science study (TIMSS) in 2003, 2007 and 2011 for 15 year olds. Results in these studies show that, Ghana consistently made progress in Mathematics scoring 276, 309 and 331 respectively but fell below the international overall mean score of 500 (Opoku-Agyemang, 2015). Mereku (2017) observed that the 48 participating countries in 2007, were ranked by their mean performances, Ghana occupied the 47th position on the overall mathematics achievement results due to her poor performance.

Researches have concluded that poor quality of students' learning correlates strongly with poor quality of teachers' teaching. Weaknesses in teachers' pedagogical content knowledge (PCK) and classroom practice duality affect student learning and achievement (Pontefract & Hardman, 2005; Moon, et al. 2005). Poor performance of Ghanaian students in mathematics is partially attributable to inadequate preparation of teachers (Butakor, Ampadu, & Cole, 2017). Teacher education in Ghana seems to be both part of the problem and the solution to poor quality of teachers' teaching culminating in poor quality of students' learning. In describing how teaching and learning occur in most Ghanaian classrooms, Mereku (2017) described students' learning as characterised by watching and listening passively to the teacher who asks them to copy and memorize facts.

In responses to the poor performance of Ghanaian students in mathematics (Butakor, Ampadu, & Cole, 2017) and lack of opportunity for regular, ongoing professional development for tutors inside the Colleges, the Government of Ghana through Transforming Teacher Education and Learning (T-TEL) introduced a weekly in-service college-based continuous professional development Programme in all the 38, (now 46), public Colleges of Education with the aim of increasing learning outcomes for tutors in Colleges of Education, their student teachers, and above all for pupils in schools. This effort is to equip tutors with the knowledge and appropriate skills to deliver in the classroom. It is believed that one critical step to improving students' achievement is by improving teachers' knowledge, skills and disposition (King & Newman, 2001) cited in (Steyn, 2008). Perhaps, this is one of the reasons why the Ministry of Education through Transforming Teacher Education and Learning (T-TEL) in Ghana, introduced the weekly in-service college-based professional development sessions in all the public Colleges of Education in September, 2015. Professional development activities are most successful when they are offered within the teachers' home school organization as continuous, reflective, and supportive practices (Hennessy & London, 2013).

The T-TEL programme sought, among other things, to increase learning outcomes for tutors in Colleges of Education, their student teachers, and above all for pupils in basis schools. To make the Programme effective and successful, T-TEL created a set of professional development resources for use by tutors, for their in-service college-based professional development. The resources are organised into twelve themes focusing on pedagogy and effective college classroom practice. The themes have been chosen because of their relevance to improving learning outcomes through the use of active pedagogies (T-TEL, 2015b). For each of the twelve themes, there are different

teaching strategies (or teaching approaches). For instance, the teaching strategies in the theme "Creative Approaches" are songs, role-play, modelling, games, storytelling, poems and rhymes, and play (Transforming Teacher Education and Learning (T-TEL), 2015b). For each of the strategies within a theme, the resources consist of three sequences of "Example - Plan - Teach - Reflect" (EPTR): one focusing on English, one on Mathematics, and one on Science. One will find an example for the use of the strategy (e.g. an example for using games in teaching a topic or concept in Mathematics), followed by a section to support planning an activity using the strategy (e.g. planning the use of games to teach a concept in a mathematics course for that semester). Tutors then try out their activities by teaching them to their student teachers after which they will find a number of activities for reflection, about their experience in the classroom. For example: Did the game achieve the intended learning outcomes? Did everybody, including girls and boys, participate in the game? What can I do to involve learners with special needs? These reflections are always shared before the start of each PDS (T-TEL, 2016a).

The T-TEL programme is to support the implementation of the new policy framework for Pre-Tertiary Teacher Professional Development and Management. The project, which started in November 2014, is funded by the UK Department for International Development (DFID) as part of its Girls Participatory Approaches to Students Success (G-PASS) Programme. T-TEL seeks to transform the delivery of pre-service teacher education in Ghana by improving the quality of teaching and learning through support to relevant national bodies and institutions and all 38 (now 46) Colleges of Education. (T-TEL, 2015b).

Before the start of T-TEL professional development(PD) programme in September, 2015 in the Colleges of Education, the college principals were given some guidelines to identify and select two tutors to serve as professional development coordinators (PDCs) for their colleges. In September, 2015 all PDCs in 38 public Colleges of Education, were called to Suyani for their first ever T-TEL professional development (PD) training workshop on two themes namely 'Creative Approaches' and 'Questioning' for one week. After the PD training workshop, PDCs were tasked to collaborate with the timetable committees of their various colleges to insert a slot/period between one-half to two hours on the timetable for a weekly-based professional development sessions (PDS) on the themes to be led by the PDCs. Subsequently, before the start of a semester, PDCs were invited and trained on the theme(s) for the semester and they in turn organize the PDS in their respective colleges. The first training workshop was very interactive and PDCs worked individually, in pairs, in small groups to share ideas. They were guided to prepare in groups and present the various teaching strategies/approaches in the themes after which they were allowed to assess their own presentations first in terms of what worked well, what did not work so well and what they would wish to change when given another opportunity. This was followed by other PDCs assessment and finally the coordinators' assessment followed. These preparations, presentations and assessments were done to help the PDCs grasps the concept of strategies/themes, presentation skills and how to organize the presentations in their colleges as well give the PDCs the opportunity to contribute to how and what should be included and be done in subsequent professional development training workshops. Figure 1 shows PDCs preparing in groups to facilitate PDS on some teaching strategies. T-TEL provided handbooks for PDCs, which gave further details on running PDS on the

various themes. Tutors and student teachers were also given PD Guide for Tutors and PD Guide for students respectively.

Figure 1 PDCs in groups planning to facilitate PDS using PD guide
Source: T-TEL. (2015b, p.32).

Back at the individual colleges, tutors meet once a week as indicated on their timetables for the school-based PDS at chosen locations identified as PDS centres. Before or on the first day of the start of PDS on the theme(s) for a semester, PDCs distribute models for the theme(s) to tutors and encourage them to read the strategies or concepts before coming for any PDS. PDCs facilitate the PDS which are usually very interactive, knowledge generating and sharing of ideas. Generally, PDS in all the colleges are to run in the same way. A session starts a prayer followed by the PDCs welcoming tutors to the PDS and asking them for their active participation and cooperation. The reflection time follows with some tutors sharing ideas on how they implemented the previous teaching strategy or concepts, after which the objective(s) of the day's PDS is read to the hearing of every tutor present. Participants are given

some few minutes to read an introduction to the teaching strategy or concepts after which the activities aspects of the session begin. Teaching strategies or concepts may have one or more activities. Tutors are put in small groups, mostly in mathematics, Science and English subject areas and asked to read and discuss an example of the strategy used, and do group presentations sometimes, after which they plan and practice together based on mathematics, Science and English using activity plans provided at the end of their PD Guide. Figure 2 shows tutors preparing in groups to present on the use of concept maps in teaching Mathematics, English and Science during PDS in St. John Bosco' College of Education.

Figure2 Tutors preparing to present on the use of concept maps during PDS
Source: PDS in St. John Bosco' College of Education, 2017

Tutors then try out their activities on their student teachers in their classrooms after which they will find a number of activities for reflection on their experiences in the classroom. For example: Did the game achieve the intended learning outcomes? Did everybody, including girls and boys, participate in the game? What can I do to involve learners with special needs? These reflections are always shared before the start of each PDS (T-TEL, 2016a).

Studies have shown that there is a clear link between professional development and teacher efficacy. Ross and Bruce (2007) suggested that confidence in implementation of the knowledge gained during staff development seminars was correlated to increased levels of teacher efficacy. Another study by Powell-Moman and Brown-Schild (2011) found increased scores of teachers' self-efficacy for inquiry-based teaching after participating in a two-year in-service program. A recent study by Dixon, Yssel, McConnell and Hardin (2014) found that teachers who received greater professional development hours in differentiation of instruction developed higher self-efficacy.

Through the support of T-TEL, the National Teachers' Standards (NTS) and the National Teacher Education Curriculum Framework (NTECF), which are very significant to the transformation of initial teacher Education in Ghana, have been developed to address the on-going and systemic problem of underachievement of Ghanaian children. (MoE, 2017). The development of the NTS and NTECF resulted into the introduction of a new 4-year B.Ed initial teacher education programme in the Colleges of Education which was to start 2018/2019 academic year. This new curriculum is aligned with the National Teachers' Standards and informed by the National Teacher Education Curriculum Framework.

1.2 Statement of the Problem

There have been numerous reforms in teacher education in Ghana in the past two decades which have had very little impact on children's learning outcomes (Addae-Boahene, 2018; Ministry of Education, 2017). According to Ministry of Education (MoE) (2017), the preparation of teachers has not adequately responded to the lack of improvement in learning outcomes at the basic school system. This suggest that the

transformation of initial teacher education in Colleges of Education and Universities that train teachers to provide highly qualified and motivated teachers who are able to inspire their pupils to achieve better outcomes in basic education (Addae-Boahene, 2018).

The Ministry of Education designed and introduced the T-TEL programme with the aim to transform the delivery of Pre-service Teacher education in Ghana by improving the quality of teaching and learning through support to all public Colleges of Education from 2014-2018.

According to T-TEL (2017a) teachers constitute the most important resource in education and that any educational system is as good as the teachers in it. To improve the quality of learning in any educational system implies improving the quality of teaching in that system. Quality of teaching in any institution can be improved by providing teachers with the opportunity to continually improve their skills and knowledge through appropriate continuing development programmes. This implies that the education and professional development of every teacher needs to be seen as a life-long task, and be structured and resourced accordingly. To equip the teaching body with the skills and competences needed for its new roles in this 21st century, it is necessary to have both quality initial teacher education and a coherent process of continuous professional development to keep teachers up to date with the skills required in the ever changing knowledge based society. One of the key mandated institutions for initial teacher training for basic schools in Ghana is the Colleges of Education.

However, research shows that before September, 2015 there was little if any regular, ongoing professional development for tutors inside the Colleges of Education in Ghana (T-TEL, 2015b). The research added that, there were eventually no opportunities for tutors' professional development other than further degrees and sometime one-shot workshop. There were also no opportunities or resources for tutors to develop their tutoring skills. Moreover, T-TEL conducted a quantitative study that measured 276 teacher educators' (college tutors') usage of student-centered teaching strategies by observing their lessons. The results showed that only 43 tutors (16 percent) demonstrated the use of interactive learner-centered methods, such as students engaged in whole group discussions and group and pair work to co-construct knowledge and skills for teaching (T-TEL, 2015a).

In order to tackle lack of opportunities or resources for college tutors to develop their tutoring skills, Transforming Teacher Education and Learning in September, 2015 introduced a weekly in-service college-based professional development Programme in all the 38 public Colleges of Education. College tutors so far have participated in eight out of the twelve themes which have been chosen because of their relevance to improving learning outcomes through the use of active pedagogies (T-TEL, 2015b).

However, there is no known study on College of Education mathematics tutors' level of participation in the T-TEL professional development sessions. Also, studies on college mathematics tutors' perceived self-efficacy beliefs about their ability to implement the new 4-year B.Ed. mathematics curriculum as a result of their participation in the T-TEL professional development sessions are not known in current literature. There is, therefore, the need to examine mathematics tutors' level of

participation in T-TEL professional development sessions, and their perceived self-efficacy beliefs to implement the new 4-year B.Ed. mathematics curriculum.

1.3 Purpose of the Study

The study sought to examine the level of participation of mathematics tutors in T-TEL professional development sessions (PDS) and their perceived self-efficacy beliefs about their ability to implement the new 4-year B.Ed. mathematics curriculum in the Colleges of Education. It also examined the relationship between Colleges of Education mathematics tutors' level of participation in T-TEL PDS and their perceived self-efficacy beliefs about their ability to implement the new 4-year B.Ed. mathematics curriculum.

1.4 Research Questions

The following questions were formulated to guide the study:

1. What is the level of participation of College of Education mathematics tutors in T-TEL professional development sessions?
2. What are mathematics tutors' perceived self-efficacy beliefs to implement the new 4-year B.Ed. mathematics curriculum as a result of their participation in T-TEL PDS?
3. What is the relationship between mathematics tutors' level of participation in T-TEL PDS, and their perceived self-efficacy beliefs to implement the new 4-year B.Ed. mathematics curriculum?

Research Hypothesis

To answer research question 3, the following hypotheses were formulated

H_o: There is no correlation between mathematics tutors' level of participation in T-TEL PDS and their perceived self-efficacy beliefs to implement the new 4-year B.Ed. mathematics curriculum.

H_1: There is correlation between mathematics tutors' level of participation in T-TEL PDS, and their perceived self-efficacy beliefs to implement the new 4-year B.Ed. mathematics curriculum.

1.5 Significance of the Study

The results of this study would enable stakeholders in teacher education and others to determine how participation of college mathematics tutors in PDS is vital in supporting the successful implementation of the new mathematics curriculum.

The study would also provide information on Ghanaian mathematics tutors' readiness to undertaken PD programmes to enhance their tutoring skills.

Besides, the study would provide relevant information on how mathematics tutors' participation in T-TEL PDS have improved their delivery skills and mathematical pedagogical knowledge.

The results of the research would provide information on mathematics tutors' ability to increase mathematics learning outcomes of their student teachers and pupils in basic schools as a results of participation in T-TEL PDS.

The study would also inform policymakers as to whether to replicate or modify the T-TEL continuing professional development programme in other levels of education.

The study would contribute to knowledge and literature on Mathematics tutors' level of participation in T-TEL professional development sessions and perceived self-efficacy to implement the new 4-year B.Ed. mathematics curriculum in the Colleges of Education. Additionally, the study would provide relevant information that can serve as reference material for mathematics educators and other researchers who would want to conduct a similar study.

1.6 Delimitations of the Study

The study looked at mathematics tutors' level of participation in T-TEL professional development sessions (PDS) and their self-efficacy beliefs to implement the new 4-year B.Ed. mathematics curriculum. The study was conducted in only seven (7) of the eight (8) public Colleges of Education in Northern Ghana involved in the (T-TEL) weekly in-service college-based continuous professional development programme right from the start of the programme. Specifically, the study was restricted to only mathematics tutors in Colleges of Education in Upper East, Upper West and Northern regions of Ghana that participated in all eight themes of the T-TEL professional development programme.

1.7 Limitations of the Study

Limited resources did not permit a wider coverage of the entire 46 public Colleges of Education in Ghana. As a result, only seven Colleges in Northern Ghana were used in the study. Consequently, the results of the study may not be generalizable to the entire Country.

The researcher used questionnaire and semi-structured interview guide as data collection instruments. These instruments though very helpful in collecting relevant data for the study, they were limited in the following ways; the questionnaire for instance did not make provisions for free expressions of respondents on the issues at hand. Another limitation has to do with the number of respondents interviewed. Only seven (7) out of 37 respondents were interviewed and recorded once. Moreover, observation of PDS in the sampled Colleges of Education by the researcher could have enriched the information on mathematics tutors' level of participation in T-TEL PDS. However, due to time constraints, the researcher was unable to undertake observation of PDS in the seven colleges.

1.8 Organization of the Study

The study is systematically organized in five different chapters. Chapter one is the introductory chapter and it entails the background to the study, statement of the problem, purpose of the study, research questions, hypotheses, significance of the study, delimitations of the study, limitations of the study and organization of the study. Chapter two is devoted to the review of relevant and related literature to the study. Chapter three describes the methodology and procedures used in the study. This includes a description of the research design, the population, sampling and sample techniques, research instruments, data collection procedures and data analysis plan. The fourth chapter comprises the results and discussion of results. The final chapter, which is chapter five, covers the summary of findings, conclusion and recommendations.

CHAPTER TWO

REVIEW OF LITERATURE

2.0 Overview

This chapter discusses the theoretical framework of the study and related literature on professional development and self-efficacy beliefs for teaching mathematics. Discussions on the literature included continuous professional development and teacher self-efficacy, characteristics of effective continuing professional development, barriers to implementation of PD/ CPD, level of teacher participation in PD/CPD and teacher efficacy, motivation and participation in CPD programmes and influence self-efficacy beliefs on teachers' instructional practice

The purposes of the literature review are to share with the reader the results of other studies that are closely related to the one being undertaken and also to relate a study to the larger, ongoing dialogue in the literature, filling in gaps and extending prior studies (Cooper, 2010; Marshall & Rossman, 2011). Literature review can take several forms and Cooper (2010) identified four types as literature reviews that (a) integrate what others have done and said, (b) criticize previous scholarly works, (c) build bridges between related topics, and (d) identify the central issues in a field. According to Creswell (2014) with the exception of criticizing previous scholarly works, most dissertations and theses serve to integrate the literature, organize it into a series of related topics (often from general topics to narrower ones), and summarize the literature by pointing out the central issues.

2.1 Theoretical Framework

Teacher education plays a crucial role in empowering individuals to adapt to the rapidly changing socio-economic and cultural environment. It also improves the human capital required for the economic and social growth of societies (Anhwere, 2013). It is said that "if teachers acquire the professional competence and attitudes that enable them to effectively perform their multiple tasks in the community, they become the single most important contributing factor in ensuring quality educational provision''(Dove, 1969:65 cited in Anhwere, 2013). The theoretical framework used for the study was B. F. Skinner's Reinforcement Theory.

2.1.1 Reinforcement Theory

Skinner believed that behaviour is a function of its consequences. The learner will repeat the desired behaviour if positive reinforcement (a pleasant consequence) follows the behaviour. An undesired behaviour will not be repeated if negative reinforcement (an unpleasant consequence) follows the behaviour (Casas, 2002). Skinner's theory of reinforcement emphasizes on the relevance of reward and punishment. This has impacted, to a large extent on the promotion of teaching and learning (Omomia & Omomia, 2014). According to Amutan (2014), reinforcement is a term in operant conditioning and behaviour analysis for process of increasing the rate or probability of a behaviour in the form of response by delivery either immediately or shortly after performing the behaviour. Two assumptions can be deduced from this theory; first, people behave the way they do because of either a positive or negative reinforcement. Second, peoples' behaviour is tuned towards a desired behaviour when there is a pleasant experience. This implies that as it is expected of teachers to step up their efforts in providing students with quality teaching to increase students' academic outcome, it is also necessary that teachers are

provided with learning opportunities (positive reinforcements) that would enrich their knowledge and skills to meet up with this demand. The researcher shares in Casas (2002) explanation of Skinner's ideology that people do not act because they believe that their behaviour will produce a desired goal, but they act because they have been reinforced (strengthened) for behaving in a certain manner. In this case, mathematics tutors have been reinforced with teaching and learning strategies that are gender-responsive, student-centred, and inclusive by T-TEL to bring about improved learning outcomes of their student teachers which would eventually lead to improved learning outcomes of basic school pupils. It is the conviction of the researcher that teachers teach the way they do because of the initial training they had at their training institutions. This initial training cannot be expected to meet all the challenges the teachers will face throughout their teaching profession (OECD, 2009). Teachers need to be provided with additional training to keep them abreast with current trends in the teaching profession. In order to shape the instructional practices of teachers towards better students' academic outcome, teachers need to be supported and provided with learning opportunities to achieve this. T-TEL recognizes this need of teachers by providing mathematics tutors and other tutors with a weekly college-based continuous professional development programme aim at upgrading and improving their teaching competencies and skills to bring improvement in their classroom practices geared towards enhanced student teachers' learning outcomes. Faryadi (2007) opine that in order for teachers to cure the global challenge with respect to students' academic achievement, teachers' behaviour has to be changed. One of the ways of changing teachers' behaviour to remedy the global challenge referred to by Faryadi (2007) is through the provision of continuous professional development training (positive reinforcement) to teachers which will increase their competences and efficiencies on

the job. Also, when teachers are given recognition (positive reinforced) by way of promotion or certification after going through CPD programmes to enhance their competences. This will motivate them to have great interest in such programmes which will gradually lead to best classroom instructional practices and in the long run will lead to higher students' learning outcomes. To encourage mathematics tutors' and other tutors' to attend and participate in T-TEL PDS to learn and implement new interactive student-focused strategies that are known to enhance learning, T-TEL beginning with Theme 7 (Assessing Trainee Teachers) started awarding certificates for attendance to PDS as well as certificates for employing student-focused approaches.

2.2 Continuous Professional Development and Teacher Self-Efficacy

It is common knowledge that over the past one and half decades, governments, parents and stakeholders in education in Ghana have raised questions on the standards and quality of education and the type of graduates that are being turned out from all levels of our education sector. This has generated a national conversation on the need to reform our education and teacher education curricula. It is however imperative to state that while the end result of all education reform should be student improvement, every reform initiative, if it is to succeed, must begin with recognition of the importance of teachers in raising student performance (Harwell, 2003). This argument has brought to the fore the need for continuous professional training and retraining. It therefore comes as no surprise when the Government of Ghana (GoG) through the T-TEL programme offered tutors in the Colleges of Education the opportunity to learn and relearn through Continuous Professional Development. This was to develop and improve tutors' tutoring skills and competences to increase the learning outcomes of

their student teachers and pupils in basic schools. It was also intended to prepare tutors to handle the new reforms in teacher education.

T-TEL PD is a peer-facilitated job-embedded programme, supported by very rich resource materials and trainer of trainers' workshops. These workshops are run by T-TEL's Teaching and Learning Advisers (TLAs) for selected college tutors known as professional development coordinators (PDCs). The aim of trainer of trainers' workshops is to empower and equip PDCs to effectively deliver PDS for all tutors in the respective colleges.

T-TEL tutor professional development (TPD) activities in the colleges have been designed to enhancing mathematics tutors' and other tutors' use of student-focused and gender-responsive teaching methods. The aim was to increase learning outcomes for tutors in Colleges of Education, their student teachers and above all basic schools pupils. Consequently, T-TEL created a set of professional development resources organised into twelve themes focusing on pedagogy and effective college classroom practice for weekly in-service college-based professional development (T-TEL, 2016a).

In theme 1(Creative Approaches), tutors were taken through how to use games, story-telling and role-play to teach mathematical concepts. For example, the PDS for using games in teaching mathematics afforded mathematics tutors to do the following:

- Discuss the benefits of using 'games' in their classrooms for improving learner participation and involvement;
- Plan one of the games in the tutor's materials or an appropriate game of their choice for their own classrooms;

- Practice and use the 'game' with their peers in preparation for using it in their classrooms
- Develop confidence to use games in their classrooms;
- Reflect on the benefits and challenges of using 'Games' with their student teachers in both their content and methodology lessons (T-TEL, 2015b).

Through these, mathematics tutors developed and improved their skills of making their classrooms participatory, fun and enjoyable.

Theme 2 was Questioning. Tutors' discussed and acquired teaching skills in the following teaching strategies: questioning to support learning, open and closed questions, common mistakes associated with questioning, using questions to promote thinking, using questions to investigate misconceptions, and involving everybody in questioning. These strategies can be and are used in games, story-telling and role-play. This implies that there a link between theme 1(Creative Approaches) and theme 2 (Questioning).

The PDS for involving everybody in questioning, for example, equipped mathematics tutors with how to: use questions effectively to involve all student teachers in answering questions; use a variety of teaching and learning strategies to get all student teachers involved and plan a lesson plan using questioning techniques that involve all their student teachers(T-TEL, 2015c).

Talk for Learning was theme 3. This theme was meant to equip tutors' with the knowledge and skills of encouraging student teachers to engage in their learning using meaningful talk which would enable them progress from recall and memorisation, to thinking and understanding, analysis and creativity (T-TEL, 2016a). Questioning is a particular form of talk. This means that theme 3 (Talk for Learning) was continuation

from the two previous themes (Creative Approaches and Questioning). The teaching strategies that were discussed in Talk for Learning were: Initiating talk for learning; Building on what others say; Managing talk for learning; Structuring talk for learning and Expressing yourself with new words. Not only were the teaching strategies in Talk for Learning meant to assist tutors to facilitate learning through student teachers' talk, but were also meant to give equal opportunities to both female and male student teachers to talk and learn mathematics concepts, content and methods in the classroom (T-TEL, 2016a).

The theme after Talk for Learning was Group Work (Theme 4). Colleges of Education in Ghana are dominated with large class size. As a result, college tutors needed appropriate strategies and skills of using group work to enhance their student-teachers active participation and collaborative learning in the classrooms. In group work, student-teachers have the opportunity to talk with one another and question each other. This indicates that there is a clear link between theme 4(Group Work) and the previous three themes (Creative Approaches, Questioning and Talk for Learning). In theme 4, tutors' discussed Group formation, Managing group work, Different types of group work, Reporting back from group work, Using group work in the multilingual classroom strategies (T-TEL, 2016b). These strategies were aimed at increasing learning outcomes of both tutors and their student-teachers through collaborative learning and support for one another. With the Group formation teaching strategy, tutors discussed how to form friendship groups, gender groups, mixed attainment groups, assign roles and responsibilities to group members. They also discussed and identified when to use them and experimented with some of them. Teaching and Learning Materials was the next theme. The purpose of introducing Theme 5, (Teaching and Learning Materials) was to give tutors practical guidance to

develop and use teaching and learning materials effectively to enhance learning in their colleges. The teaching strategies that were discussed under this theme were as follows:

- Using low/no-cost materials (finding and making low/no cost materials); Using books and other written materials (different types of books; newspapers);
- Activity-based learning (includes materials needed for investigations and to conduct specific experiments);
- Using the Outdoors and the Environment (using the environment as a resource; field trips, the community as a resource);
- Using TLMs Effectively (a review session on the use of TLMs together with the teaching strategies we have previously met) and
- Using Open Educational Resources (using and re-using digital and printed documents) (T-TEL, 2016c).

Theme 6 looked at the National Teachers' Standards (NTS) and National Teacher Education Curriculum Framework (NTECF) for Ghana. Tutors, through this theme discussed and acquired knowledge on the three main domains of the Standards (Professional Values and Attitudes, Professional Knowledge and Professional Practice) and their subdivisions. They also discussed and acquired knowledge on the four integrated pillars or main curriculum and knowledge areas of NTECF which included Subject and Curriculum Knowledge (which includes subject matter knowledge and curriculum studies), Literacy Studies in Ghanaian Languages and English, Pedagogic Knowledge, and Supported Teaching in School (Ministry of Education, 2017). Issues that cut across these four pillars such as Equity and Inclusivity, Core or Transferable Skills, ICT, Assessing Pupils' Learning and

Progress, Professional Values and Attitudes, Assessing Student-teachers, and Quality Assurance Strategy were also considered.

Theme 7 (Assessing Trainee Teachers) was designed to introduce tutors to the new forms of assessment of teacher trainees indicated in theme 6, the National Teachers' Standards (NTS) and National Teacher Education Framework (NTECF). Tutors were led to discuss the following in this theme:

- Assessing Trainee Teachers against the NTS and through the new Diploma in Basic Education;
- Developing Professional Teaching Portfolios;
- Assessing Professional Teaching Portfolios;
- Understanding Assessment of Transferable Skills;
- Introduction to Supporting Trainee Teachers with Diverse Needs and Abilities, Inclusivity and Equity in Training new teachers;
- Assessing Practical Skills;
- Assessing In-School / Off-Campus Teaching and Learning and
- Assessing In-School / Off-Campus Teaching and Learning and review (T-TEL, 2017a).

Through this theme, tutors were equipped with the knowledge and skills of assessing student-teachers against the main domains of NTS namely Professional Values and Attitudes, Professional Knowledge and Professional Practice. One cardinal important concept that was discussed and learnt was developing professional teaching portfolios because it is key in assessing student-teachers against the NTS.

The purpose of theme 8, (The Tutor as a Researcher) was to empower tutors to appreciate and use classroom action research in particular to improve teaching and learning in the colleges (T- TEL, 2017b). It was also meant to assist and encourage tutors publish papers to meet part of their promotion requirements as well as guide their student-teachers conduct action research to meet the requirements of assessment introduced in theme 7. In theme 8, tutors were led to discuss and acquire knowledge and skills that made them practitioners and researchers at the same time. Figure 3 shows a conceptual framework for T-TEL's tutor PD programme in Colleges of Education in Ghana.

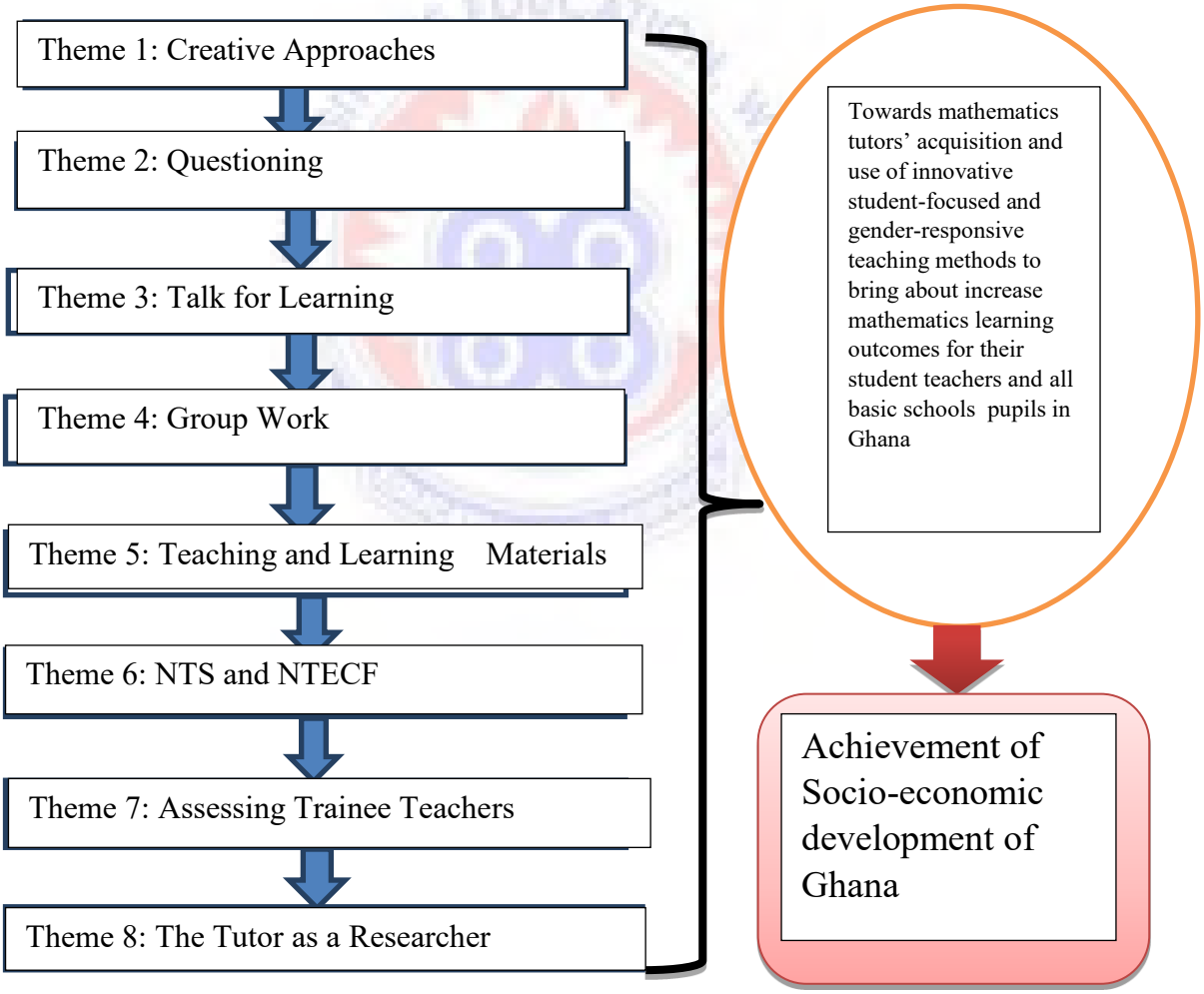

Figure 3 Framework for first eight themes of T-TEL PD programme in Colleges of Education in Ghana (Researcher's Conceptualization)

Figure 3 shows that all the first eight themes were geared towards equipping the mathematics tutors and other tutors with innovative student-focused and gender-responsive teaching methods. They would in turn use these teaching strategies in their classrooms to bring about increase mathematics learning outcomes for their student teachers and all basic schools pupils in Ghana. Figure 3 also shows the order in which the themes were facilitated and the link between one theme and the previous one. For example, in using games or role-plays in teaching mathematics, questioning is used to support students' learning of concepts and content. Questioning is a particular form of talk that can allow students to build on what others say. Also, student-teachers have the opportunity, in group work, to talk with one another and question each other when playing mathematical games. Therefore, the major aim of introducing these themes in the PD programme in colleges was to change the Ghanaian mathematics classrooms experience of being boring, teacher dominated and non-participatory to being fun, enjoyable and highly interactive that lead to improve mathematics learning outcomes. Improved mathematics learning outcomes would eventually lead to the socio-economic development of Ghana.

Continuous Professional Development (CPD) of teachers brings about increase self-efficacy (Powell-Moman & Brown-Schild, 2011) which leads to higher students' academic achievement and overall job satisfaction (The Organization for Economic Co-operation and Development [OECD], 2009). According to Uzal, Erdem, Önen, and Gürdal (2010), professional development, both individual and collective is important to a teacher's sense of self-efficacy as research has demonstrated a correlation between the professional development received and a teacher's sense of positive self-efficacy (Kober & Rentner, 2011). Similarly, Addah (2015) discovered in his study that 88.2% of respondents affirmed that continuous professional

development programmes enabled them to gain self-efficacy beliefs which gave them the confidence in whatever they were doing.

Professional development focuses on developing and orienting the teacher towards improving the academic performance of students in classrooms and schools (Nortey, 2010). Professional development refers to the teacher training programmes of any format offered by the school district with the intention of providing learning experiences for staff (Jao & McDougall, 2015). European Union (2010) defines professional development broadly as the body of systematic activities to prepare teachers for their job, including initial training, induction courses, in-service training, and continuous professional development within school settings. This last category according to the European Union is viewed as a form of continuous on-the-job training located in school setting. Similarly, the OECD (2009) defines teacher professional development (PD) as "activities that develop an individual's skills, knowledge, expertise and other characteristics as a teacher" (p.49). Out of the several definitions given to CPD, Day's (1999) definition captures all the elements and is increasingly appreciated by many scholars. Day (1999) describes professional development as:

> Professional development consists of all natural learning experiences and those conscious and planned activities which are intended to be of direct or indirect benefit to the individual, group or school and which contribute through these to the quality of education in the classroom. It is the process by which, alone and with others, teachers review, renew and extend their commitment as change agents to the moral purpose of teaching; and by which they acquire and develop critically the knowledge, skills and emotional intelligence essential to good professional thinking, planning and practice with children, young people and colleagues through each phase of their teaching lives (p.4).

In simplifying Day's (1999) definition of PD, James, Phillip, Herbert, Augustin, Yamin-Ali, Ali, and Rampersad (2013) explained that teacher PD is about teachers engaging in programmes and reflective activities whereby they learn or relearn, with a view to altering their beliefs, attitudes, values, understandings, and professional practice for the benefit of improving their students' learning. Adding to that Nortey (2010) asserts that professional development focuses on developing and orienting the teacher towards improving the academic performance of students in classrooms and schools. Generally, professional development refers to an organizational response to the developmental needs of both individuals and organizations. It may also be referred to as any form of continuous training offered to professionals, in this case a teachers, to improve their lessons delivery for effective and quality teaching and learning (James, *et al*, 2013; Darling-Hammond, Newton, & Wei, 2010; Nortey, 2010). Professional development can also be skills required for maintaining a specified path or to general skills offered through continuing education, including the more general skills area of personal development (Nortey, 2010). The purpose of a professional development could be for teachers to learn new teaching methods, to broaden their subject matter content knowledge, or to stay informed of changing policies (Scotchmer, McGrath, & Coder, 2005) cited in (Hill, 2015). Guskey (2009) supports a strong system for professional development that is well executed and benefits teachers. He explains that "it is probably safe to say that in fact, no improvement effort in the history of education has ever succeeded without thoughtfully planned and well implemented professional development activities designed to enhance educators' knowledge and skills" (p.226). The nature of PD/CPD involves two main elements that are mutually dependent: knowledge acquisition and skills development (Field, 2011).

Earley and Bubb (2004) believed that broadly speaking, continuing professional development encompasses all formal and informal learning that enables individuals to improve their own practice and personal development. It is their assertion that personal development is an aspect of professional development and that wherever possible, improving practice and personal development should interact and complement each other (Earley & Bubb, 2004). Whether formal or informal, CPD is important and its main purpose is to facilitate the enhancement of teacher quality through engagement in a systematic programme geared to bring about change in three main areas (Guskey, 2002; Knight, 2002) namely;

- Change in teachers' beliefs, attitudes, values, and understandings
- Change in teachers' educational practices and
- Change in student outcomes

Similarly, Anhwere (2013) believes that no matter how good pre-service training for teachers is, it cannot be expected to prepare teachers adequately for lifelong professional service and as such opportunities for in-service (continuous professional training) is important in order to maintain a high standard of teaching and to retain a high teaching work force. He argues that the development of teachers beyond their initial training is therefore important because it can serve a number of objectives namely;

- To update individual's knowledge of a subject in light of recent advances in the area;
- To update individuals' skills, attitudes and approaches in the light of the development of new teaching techniques and objectives, new circumstances and new educational research;

- To enable individuals to apply changes made in curricular or other aspects of teaching practice;
- To exchange information and expertise among teachers and others e.g. Academics, industrialists; and
- To help weaker teachers become more effective.

In this study, PD/CPD means the weekly college-based structured continuous professional learning activities that tutors engage in whiles on the job with the aim of increasing learning outcomes for tutors in college of education, their student teachers and above all for pupils in basic schools.

2.3 Characteristics of Effective Continuing Professional Development

Students/learners need to acquire transferrable skills in preparation for further education/studies and work in this 21st century. For teachers to inculcate these 21st century skills in students/learners, they need to continuing learn and refine their pedagogies through effective professional development (Darling-Hammond, Hyler, & Gardner, 2017). The question is what is effective professional development? Darling-Hammond, Hyler, and Gardner (2017) define effective professional development as structured professional learning that results in changes to teacher knowledge and practices, and improvements in student learning outcomes.

Although international studies in the field of continuing professional development (CDP) for teachers have failed in identifying the characteristics of effective continuing professional development, a number of independent studies and reviews of teacher CPD which when compared from around the world show some common features of effective CPD (Whitehouse, 2011). A careful observation of a sample of the studies revealed six features of effective CPD as be based on the identified

learning needs of both students and teachers; be sustained; be subject specific; be based in the classroom and classroom practice; be collaborative, so that reflective practice is encouraged; and, make use of external expertise (Whitehouse, 2011). He added that, when present, these features provide the foundations for CPD that challenges teachers' current personal teaching theories and provides opportunities for modelling and practicing new teaching methods in the classroom which leads to permanent changes in teaching practices (Whitehouse, 2011). .

However, Darling-Hammond, et al (2017) identified seven widely features of effective professional development by extensive study of literature and reviewing of 35 studies over the last three decades. Specifically, they found that effective professional development:

Is content focused: PD that focuses on teaching strategies associated with specific curriculum content supports teacher learning within teachers' classroom contexts. This element includes an intentional focus on discipline-specific curriculum development and pedagogies in areas such as mathematics, science, or literacy.

Incorporates active learning: Active learning engages teachers directly in designing and trying out teaching strategies, providing them an opportunity to engage in the same style of learning they are designing for their students. Such PD uses authentic artifacts, interactive activities, and other strategies to provide deeply embedded, highly contextualized professional learning. This approach moves away from traditional learning models and environments that are lecture based and have no direct connection to teachers' classrooms and students.

Supports collaboration: High-quality PD creates space for teachers to share ideas and collaborate in their learning, often in job-embedded contexts. By working collaboratively, teachers can create communities that positively change the culture and instruction of their entire grade level, department, school and/or district.

Uses models of effective practice: Curricular models and modeling of instruction provide teachers with a clear vision of what best practices look like. Teachers may view models that include lesson plans, unit plans, sample student work, observations of peer teachers, and video or written cases of teaching.

Provides coaching and expert support: Coaching and expert support involve the sharing of expertise about content and evidence-based practices, focused directly on teachers' individual needs.

Offers feedback and reflection: High-quality professional learning frequently provides built-in time for teachers to think about, receive input on, and make changes to their practice by facilitating reflection and soliciting feedback. Feedback and reflection both help teachers to thoughtfully move toward the expert visions of practice.

Is of sustained duration: Effective PD provides teachers with adequate time to learn, practice, implement, and reflect upon new strategies that facilitate changes in their practice.

Effective professional learning according to Darling-Hammond, et al (2017) incorporates most or all of these elements. They also examine professional learning communities (PLCs) as an example of a PD model that incorporates several of these effective elements and supports students learning gains. This collaborative and job-embedded PD can be a source of efficacy and confidence for teachers, and can result in widespread improvement within and beyond the school level.

Whitehouse (2011) identified teachers' content knowledge and pedagogical knowledge; teachers' self-efficacy in teaching their subject; the frequency of specific behaviours in the classroom and in teaching and learning activities; and, students' attainment outcomes as outcomes that may be used to measure the effectiveness of CPD.

One may characterise the T-TEL professional development programme for tutors of College of Education as an effective professional development programme because it possesses almost all the features of effective professional development discussed above.

The T-TEL professional development is content focused to the extent that the teaching strategies and other activities are mainly centred on Mathematics, English and Science though they also apply to most of the subjects or courses taught in the Colleges of Education. The examples provided in the three 'Example-Plan and Practice-Teach-Reflect'(EPTR) sequence are usually in English, mathematics, and science, while the Plan and Practice Together section draws on examples across the college syllabus, covering all subjects (T-TEL, 2016a).

During the PDS tutors are put in small groups, and asked to read and discuss examples of the teaching strategies and/or concepts and sometimes do presentations. They also plan and teach their student teachers in the real classroom, using the teaching strategies and/or concepts, after which they reflect. This implies the T-TEL PD/CPD incorporates active learning.

Moreover, during the T-TEL PDS tutors normally interact, share ideas and work collaboratively during group work, presentations and reflections.

Teaching and Learning Advisers (TLAs) from T-TEL come around once in a while during PDS to observe and offer coaching and expert support if need be. The PDCs also offer coaching and expert support to tutors during the PDS or outside PDS.

Also reflection and feedback are major components of the T-TEL PDS. Every PDS begins with a reflection followed with feedback from other tutors. After individual and/or group presentations, tutors would normally get feedback from their colleagues.

The T-TEL PD/CPD programme started in September, 2015 and it is still on going. This implies that tutors have been provided with adequate time to learn, practice, implement, and reflect upon the use and impact of the new strategies on their student teachers learning. These in the researcher's view make the T-TEL PD/CPD programme an effective PD/CPD programme.

However, PD/CPD may have all or most of the elements of effective PD/CPD and may still not bring about the needed changes in mathematics teachers' and teachers' in general teaching practices and students' learning outcomes as a result of implementation challenges

2.4 Barriers to implementation of PD/ CPD

Professional development/ continuing professional development may possess all the identified features of effective CPD but may fail to bring about the needed changes in teachers' teaching practices and learning outcomes of learners, according Darling-Hammond, et al (2017), due to the following implementation challenges:

- inadequate resources, including needed curriculum materials;

- lack of shared vision about what high-quality instruction entails;
- lack of time for planning and implementing new instructional approaches;
- conflicting requirements, such as scripted curriculum or pacing guides; and
- lack of adequate foundational knowledge on the part of teachers.

In their study of 4th to 6th grade teachers, Bucznyski and Hansen (2010) discussed several barriers to the implementation of PD. They challenge the notion that PD is only as effective as a teacher's will to employ the knowledge and skills gained. They note, "… teachers that are willing to implement professional development practices in the classroom often face hurdles that are beyond their control."(p. 606). Teachers may also face hurdles that are within their control, but which are difficult, if not impossible, to attend to, given the challenging nature of their specific school environments.

Among these barriers are a lack of time allotted to teaching curriculum that uses the newly acquired knowledge and skills; the need to teach mandated curriculum on a pacing guide; challenges of teaching English learners without specific PD to address students' learning needs; a lack of resources (such as curriculum materials, technology, or science equipment); and classroom management issues. Of these barriers, the study's authors noted that lack of resources was the largest barrier to PD implementation, commenting that teachers often have to pay for their own materials for their classrooms. As a result,

> when funds are out of pocket for teachers, a financial divide is in place for students of more affluent teachers and students of teachers whose own financial resources are limited. Other resources provided by schools, such as technology, are also limited (p. 606).

These barriers affect students and teachers in a wide range of contexts; they are of particular concern for schools and districts located in high-poverty neighborhoods where financial constraints are often particularly acute. Bucznyski and Hansen (2010) recommend that teachers be given strategies during PD to proactively address possible obstacles as they arise.

Johnson and Fargo (2010) echoed these equity challenges, discussing the specific obstacles to applying the lessons of PD in urban schools. They note, "Teachers in urban schools often get caught up in the many distractions occurring on a daily basis and struggle to engage learners who are often distracted by complicated lives outside of school." (p. 23). Crises such as school closings and the uncertainty of employment were cited as examples of the type of "turbulence" that urban science teachers faced in the course of acquiring and implementing new learning from PD opportunities. These examples also demonstrate how the obstacles faced by teachers in schools may actually be manifestations of broader issues that stem from systemic problems. In the case of limited funding, for example, the learning experiences of teachers as well as students are influenced by broader policy about resource allocation.

However, to implement PD/CPD appropriately requires responsiveness to the needs of educators and learners and to the contexts in which teaching and learning will take place (Darling-Hammond, et al, 2017). They suggested that well-designed and implemented PD should be considered an essential component of a comprehensive system of teaching and learning that supports students to develop the knowledge, skills, and competencies they need to thrive in the 21st century. To them, a coherent system that supports teachers across the entire professional continuum, professional

learning should link to their experiences in preparation and induction, as well as to teaching standards and evaluation.

2.5 Level of teacher Participation in PD/CPD and teacher efficacy

When teachers attend professional development they make choices about how they will engage in the information and activities presented. This implies that teachers' attendance to professional development does not guarantee they are participating in the activities and motivated to learn from the activities to change their teaching practices.

When in attendance, teachers will either choose to actively participate or to just be present. Guskey (2000) states:

> Educators themselves frequently regard professional development as having little impact on their day-to-day responsibilities. Some even consider it a waste of their professional time. They participate in professional development primarily because of contractual obligations but often see it as something they must "get out of the way" so that they can get back to the important work of educating students. (p. 4)

It is clear that the intention of these teachers was to complete the professional development rather than learn, which will affect their decision to actively participate when in attendance, and they may likely choose not to participate. These teachers seem to be just present and are not attending the professional development to learn, but to fulfill their obligation, which will likely not result in the teachers changing their teaching practices due to the professional development. Although, in literature on professional development, participation is seen as a synonym for attendance, the example above demonstrates that participation is different from and more than attendance (Hill, 2015). Attendance is used as participation in the report published by the National Staff Development Council (Wei, Darling-Hammond, & Adamson,

2010) where findings of the Schools and Staffing Survey (SASS) are analyzed among the research literature. One finding was that participation in professional development varies across school context. Participation in this finding is defined as teacher attendance.

In distinguishing between attendance and active participation, Hill (2015) use attendance to define a teacher who is present and active participation to define a teacher who engages with the intent to learn or gain more knowledge. When attending is a required or non-required for professional development, teachers will either choose to actively participate or to just be present.

The observable actions and behaviours of students' that is the actual interaction with tasks and activities in the classroom is the students' behavioural engagement (Skinner & Pitzer, 2012). Behavioural engagement has different aspects and one of them, student engagement with academic work, aligns with Hill (2015) definition of active participation. Student engagement with academic work (Skinner & Pitzer, 2012) means participating or interacting with tasks or activities with the intent to learn.

Hill (2015) investigated the relationship between motivation and participation in PD among several grade mathematics teachers, and how these two aspects influenced teachers' intent to change their teaching practice**.** All teachers attending the professional development completed a pre- and post-survey about their motivation, ways of participating in professional development, and their intent to change teaching practices. From his sample, three teachers were identified for in-depth study and were videotaped during the professional development sessions and interviewed once after the last videotaped professional development session. Hill chose two teachers from

whom their pre-survey responses showed intent to change their teaching practices beyond a superficial change, and one teacher who did not have intent to change his teaching practice. This allowed him to make comparisons between teachers who intend to change as well as compare them to the teacher who did not.

The three focus teachers where videotaped for three concurrent professional development sessions to determine the ways that they participated. From the analysis of the observation data, Hill described how each focus teacher actively participated in the professional development, and how their participation differed. He described Amber as an *attentive, inquisitive*, and *involved explorer*. During the professional development sessions she paid attention, asked questions, involved herself in the small and large group discussions and tasks, and explored connections. These connections were either between mathematical ideas or between her prior knowledge and the content of the professional development. Ben can be described as an *attentive* and *involved conversationalist*. During the professional development he paid attention, and was involved in doing the tasks and in the small and whole group discussions. When lulls in the discussion occur, he moved the discussion along by asking questions, prompting others to share, or sharing himself. However, Carl can be described as a *passive, distractible*, yet *cooperative team player*. In the professional development he listened but was not always paying attention. He got distracted easily but, cooperated and worked well in his small groups. He did not actively seek out new learning, but participated because he was required to attend.

To fill the gap of participation in PD/PDC seen as either attendance or engagement in PD activities, in this research, the researcher takes participation to include attendance to and punctuality to T-TEL PDS as well as level of engagement of mathematics

tutors in PDS activities such as individual studying of examples of the mathematics teaching strategies, group discussions and presentations, think-pair and share, plan and practice together, whole group discussions just to mention some. Attendance is part of participation because one must be present to be able to take part in the activities of T-TEL PDS. Punctuality is also crucial in the sense that it may determines how long tutors' level of engagement will be in PDS activities and how many activities tutors' would come to meet and undertake during PDS.

2.6 Motivation and Participation in CPD Programmes

Motivation refers to reasons that underlie behaviour that is characterized by willingness and volition (Lai, 2011). Beltman (2005) associates motivation to an individual's engagement, participation and persistence in particular activities. According to Macmillan (2002) cited in Anhwere, (2013) motivation is a feeling of enthusiasm or interest that makes one determined to do something. Lai (2011) explains that motivation is made up of factors within a human being that arouse and direct goal-oriented behaviour. Motivation deals with the issue of why people do the things they do (Anhwere, 2013). Motivation can be intrinsic or extrinsic (Center on Education Policy [CEP], 2012).

Lai (2011) asserts that intrinsic motivation is motivation that is animated by personal enjoyment, interest, or pleasure. Similarly, Deci, Koestner and Ryan (1999) believe that, intrinsic motivation energizes and sustains activities through the spontaneous satisfactions inherent in effective volitional action. It is manifest in behaviours such as play, exploration, and challenge seeking that people often do for external rewards.

Extrinsic motivation is the desire to do or achieve something not for the enjoyment of the thing itself but because doing so leads to a certain results (Lai, 2011) Traditionally, educators consider intrinsic motivation to be more desirable and to result in better learning outcomes than extrinsic motivation (Deci, *et al*., 1999).

However, Anhwere (2013) believes that the extent to which motivation is intrinsic, is difficult to ascertain, since it is difficult to determine the level of the role of nature in facilitating those intrinsic values. If individuals (teachers) are to persist and implement professional learning in their everyday practice, they would need to be motivated (Beltman, 2005) be it intrinsic or extrinsic. Consistent with current conceptualizations of learning and motivation, individual motivational beliefs regarding the self and learning activities are seen as inseparable from the social context in which these activities are situated (Beltman, 2005). Similarly, in the workplace, to understand individual cognitions and actions, the social practices in which they are embedded must also be considered (Anhwere, 2013). According to Clark (2007) the complexity of factors motivating professional development has dramatically increased since the studies on factors of adult-student's participation in higher and continuing education began. Clark (2007) found out in her study that the following factors motivated teachers to participate in CPD programmes;

Gaining qualifications: Continuous professional development programmes afford teachers the opportunity to gain formal qualifications within their chosen fields. Professional development programmes also enhance teachers' base qualifications to gain promotion or to move to a new professional situation.

Enhancing job skills: It is expected that professional development would enhance teachers' content knowledge and pedagogical skills so that they could carry out the

requirements of their employment with greater satisfaction for themselves, their students and their employer.

Gaining credibility and employment opportunity: Formal professional development has the capacity to impose credibility upon the teacher's credentials. This helps him/her to gain employment opportunities out his/her professional field and also to achieve higher goals and accomplishments his/her professional career.

Benefitting the profession: Aside gaining knowledge, credibility and skills enhancement, participating in professional development programmes is an altruistic exercise for the purpose of benefiting the profession to which teachers belonged.

Responding to developments in information and communication technology: The emergence and integration of Information and Communication Technology (ICT) into all spheres of professional activities has compelled professionals such as teachers to take short courses and trainings in ICT to increase their knowledge and competences so as to be able to function effectively and efficiently in the global village.

Mandatory professional development: Some professional development programmes are a requirement for keeping a job or securing an employment. For this reason it is mandatory that for teachers to participate in such programmes. For instance, due to the upgrade of the Colleges of Education in Ghana into University Colleges, it has become mandatory for the teachers teaching in such institutions to upgrade their knowledge through PD/ CPD. Being a teacher includes a continuous growth and a commitment to learning throughout one's career and continuous professional development is ideal to meet these needs (National Council for Teaching Mathematics [NCTM], 1991).

2.7 Factors that Influence Teacher Participation in PDS

Teachers can learn to improve their teaching practice through participation in PD and their motivation to actively participate in a professional development session or programme is influenced by external and internal factors (Hill, 2015). According to him the external factors that can influence teachers' motivation are first, the effective characteristics of professional development and second, the orientation of the professional development. The orientation of a professional development is considered to be the focus and direction of the professional development (Hill, 2015). Marra et al. (2011) empirically developed six orientations that mathematics professional development is categorized into: (1) activity-driven, (2) content-driven, (3) pedagogy-driven, (4) curriculum materials-driven, (5) needs-driven, and (6) balanced-mathematics content and pedagogy driven orientations. Table 1 provides a description of each of these different orientations and their pedagogical values.

Table 1 Orientations and Description of Professional Development

	Orientation	Description
1	Activity-driven	Engage teachers in hands-on activities intended for students. The value of the activity comes from the activity itself. The conceptual or pedagogical value of the activity may not be made explicit
2	Content-driven	Help teachers learn new mathematical content and techniques to enhance the teachers' understanding of the concept(s) focused on.
3	Pedagogy-driven	Model specific instructional strategies and encourage its use to help teachers facilitate student learning.
4	Curriculum materials-driven	Guide teachers through lessons and units of curriculum materials so teachers learn how to use the materials in a classroom.
5	Needs-driven	Enlist teachers to determine needs. Then design and implement instruction based on those needs. The major feature is teacher networking.
6	Balanced-Mathematics Content and Pedagogy driven	Simultaneously focusing on content and pedagogy knowledge. Incorporates or balances the characteristics of the content-driven and pedagogy driven

Source: (Hill, 2015, p.21)

The orientations encompass the specific characteristics of professional development and provide a framework for describing professional development as one whole experience instead of the sum of individual factors (Marra et al., 2011). Within each orientation are internal and external factors that drive teachers' attendance, participation in PD and their willingness to change teaching practices. The internal and external factors work together to facilitate active participation (Hill, 2015). Livneh and Livneh (1999) found out in their study that self-motivation (internal) and external motivation (networking with others/salary improvement) are the reasons for teachers' participation in professional development activities. Similarly, teachers decided to participate in a professional development program mainly for intrinsic reasons (e.g., to link theory to practice, to improve students' learning, to collaborate, for curiosity, for pleasure, for knowledge) and extrinsic reasons (qualification achievement, compliance with authority, professional benefits) (Hynds & McDonald, 2009). Stout (1996) recognized four motives affecting teachers' participation in professional development:

- Gaining new skills/knowledge to enhance classroom practice
- Salary enhancement
- Eligibility to compete for a position/certificate maintenance and
- Career mobility/CV building.

From the above discussions, it is clear that several reasons and factors account for teachers' decision to participate in continuous professional development programmes. Teachers participate in professional development programmes to gain knowledge, improve upon their competences and instructional practices, become more relevant and credible in their job (this is self-motivation from within). Similarly,

environmental factors (external motivation) such as networking with others, salary improvement, qualification achievement, compliance with authority, professional benefits and career mobility inspired teachers' participation in PD programmes. This implies that motivation (whether intrinsic or extrinsic) cannot be ruled out when it comes teachers' participation in professional development programmes.

2.8 Influence of Self-Efficacy beliefs on Teachers' Instructional Practice

Self-efficacy does not lend itself to one definition as different writers have definite it in different ways. Self-efficacy, according to Albayrak and Unal (2011) is an individual's judgments about how well one can organize and execute courses of action required to accomplish certain goals. Self-efficacy is the belief about one's own capacity of reaching the necessary degrees of learning and behaving (Bandura, 1977). Liu and Koirala (2009) define self-efficacy as one's belief in successfully fulfilling a given task.

Self-efficacy is a person's judgment of his or her capabilities to organize and execute courses of action required to attain chosen types of performances (Opoku, 2016). Simply put, self-efficacy is the response of a person to the question, "Can I do this task well?" (Opoku, 2016). According to Ormrod (2006) self-efficacy is the measurement of individuals' skills to reach their goals and complete given tasks. Perceived self-efficacy is an individual's belief about his/her own capability to execute an action in a given situation. It is the degree to which a person believes they can do something, and it influences how a person behaves, feels, thinks, and makes choices (or decisions).

Teachers' self-efficacy beliefs have been shown to influence teachers' job satisfaction, resilience, burnout rates, health, motivation, teaching behaviours, and students' academic achievement (Mccampbell, 2014). Research has revealed that high efficacious teachers implement and assess their instruction more effectively (Lawrence & Sanders, 2012).

Self-efficacy beliefs are believed to be based on two constituents namely performance efficacy beliefs and outcome efficacy beliefs. While the former refers to one's sense of efficacy in how he/she will perform a task, the latter is related to one's sense of efficacy in achieving a goal or outcome (Bandura, 2001). In this sense, self-efficacy is related to one's perceptions of his/her competence in a certain area; thus, it may not be an accurate reflection of one's actual performance. People may overestimate or underestimate their actual abilities, which could, in turn, have an impact on the conducts they pursue and the effort they put into them (Woolfolk Hoy & Spero, 2005).

Teacher self-efficacy is an important motivational construct that shapes teacher effectiveness in the classroom. Mathematics self-efficacy is a person's belief in his/her ability to successfully performance mathematics (Burnham, 2011). This implies that self-efficacy for teaching mathematics or teaching mathematics self-efficacy is a person's belief in his/her ability to successfully teach mathematics. In this study, self-efficacy beliefs refer to mathematics tutors' beliefs about the knowledge and skills they have gained and can apply them in teaching mathematics in the new 4-year B.Ed. mathematics curriculum successfully.

With regards to self-efficacy Dede (2008) maintained that a teacher who lacks background knowledge required for the field will most probably fail to create a convenient classroom atmosphere for the students. For this reason, if a teacher has expertise in mathematics, then he first needs to have a high self-efficacy perception in mathematics discipline since having a high self-efficacy belief is the most important feature expected by a well-trained mathematics teacher (Dede, 2008).

According to Zimmerman (1995), there are four basic characteristics of self-efficacy construct, which represent its uniqueness. First, self-efficacy beliefs reflect people's judgment about their competencies to perform rather than the actual skills and knowledge they possessed. Secondly, they are multidimensional and connected with distinct domains of functioning. Thirdly, self-efficacy beliefs are task-and situation-specific. For example, one's judgments on his or her efficacy in Chemistry can differ from his or her efficacy in Mathematics or other fields. Finally, the level of self-efficacy beliefs is determined based on a mastery criterion for performance, instead of a normative criterion. Pendergast, Garvis, & Keogh, (2011) explained that teacher self-efficacy is itself influenced by four sources namely (1) Mastery experiences (serving as an indicator of capability), (2) Verbal persuasion (verbal influences on your perceived capability), (3) Vicarious experiences (modelling and observation of techniques) and (4) Emotional arousal (associated with the perceived capability that influence the process and outcomes of the task attempted).

The four sources undergo a form of cognitive processing that determines how the source of information will be weighted to influence the desired teaching task (Pendergast, *et al*, 2011). Mastery experiences are considered the most powerful influence as they provide authentic evidence of one's performance in a teaching situation (Bandura, 1997; Mulholland & Wallace, 2001). Successful performance by a

teacher leads to increased self-efficacy, while a failure creates a decrease in self-efficacy. As teachers develop mastery experience that lead to accumulating increases in teacher self-efficacy, they rely on these as memories and interpretations of similar past teaching experiences (Tschannen-Moran, Woolfolk-Hoy & Hoy, 1998).

Similarly, Bandura (1997) mentions four sources that influence self-efficacy: mastery experiences, vicarious experiences, social or verbal persuasion, and physiological and emotional states. Mastery experiences refer to experiences of success. If the teacher feels successful in his/her teaching performances, his/her level of self-efficacy for future performances increases. On the other hand, experiencing failures repeatedly lowers levels of self-efficacy. *Vicarious experiences* are those experiences that are based on the modeling of the target activity by someone else. The more the observer identifies with the modeled behavior, the higher level of self-efficacy he/she holds. *Social or verbal persuasion* is related to the feedback or comments a teacher receives from other people regarding his/her teaching performance. The more positive feedback and comments a teacher receives, the higher the level of self-efficacy a teacher has. Finally, *physiological and emotional states* also contribute to a teacher's feeling of capability or incompetence. While positive feelings experienced from a teaching practice may increase a teacher's sense of efficacy, negative feelings, such as stress and anxiety, may lead to lower self-efficacy beliefs. Researchers in education are interested in teacher self-efficacy as teacher's self-efficacy beliefs are believed to be one of the crucial factors impacting student achievement (Hoy & Spero, 2005). According to Bandura (1997), self-efficacy beliefs have an impact on their level of motivation and choice of activities.

Teachers who engage in PD programmes gain the needed content knowledge and pedagogical skills and also develop mastery of the subject matter to be imparted to the student. This is because a fully capable person may excel, perform adequately, or perform poorly as a result of self-efficacy beliefs (Bandura, 1993). Teacher self-efficacy beliefs can affect student achievement (Shaughnessy, 2004). Teachers with low self-efficacy beliefs are less willing to motivate, engage, and provided feedback to difficult students. Sustained engagement paired with good instruction leads to greater student competence and confidence which in turn leads to improved student learning and achievement (Butts, 2016).

Allinder (1995) found out that self-efficacious teachers display a tendency to exhibit greater levels of planning, are more open and willing to experiment with new methods, are more persistent and resilient when things do not go smoothly, are less critical of students when they make errors, and are less inclined to refer a difficult student to special education. Teachers with a high level of teacher self-efficacy have been shown to be more resilient in their teaching and likely to try harder to help all students to reach their potential (Pendergast, *et al*, 2011). Sharing similar view, Tran (2014) believes that teachers with high self-efficacy often perceive difficult situations and tasks as something to be mastered rather than avoiding them. Strong teacher efficacy is often related to effective classroom behaviours, (Stein & Wang, 1988) positive student outcomes, (Woolfolk Hoy & Spero, 2005) and the perceived ability to work with students from diverse backgrounds.

Teachers' self-efficacy beliefs play a crucial role in shaping teachers' classroom attitude and instructional practices. This is so, because greater efficacy motivate and encourage teachers to be less critical on students' mistakes, to provide enriched types of feedback for students' improvement and to work with students who have problems (Gibson & Dembo, 1984). Teachers with high sense of efficacy are open to reforms, more willing to implement new methods and materials, and tend to present great deal of planning and organization, through their search for the better ways of teaching (Kabaoğlu, 2015). Özge (2015) who investigated the differences between primary school teachers who have high and low self-efficacy beliefs regarding their mathematics teaching in Turkey found that teachers with a higher self-efficacy beliefs showed a higher level of effort and persistence with students, being more open to new ideas and new methods, believing in students' achievements and taking responsibility for students' success, placing more importance on building a warm relationship with their students rather than with the parents than teachers with a lower self-efficacy belief.

Unsal, Korkmaz, and Percin (2016) whose study was to determine whether or not mathematics teachers' opinions on their teaching process self-efficacy levels differed with regards to gender, school of graduation, educational background, professional seniority, type of school of profession and level of school of profession variables found that mathematics teachers have high self-efficacy beliefs concerning the teaching process, and that these self-efficacy beliefs differed based on gender, year of service, level of school of profession variables and that these opinions did not differ based on the type of school of graduation, educational background and type of school variables. Similarly, Dede (2008) conducted a study to determine self-efficacy levels of mathematics teachers on teaching and concluded mathematics teachers have high

self-efficacy beliefs for teaching. Likewise, Ağçam and Babanoğlu (2016) examined self-efficacy beliefs of teachers working at primary state schools in Turkey regarding dimensions such as instruction, adapting instruction to individual needs, motivating students, and maintaining discipline. Findings of the study suggest that teachers' self-efficacy beliefs are improved through gaining professional experience, and that female teachers seem to have lower self-efficacy beliefs than their male colleagues with respect to motivating students, keeping discipline in classroom, and coping with challenges.

Gibson and Dembo (1984) see self-efficacy beliefs of teachers as the strongest predictors of their choices and behaviours, have a powerful influence on the amount of effort they put for teaching, the goals they set, their persistence in the face of challenges, and their enthusiasm. From the above, one cannot be faulted for concluding that achieving high self-efficacy may be elusive if teachers do not continually upgrade their knowledge, competences and skills on the job as the NCTM (1991) asserts that being a teacher includes a continuous growth and a commitment to learning throughout one's career. This assertion was further strengthened by Hill, (2015) conviction that there is always something that a teacher can learn to improve their teaching practice.

2.9 Summary of Literature Review

The theoretical framework used for justification for the need for adults (teachers) learning was B. F. Skinner's Reinforcement Theory. The tenets of this theory are that, a desired behaviour will be repeated if positive reinforcement (a pleasant consequence) follows the behaviour; and a behaviour will not be repeated if negative reinforcement (an unpleasant consequence) follows the behaviour. This theory provided support for the need to provide teachers with learning opportunities (positive

reinforcement) that will boost their competence and increase their self-efficacy beliefs for teaching to teach in a way that will increase students' academic achievements.

The literature looked at various definitions of professional development. Definitions by Day (1999), Earley and Bubb (2004), OECD (2009), European Union (2010), Nortey (2010), Jao and McDougall (2015) were considered. Though there were barely noticeable differences in the definitions given on PD by these scholars and organizations, they all seem to agree that PD is any continuous training of any format offered to teachers to improve teaching in schools. Literature showed that the purpose of teacher professional development is to bring about change in:

- teachers' beliefs, attitudes, values, and understandings
- teachers' educational practices and
- students' learning outcomes (Guskey, 2002; Knight, 2002).

Literature on effective professional development identifies the following as features of effective professional development:

(1) Is content focused, (2) Incorporates active learning utilizing adult learning theory, (3) Supports collaboration, typically in job-embedded contexts, (4) Uses models and modeling of effective practice, (5) Provides coaching and expert support, (6) Offers opportunities for feedback and reflection and (7) Is of sustained duration.

In the literature reviewed on level of participation of Teachers in PD/CPD, it came to light that participation in some cases is seen as synonymous to attendance. However, in distinguishing between attendance and active participation, Hill (2015) use attendance to define a teacher who is present and active participation to define a teacher who engages with the intent to learn or gain more knowledge. Amber was described A in terms of participating in professional development as someone who

paid attention, asked questions, involved herself in the small and large group discussions and tasks, and explored connections. It is clear that there is a gap in literature regarding the term participation of teachers in PD/PDC as some writers use participation to mean attendance and other use it to mean engagement in activities. The gap created by the different meaning given to participation of teacher in PD/PDC is what this study sort to fill. To find out mathematics tutors' level of participation in T-TEL PDS in terms of attendance, punctuality and engagement as well as find their self-efficacy beliefs about their ability to implement the new 4-year B.Ed. mathematics curriculum as a of their participation in T-TEL PDS.

From discussions of motivation to participate in continuing development programmes, literature shows that several reasons and factors account for teachers' decision to participate in continuous professional development programmes. Teachers participate in professional development programmes to gain knowledge, improve upon their competences and instructional practices, become more relevant and credible in their job (this is self-motivation from within). Similarly, environmental factors (external motivation) such as networking with others, salary improvement, qualification achievement, compliance with authority, professional benefits and career mobility inspired teachers' participation in PD programmes. This implies that motivation (whether intrinsic or extrinsic) cannot be ruled out when it comes teachers' participation in professional development programmes.

Influence of self-efficacy beliefs on teachers' instructional practice concluded the literature review. Several definitions of self-efficacy beliefs were considered. From the various definitions, self-efficacy is seen as an individual's belief about his/her own capability to execute an action in a given situation. Generally, it was found out

that teacher self-efficacy is influenced by four sources namely (1) Mastery experiences (serving as an indicator of capability), (2) Verbal persuasion (verbal influences on your perceived capability), (3) Vicarious experiences (modelling and observation of techniques) and (4) Emotional arousal (associated with the perceived capability that influence the process and outcomes of the task attempted). Empirical evidence showed that teachers with high sense of efficacy are open to reforms, more willing to implement new methods and materials, and tend to present great deal of planning and organization, through their search for the better ways of teaching.

CHAPTER THREE

METHODOLOGY

3.0 Overview

This chapter talks about the methodology used in the study. It discusses the research design adopted for the study, the population, the sample size as well as the sampling technique. It also describes the research instruments, piloting of instruments, validity and reliability, data collection procedure and data analysis. In addition, ethical issues in the study are discussed.

3.1 Research Design

Research design articulates what data is required, what methods are going to be used to collect and analyse data, and how all of these are going to answer the research question(s). According to McMillan and Schumacher (2014) a research design describes the procedures for conducting the study, including when, from whom, and under what conditions the data will be obtained. A research design is a plan outlining how information is to be gathered from subjects for an assessment or evaluation that includes identifying the data gathering method(s), the instruments to be used, how the instruments will be administered, and how the information will be organized and analyzed (Asamoah-Gyimah & Duodu, 2007). Research design provides the glue that holds the research project together (Trochim, 2006). From a careful examination of these definitions, one can describe a research design as the overall plan for collecting data in order to answer the research questions.

The mixed methods design was used for this study. The mixed methods research is an approach to inquiry that involves collecting both quantitative and qualitative data, integrating the two forms of data, and using distinct designs that may involve

philosophical assumptions and theoretical frameworks. The core assumption of this form of inquiry is that the combination of qualitative and quantitative approaches provides a more complete understanding of a research problem than either approach alone (Creswell, 2014). Yin (2006) describes the mixed methods research as a systematic integration of quantitative and qualitative methods in a single study for purposes of obtaining a fuller picture and deeper understanding of a phenomenon. From the above definitions, the mixed methods can be described as an approach to research that uses variety of research instruments in a single study to collect and analyze data.

The use of a mixed methods design comes with both advantages and disadvantages. For example, using mixed methods does not only enhance credibility of findings from a single method but also allows the researcher to incorporate the strengths of each method, thereby addressing deficiencies in each method. This brings about a more comprehensive picture of what is being studied, emphasizing quantitative outcomes as well as the process that influenced the outcomes (McMillan & Schumacher, 2014; Creswell, 2014). However, the use of mixed methods may mislead readers if the approach doesn't fully integrate both types of designs. The difficulty in writing reports and forming conclusions may also arise when the mixed methods is employed in a study (Creswell & Plano-Clark, 2011).

In convergent mixed methods, the researcher converges or merges quantitative and qualitative data in order to provide a comprehensive analysis of the research problem. In this design, the researcher typically collects both forms of data at roughly the same time and then integrates the information in the interpretation of the overall results.

Contradictions or incongruent findings are explained or further probed in this design. (Creswell, 2014).

Considering the research problem, the purpose and the research questions formulated to guide this study, the researcher adopted the mixed methods survey approach that involves concurrent triangulation of data. Concurrent triangulation design is described by McMillan and Schumacher (2014) as a design in which the researcher simultaneously gathers both quantitative and qualitative data, merges them using both quantitative and qualitative data analysis methods, and then interprets the results together to provide a better understanding of a phenomenon of interest. This design was adopted by the researcher because it would enable him collect both quantitative and qualitative data, interpret and present the results together for a more comprehensive and deeper understanding of mathematics tutors' level of participation in the T-TEL professional development sessions and their perceived self-efficacy beliefs to implement the new 4-year B.Ed. mathematics curriculum.

3.2 Population

Population is a group of elements or cases, whether individuals, objects, or events, that conform to specific criteria and to which we intend to generalize the results of the research (McMillan & Schumacher, 2014). In other words, population refers to the group of individuals or events from which a sample is drawn and to which results can be generalized. Population according to Kusi (2012) is a group of individuals or people with the same characteristics and in whom the researcher is interested. The population for this study comprised forty-five (45) mathematics tutors in eight (8) public Colleges of Education, which have taken part in all the eight (8) themes so far, in the Northern Ghana.

3.3 Sample for the Study

A sample is a group of elements, or a single element, from which data are determined. It could also be defined as a subset or collection of some units of the universe or population (Amoah & Eshun, 2015). Seven Colleges of Education, two from the Upper East, two from the Upper West and three from the Northern regions were sampled for the study. All the mathematics tutors numbering thirty-nine (39), in the seven (7) sampled Colleges of Education, were involved in the study. Wiersema (2009) points out that a sample should be large enough so that the validity and reliability of the data is achieved. Therefore, he proposes a sample size of 30% of the population as being reliable. To this end, a total of 39 mathematics tutors representing 86.7% of accessible population (45mathematics tutors) were selected for the study.

3.4 Sampling Techniques

Specifically convenience sampling technique was used to select seven Colleges of Education; two (2) from the Upper East, two (2) from the Upper West and three (3) from the Northern regions for the study. The convenience sampling technique was used due to easy accessibility and proximity of the Colleges of Education to the researcher. All the mathematics tutors numbering thirty-nine (39) (2 females, 37 males), in the seven (7) sampled Colleges of Education, were purposively sampled for the study. Purposive sampling was used because the researcher was interested in information from only mathematics tutors but not other tutors in the sampled Colleges.

Seven (7), (2 females, 5 males) mathematics tutors, one from each of 7 colleges, were sampled for interview for in-depth information about their level of participation in T-TEL professional development sessions and their perceived self-efficacy beliefs to implement the new 4-year B.Ed. mathematics curriculum. The only 2 female

mathematics tutors in the study were purposively sampled for the interview to take care of gender representation while the 5 males were selected based on their availability.

3.5 Research Instruments

Questionnaire and semi-structured interview guide were used to collect data for the study. A questionnaire is normally made up of a list of questions, which also includes clear instructions and space for answers or administrative details (Amoah & Eshum, 2015). A good questionnaire must always have a definite purpose that is related to the objectives of the research and must be clear from the onset how the findings will be used. According to Kusi (2012) a structured questionnaire contains predetermined standardized questions or items meant to collect numerical data that can be subjected to statistical analysis. It is advantageous to use questionnaire whenever the sample size is large enough to make it uneconomical for reasons of time or funds to observe or interview every subject (Asamoah-Gyimah & Duodu, 2007). Dampson and Mensah (2014) on their part suggested that, in order to gather information about respondents' opinion on how far they agree or disagree on a statement given, the questionnaire is the ideal instrument. For these reasons, a structured questionnaire for Level of Participation and Perceived Self-Efficacy for Teaching Mathematics Instrument (LPPSETMI) was developed and used to gather background information of mathematics tutors, their level of participation in T-TEL professional development sessions and their perceived self-efficacy beliefs about their ability to implement the new 4-year mathematics curriculum. The researcher used the questionnaires because they are easier to administer and analyze. The questionnaires were also used for the fact that all the participants were literate.

The level of participation aspect of the questionnaire was developed by the researcher with the help of colleagues, lecturers and the supervisor while the self-efficacy beliefs for implementing the new B.Ed. mathematics aspect was adapted from McGee and Wang (2014) Self-Efficacy for Teaching Mathematics Instrument (SETMI) items with Cronbach's alpha reliability co-efficient of α = .92 and Teachers' Sense of Efficacy scale (TSES) with α =0.96. The wording was modified to reflect the context of the study.

An interview instrument is best for collecting facts about people's place of work and to gain insight of an event (Dampson & Mensah, 2014). A semi-structured interview is flexible to a greater extent, offering interviewees the opportunity to express their views, feeling and experiences freely and the interviewers the freedom to divert from the questions in the schedule to seek clarifications during the interview process (Kusi, 2012). Therefore, a semi-structured interview guide was developed and used to gather in-depth qualitative data on mathematics tutors' level of participation in T-TEL professional development sessions and perceived self-efficacy beliefs to implement the new 4-year B.Ed. mathematics curriculum.

3.5.1 Questionnaire

A questionnaire for Mathematics Tutors of College of Education was designed by the researcher (see Appendix A) and used to gather data on Mathematics Tutors' level of participation in T-TEL professional development sessions and perceived self-efficacy beliefs to implement the new 4-year B.Ed. mathematics curriculum in the Colleges of Education. The questionnaire consists of three sections 'A' 'B' and 'C'. Section 'A' contained five items (1 to 5) that sought information on the bio data of the Mathematics Tutors. The items elicited information on respondents' gender, age,

years of teaching in Colleges of Education, academic qualifications, and mathematics course(s) being taught in the Colleges of Education.

Section 'B' contained 3 items (6 to 8) with item 8 subdivided into 11 items ('a' to 'k'). All the items in this section elicited information on level the of mathematics tutors' participation in T-TEL professional development sessions. The item 8 subdivided into 11 items ('a' to 'k') were also further divided and used to elicit information on level of mathematics tutors' participation in activities that led to acquisition of knowledge and skills, and on their level of participation in implementation of the knowledge and skills acquired. Items 'b', 'c', 'd', 'e', 'g' and 'h' were used to measure level of participation that led to acquisition of knowledge and skills while items 'a', 'f', 'i', 'j' and 'k' were used to measure level of participation that led to implementation of knowledge and skills. The items in this section were developed by the researcher with the help of colleague students, lecturers and the supervisor. A 5-point Likert Scale with options (1 = Very Low, 2 = Low. 3 = Average, 4 = High, 5 = Very High) was used to ascertain mathematics tutors' level of participations in T-TEL professional development activities for item 8 subdivided into 11 items ('a' to 'k').

Section 'C' contained item 9 subdivided into 12 items ('i' to 'xii') which sought information on mathematics tutors' perceived self-efficacy beliefs to implement the new 4-year B.Ed. mathematics curriculum in the Colleges of Education. Item 9 subdivided into 12 items were further divided into (i, ii, iii, vi, vii, viii and ix) and (iv, v, x, xi, xii) and used to elicit information on mathematics tutors' perceived self-efficacy beliefs to implement the new 4-year B.Ed. mathematics curriculum using 'professional knowledge and practice' and 'cross-cutting issues' respectively. The

items in this section were adapted from McGee and Wang (2014) Self-Efficacy for Teaching Mathematics Instrument (SETMI) items with Cronbach's alpha reliability co-efficient of α = .92 and Teachers' Sense of Efficacy scale (TSES) with α =0.96. The wording was modified to reflect the context of the study. The items ('i' to 'xii') were on a 5-point Likert Scale with options (1= Not at All, 2=Very Little, 3=Little, 4=Quite A Bit, 5=A Great Deal) designed to ascertain mathematics tutors' perceived self-efficacy beliefs to implement the new 4-year B.Ed. mathematics curriculum in the Colleges of Education

3.5.2 Interview

An interview is a verbal conversation with the objective of collecting relevant information for the purpose of research (Amoah & Eshum, 2015). Kusi (2012) describes the semi-structured interview as flexible and offers the interviewees the opportunity to express their views, feelings and experiences freely. It also offers the interviewers the freedom to divert from the items/questions in the schedule to seek clarifications (using probes) during the interview process. The purpose for using the semi-structured interview was to enable the researcher to probe the interviewees' responses on the questionnaire for clarifications and to obtain in-depth information of their level of participation in T-TEL PD activities and perceived self-efficacy beliefs to implement the new 4-year B.Ed. mathematics curriculum. Again, the semi-structured interview was used because it expands the responses of interviewees to ascertain their feelings and experiences (Kusi, 2012).

The researcher also used the interview for the purpose of triangulation, cross-checking and to compare and contrast to validate findings of the data. According to Akurugu (2012), "interview goes beyond the spontaneous exchange of views in everyday

conversations, and becomes a careful questioning and listening approach with the purpose of obtaining thoroughly tested knowledge" (p. 83).

The designed interview guide contained 6 questions with 2 of them subdivided into 3 and 4 questions. The whole interview guide was divided into two parts, which is part I and part II(see Appendix B). Part I had the broad theme 'Level of Participation in T-TEL Professional Development Sessions' which asked mathematics tutors to indicate how often they attended and how punctual they were to T-TEL professional development sessions. They were also asked to explain their level of engagement in T-TEL professional development sessions with regards to:

a. The Teaching Strategies/Approaches of various Themes,
b. Example-Plan and Practice,-Teach-Reflect
c. Cross-cutting issues, such as Equity and Inclusivity, Transferable Skills, ICT, and Assessing Pupils' Learning and Progress

Part II of the guide was on 'Self-Efficacy Beliefs' of mathematics tutors ability to implement the new 4-year B.Ed. mathematics curriculum in the Colleges of Education as a result of their participation in the T-TEL Professional Development Sessions.

3.6 Piloting of Research Instruments

The piloting of the research instruments is very critical because it serves among other things, to check clarity of the statements/questions, give feedback on validity of the statements/questions and also to make sure that the data required will answer the research questions. The pilot study was conducted in St. Vincent and McCoy Colleges of Education, in the Northern and Upper West regions. The researcher administered the questionnaire to eight mathematics tutors and interviewed one who willingly agreed to be interviewed using the interview guide as a trial. These Colleges of

Education were used for the pilot study because the mathematics tutors have similar characteristics and features in terms of academic qualifications, the activities and programmes they undertake as the participants in the Colleges of Education for the actual study. The pilot study was done in these Colleges of Education to avoid giving the respondents the fore-knowledge about the information required which will lead to pre-determined responses during the actual study (Kusi, 2012). Also, those undertaking the pilot will have become sensitized to the questions so that any answers they give in the main study will be influenced in a different way from those who have not. Another reason for pilot testing the research instruments was to make sure that they (instruments) would be able to elicit the needed response from the respondents during the actual study. The researcher also piloted the interview guide on one of the eight mathematics tutors who responded to piloted questionnaire to check for omissions and make additions where necessary as well as find out how appropriate the responses will be in answering the research questions 1 and 2. The recorded response of the respondent was played back to the interviewee for clarification and verification of his responses. The responses were found to be partly appropriate for answering the research questions 1 and 2.

3.6.1 Validity (content and face)

Measurement validity is the extent to which inferences made on the basis of numerical scores are appropriate, meaningful, and useful (McMillan & Schmacher, 2014). They suggested that validity is the single most important aspect of an instrument and the findings that result from the data. Kankam and Weiler (2010) in their view opined that validity refers to the "degree to which an instrument accurately measures what it intended to measure" (p.78). Moreover, Mugenda and Mugenda (2009) described validity as the degree to which results obtained from the analysis of

the data actually represent the phenomenon under study. There are several approaches of ensuring validity of an instrument. The researcher, therefore, adopted face and content validity to test the validity of the questionnaire and interview guide. To check for face validity of the instruments, the researcher gave/emailed copies of the questionnaire and interview guide to three senior lecturers including his supervisor for scrutiny and to make comments on the structure, language, depth and items of the instruments. Comments and suggestions from the three senior lecturers led to some additions, and changes in wording of few items of the instruments. For example, one suggested that item number 7 and its options which read

'Tick one of the options below to indicate how punctual you are to PDS.'

a) 60 or more minutes late

b) 30 or more minutes late

c) 15 or more minutes late

d) On time

e) In time

be changed to read, 'How punctual were you at the PDS (Please, tick one of the options below)'

f) I was **always late** and missed the first 30 minutes ☐

g) I was **sometimes late** and missed the first 30 minutes ☐

h) I was **two or three times late** and missed the first 15 minutes ☐

i) I was **always present** at the PDS venue before it begins. ☐

Also comments and suggesting from the researcher's supervisor led to the rewording of Instructions for item 8 for the questionnaire from: 'On a scale of (**1**to **5**), **1 = Very**

Low, 2 = Low, 3 = Average, 4 = High, 5 = Very High, rate your engagement during T-TEL Professional Development Sessions (PDS) by ticking [√] in the appropriate box' to 'Read the statements numbering **a-k**. On a scale of (**1**to **5**), **1 = Very Low, 2 = Low. 3 = Average, 4 = High, 5 = Very High**, rate your level of engagement in the T-TEL Professional Development activities for teachers of Colleges of Education in the table below by ticking [√] the appropriate cell (or box)' Content validity of the instruments were based on the fact that, the items of the questionnaire and interview guide were all teaching strategies/approaches and concepts in the T-TEL models/books. A copy of the questionnaire and interview guide was also given to the researcher's colleague graduate M. Phil. mathematics education student, who was a T-TEL professional development coordinator (PDC), to check and comment on the items in the instruments. After careful examination, his comment was that all the items are based on the T-TEL models/books.

3.6.2 Reliability

Reliability is the measure of the degree to which a research instrument consistently measures whatever it is measuring in repeated trials (Gay & Airasian, 2009). Reliability refers to the consistency of a measure (Cherry, 2014). Cronbach's alpha reliability co-efficient is one of several methods of determining the reliability of an instrument. However, according to (McMillan & Schmacher, 2014), the drawback to using a measure of alpha for internal consistency is that it requires at least three questions (preferably five or more) that measure the trait or variable. Nonetheless, this drawback does not apply to this questionnaire since each variables has more than five statements to measure them. An instrument is thus, considered reliable if one gets the same results when it is administered repeatedly. It is against this background that the researcher conducted a pilot study at St. Vincent and McCoy Colleges of Education to

determine the reliability of the research instruments. The questionnaire was administered to eight mathematics tutors and one of them was randomly selected and interviewed using the interview guide. After the pilot study, IBM SPSS (version 21) was used to analyze the data from the pilot study to determine the internal consistency (Cronbach's alpha reliability co-efficient) of the questionnaire. Cronbach's alpha determines agreement of answers on questions targeted at a specific trait and used to answer questions made on a scale of some kind rather than as right or wrong (McMillan & Schmacher, 2014). They added that the scale could be levels of agreement; height; high, medium, and low socioeconomic status; extensive to little experience; and so on.

At the end of the analysis, the Cronbach's alpha values of .903 and .943 for the variables mathematics tutors' Level of Participation in T-TEL PDS and self-efficacy beliefs of mathematics Tutors respectively as showed in Table 2.

Table 2 Reliability Coefficients of Questionnaire for Mathematics Tutors of College of Education

	Variables	No. of Items	Cronbach's Alpha Coefficient
1	Level of Mathematics Tutors' Participation in T-TEL Professional Development Sessions	13	.902
2	Mathematics Tutors' Perceived Self-Efficacy Beliefs	15	.943
	Total	**25**	

Source: Field data, 2019

Alpha coefficients should be reported for every total and for each subscale score that is used as a variable (McMillan & Schmacher, 2014). According to Leech, Barrette and Morgan (2005), alpha value of 0.70 and above indicates a reasonable internal consistency and alpha values between 0.60 and 0.69 indicate minimally adequate reliability. Ary, Jacobs and Razavieh (2002) explain that if the results are used to make decisions about a group or for research purposes, reliability coefficients of .50

to .60 are accepted. Apart from the individual alpha values of the variables which were reliable, the overall internal consistency of the questionnaire was .954. Therefore the research questionnaire was accepted and deemed reliable.

3.7 Trustworthiness of the Instruments

According to Veal (2011) and Bryman (2012) trustworthiness consists of four different components namely credibility (the validity of the findings), transferability (the applicability of the findings in other contexts), dependability (reliability of the findings at another time), and confirmability (objectivity of the researcher while carrying out his/her research). All four combined constitute trustworthiness for any qualitative research.

3.7.1 Credibility

Guba and Lincoln (1989) described credibility as being parallel to internal validity and focuses on establishing a match between the constructed realities of respondents and those realities represented by the researcher(s). In other words credibility is how confident the qualitative researcher is in the truth of the research findings and answers the question: "How do you know that your findings are true and accurate?"

Contextualizing the study and member checks (Merriam, 1998) have been suggested among others as strategies for establishing credibility of a qualitative study. Kuzel and Like (1991) explained that member checking consists of the researcher restating, summarizing, or paraphrasing the information received from a respondent to make sure that what was heard or written down is the correct response or member checking consists of reporting back preliminary findings to respondents or participants, seeking critical commentary on the findings, and potentially incorporating these critiques into the findings. To establish the credibility of this research findings, the researcher gave

back the transcriptions of the interviews to the interviewees to check whether what were transcribed were true reflection of their responses. They were allowed to offer comments on whether or not they felt the data were interpreted in a manner congruent with their own experiences. The feedback from the participants increased the credibility of the findings of this study.

3.7.2 Transferability

Transferability is how the qualitative researcher demonstrates that the research findings are applicable to other contexts (Marshall & Rossman, 2011). According them "other contexts" can mean similar situations, similar populations, and similar phenomena. Qualitative researchers can use thick descriptions to show that research findings can be applicable to other contexts, circumstances, and situations. Thick descriptions may include providing vivid explanation of the methods and procedures followed during and after data collection (Kuzel & Like 1991). The researcher used thick descriptions to substantiate and illustrate assertions made by individual participants to illuminate the contexts. He also discussed thoroughly the research methods and procedures he followed during and after data collection.

3.7.3 Dependability

Dependabilit*y* is the extent to which a study could be repeated by other researchers and the findings would be consistent (Veal, 2011). In other words, if a person replicates a study, he/she should have enough information from that research report to do so and obtain similar findings as that study did. Veal, added that a qualitative researcher can use inquiry audit in order to establish dependability, which requires an outside person to review and examine the research process and the data analysis in order to ensure that the findings are consistent and could be repeated.

In this study both research methods and data analysis documents were audited by my supervisor and other senior lecturers in the mathematics department who have expert knowledge and experience with qualitative research. Their suggestions were incorporated into the work and based on practice in qualitative research, dependability of the research methods and data analysis procedures were established.

3.7.4 Confirmability

Confirmability is the degree of neutrality in research findings. In other words, the findings are based on participants' responses and not any potential bias or personal motivations of the researcher (Kuzel & Like 1991). It involves making sure that researcher's bias does not skew the interpretation of what the research participants said to fit a certain narrative. Confirmability was taken care of in this study by the use of questionnaire and interview to minimize instruments' bias. Moreover, the research methods were audited by a competent expert.

3.8 Data Collection Procedures

To facilitate the process of data collection from mathematics tutors in the sampled Colleges, the researcher asked for an introductory letter from the head of mathematics Education department of University of Education Winneba to the principals of the sampled Colleges, (see Appendix C). The researcher visited the seven Colleges of Education and administered the questionnaire and the interview to the mathematics tutors with support from Mathematics Heads of Departments (HODs). In each College, the researcher first went to the Principal's Office or the Vice Principal's Office (when the principal was not available), submitted his introductory letter and obtained permission to administer the research instruments. The researcher then contacted the Heads of Mathematics Department and explained to them the purpose of

the research and asked for their support to administer the questionnaire and interview to the mathematics tutors in their departments. The researcher and HODs of the various sampled colleges agreed that one week would be used to distribute the questionnaires and the following week for collection of completed questionnaires since not all mathematics tutors' resided on campus or were at time, on campus.

In all, 39 questionnaires were distributed to all sampled thirty-nine (39) mathematics tutors to ascertain their level of participation in T-TEL PDS and their perceived self-efficacy beliefs to implement the new 4-year B.Ed. mathematics curriculum. However, 37 out of the 39 questionnaires distributed to the participants were completed and returned. The data from the 37 participants were used for the study.

The data collection lasted for five weeks. The first week was used to distribute the questionnaires to participants in the Northern region Colleges of Education. The researcher used the second week to collect the completed questionnaires and conducted interviews with three of the participants. Similarly, the researcher used the third week to distribute the questionnaires to participants in the Upper East and Upper West regions Colleges of Education. The fourth week was used to collect the completed questionnaires and conducted interviews with two participants. Two other participants were interviewed in the fifth week. Seven participants (2 females and 5 males), one from each of the 7 sampled colleges were selected, interviewed and audio recorded. The researcher randomly selected one male participant from those who were available in each college at the time of his visit to collect the completed questionnaires. All 5 male participants agreed to be interviewed and audio recorded. They were interviewed and audio recorded with a smart phone in the HODs offices to minimize noise interference. The 2 female participants were purposively selected, interviewed and recorded on phone at their convenient day and time within the fifth

week of data collection. These were done after they had agreed and permitted the researcher to interview them and record.

3.9 Data Analysis Procedures

Data were collected using questionnaire and a semi-structured interview in this study. Data from the instruments yielded both quantitative and qualitative data and were analyzed both quantitatively and qualitatively.

According to Dampson and Mensah (2014) research data can be analyzed quantitatively by means of graphs, charts, frequencies, percentages, averages and ratios among others. Descriptive statistics for the items were generated using the IBM Statistical Package for Social Sciences (SPSS, version 21.0.) for easy analyses. Data collected from the questionnaire were coded and entered into SPSS, version 21.0. With the exception of items ii, iv, viii and x, each subdivided items of question 9 were coded as 1 for 'Not At All', 2 for 'Very Little', 3 for 'Little', 4 for Quite A Bit' and 5 for 'A Great Deal'. However, the coding for items ii, iv, viii and x was noted and reversed as 5 for 'Not At All', 4 for 'Very Little', 3 for 'Little', 2 for Quite A Bit' and 1 for 'A Great Deal' since the statements were negative.

The qualitative data collected from the semi-structured interview guide were transcribed word-for-word by listening to the recorded audio interviews. The transcribed interview was analyzed according to themes and used to partly answer research questions 1 and 2. The themes were generated from level of participation in T-TEL PDS and perceived self-efficacy beliefs to implement the new 4-year B.Ed. mathematics curriculum. The researcher gave back the transcriptions of the interviews to the interviewees to check whether what were transcribed were true reflection of their responses.

3.10 Ethical Consideration

According to Kusi (2012) ethics in educational research are those issues that are related to how the educational researchers conduct themselves or their practices and the consequences of these on the people who participate in their research. Ethical issues that were considered in this study are the permission to collect data, informed consent, confidentiality, and anonymity.

3.10.1 Permission to Collect Data

The researcher obtained a letter of introduction from the Department of Mathematics Education, University of Education, Winneba to enable him access and to facilitate the smooth collection of data from the sampled Colleges of Education and the mathematics tutors without violating ethical rules as Kusi (2012) citing Creswell (2005) puts it, it is unethical to enter into an organization or social groups to collect data without permission from the 'gate-keepers' of the organization, (see Appendix C).

3.10.2 Informed Consent

Participants were informed about the purpose of the study as captured in the preamble of the questionnaire, how it will be carried out and the role they are expected to play, the kind of data to be collected and how it would be used. This was done to give the participants the choice to decide whether to participate or not to participate in the study. This kind of information was also necessary because people make decisions to participate in a study depending on the quality of information they receive about it (Karma, 1999). It was therefore very prudent to equip participants with the needed information so as to get them to participate in the study and also pull out at any part of the study.

3.10.3 Anonymity

Anonymity means that the researcher cannot identify the participants from information that has been gathered. This implies that there is no way for the researcher(s) to know who said or did what, even when inspecting data that are collected (McMillan, & Schumacher, 2014). The researcher ensured that participants did not provide their names and addresses on the questionnaire. Each participants was given an A-4 brown envelop for putting and sealing completed questionnaire to avoid being identified. According to anonymity is easily achieved in much survey research in which little or no identifiable information is gathered and the participants' responses are objective, with no open-ended questions.

The researcher also ensured that information about the College of Education does not appear in the report of the study. However, anonymity was not possible during the face-to-face interviews between the researcher and the seven (7) sampled participants. Nonetheless, the researcher ensured participants of confidentiality.

3.10.4 Confidentiality

According to McMillan, and Schumacher (2014), confidentiality means that no one has access to individual data or the names of the participants except the researcher(s). They added that confidentiality is ensured by making certain that the data cannot be linked to individual subjects by name. The researcher made sure that the information provided by participants was treated with care so that it does not get to unauthorized persons who are not connected to the study in any way. The data collected from participant **were** also used for the purpose of the study only.

CHAPTER FOUR

RESULTS AND DISCUSSIONS

4.0 Overview

The study examined colleges of education mathematics tutors' level of participation in the T-TEL professional development sessions and their perceived self-efficacy beliefs to implement the new 4-year B.Ed. mathematics curriculum as a result of their participation in the T-TEL professional development sessions. Both questionnaire and interview were used to collect data. The questionnaire was used to collect quantitative data on mathematics tutors' biometric data, level of participation in T-TEL PDS, and their perceived self-efficacy beliefs while the interview was used to collect qualitative data on the same variables. The results of the analysis of data are presented and discussed in this chapter. The chapter is organized in three parts. Part one examines the demographic composition of the sample. The data presentation on the research questions and hypotheses is done in the second part, and finally, the discussion of the results is captured in the third part.

4.1 Demographic Composition of Respondents

Section A of the questionnaire comprising questions 1 to 5 required participants' to provide their demographic characteristics such as gender, age, years of teaching in College of Education, academic qualifications and teaching courses. Their responses were organized into frequencies and percentages and presented in Table 3.

Table 3 Demographic characteristics of Mathematics tutors/ respondents

Variable	Category	Frequency	Percent
Gender	Male	35	94.6
	Female	2	5.4
	Total	37	100
Age	35 - 39 years	8	21.6
	40 - 44 years	10	27.0
	45 - 49 years	7	19.0
	50 - 54 years	6	16.2
	55 - 59 years	6	16.2
	Total	37	100
Teaching Experience in CoE	1 - 5 years	8	21.6
	6 - 10 years	9	24.3
	11 - 15 years	11	29.7
	16 - 20 years	7	19.0
	21 years and above	2	5.4
	Total	37	100
Academic Qualification First Degree	B.Sc. Mathematics	3	8.1
	B.Sc. Maths. Education	2	5.4
	B.Ed. Mathematics	24	64.9
	B.Ed. Statistics	2	5.4
	Others (Specify)	6	16.2
	Total	37	100
Academic Qualification Master's Degree	M.Ed. Mathematics	19	51.4
	M.Phil. Mathematics	1	2.7
	M.Phil. Maths. Education	3	8.1
	M.Phil. Statistics	3	8.1
	Others (Specify)	7	18.9
	Total	33	89.2
Ph.D.	Ph.D. Maths. Education	0	0
	Ph.D. Maths.	0	0
	Ph.D. Statistics.	0	0
	Others	1	2.7
	Total	1	2.7
Teaching Courses	Number and Basic Algebra	12	32.4
	Algebra and Geometry	3	8.1
	Geometry and Trigonometry	15	40.5
	Trigonometry	4	10.8
	Calculus	6	16.2
	Algebra I	15	40.5
	Algebra II	8	21.6
	Further Algebra	12	32.4
	Statistics and Probability	23	62.2
	Vectors and Rigid Motion	4	10.8
	Methods of Teaching Basic School Mathematics	29	78.4
	Mathematics Activities	2	5.4

Table 3 indicates that the teaching of Mathematics at the Colleges of Education (CoEs) in Northern Ghana is dominated by males. The results revealed that majority of the mathematics tutors were males (n=35, 94.6%) as compared to the females who participated in the study (n=2, 5.4%). This suggests a wide gender disparity in favour of the male tutors. This situation calls for a deliberate recruitment drive of female mathematics tutors into colleges of education in Northern Ghana to close the gender gap and to make recruitment of mathematics tutors gender responsive in the colleges of education. More female mathematics tutors teaching in the CoEs can serve as role models for female pre-service Mathematics and Science teachers.

Table 4.1 also revealed that majority of the respondents were below 50 years (n= 25, 67.5%) while the remaining 12 respondents representing 33.3% were 50 and above years. This indicates that most of the mathematics tutors still have at least 10 years to use the knowledge gained from T-TEL PD (and higher qualifications) to impact learning outcomes of student teachers leading to academic achievement of basic school pupils. The results further indicate that mathematics tutors have varied years of teaching experiences with most of them (n=27, 72.9%) having been teaching between 6 to 20 years in the Colleges of Education. This means that the tutors have gained a lot of experience over the years and can, therefore, implement the cross-cutting issues and the innovative teaching strategies in their teaching to bring about improved learning outcomes of both student teachers and basic school pupils. Moreover, the composition of the sample by work experience suggests that the sample was made up of both experienced and beginner mathematics tutors whose diverse views provided rich data for the study.

It is also apparent that the highest academic qualification of mathematics tutors in the colleges of education is a Ph.D. (n=1, 2.7%) followed by Master's degree (n=33, 89.2%) majority of whom hold M.Ed. mathematics education degree (n=19, 51.4%). Only 3 tutors representing 8.1% do not have Master's degree. The implication is that there is the urgent need for mathematics tutors to upgrade and acquire M.Phil. and/or Ph.D. degrees in mathematics. In addition, Table 3 shows that the sample mathematics tutors teach 11 mathematics courses with majority of them (n= 29, 78.4%) teaching methods of teaching basic school mathematics followed Statistics and Probability (n=23, 62.2%).

4.2 Mathematics tutors' level of participation in T-TEL PDS

The study was about Colleges of Education mathematics tutors' participation in T-TEL weekly college-based continuous professional development sessions and how it shaped their perceived self-efficacy beliefs for teaching mathematics in the new 4-year B.Ed. mathematics curriculum. There was the need to find out the level of mathematics tutors' participation in T-TEL PDS in terms of their 1) attendance, 2) punctuality and 3) level of engagement in the main activities. Consequently, items 6, 7 and 8a to 8k of the questionnaire sought information about mathematics tutors' attendance, punctuality and level of engagement in the main activities during the PDS. Tutors' responses to the items are shown in Table 4 Table 5 and Table 6.

Table 4 Number of PD sessions attended by mathematics tutors in theme 8

Number of PDS attended in a semester	No of tutors	Percentage (%)
Three	1	2.7
Five	1	2.7
Six	9	24.3
Seven	4	10.8
Eight	22	59.5
Total	**37**	**100**

Source: Field data, 2019

The data displayed on Table 4 show the number of PD sessions tutors attended in theme 8. From Table 4 one Mathematics tutor representing 2.7% indicated he/she attended 3 out of 8 PD sessions in theme 8. Another 2.7% (n = 1) also stated that he/she attended 5 out of 8 PD sessions in theme 8. The data further indicate that 24.3% (n = 9) Mathematics tutors admitted that they attended 6 out of 8 PD sessions in theme 8 whiles four (4) Mathematics tutors representing 10.8% agreed that they attended 7 out of 8 PD sessions. As many as 59.5% (n = 22) tutors said they never missed PD sessions in theme 8, implying that these tutors attended 8 out of 8 PD sessions in that a semester. The data indicate that majority, 94.6% (n = 35) of the mathematics tutors who participated in this study attended between 6 – 8 PD sessions in theme 8.

To complement the quantitative findings on attendance, the interviews were conducted on seven mathematics tutors to solicit information about their attendance to T-TEL PDS. The abbreviations FT and MT followed by a number in the presentation is the identity of the mathematics tutor interviewee (e.g. FT1 and MT1 means first female tutor and first male tutor interviewee respectively as labeled in the

transcription in Appendix D). Direct quotes from participants are provided and these quotes have been edited as little as possible.

Generally, mathematics tutors' interview responses to how often they attended the T-TEL professional development sessions revealed that they were always present unless they were involved in other official programmes or taken by ill health.

Three of the mathematics tutors had this to say:

> *I am even one of the PDCs, so unless my absence in the college I am always present (FT1). I go any time we have professional development. Unless, I have a programme which is official, I have to be there because it is in the timetable that every Wednesday you have to be there (FT2). If am not sick and nothing takes me off, I don't miss T-TEL (MT1)*

The above excerpts showed that, unless they are involved in other official programmes or are not well, the mathematics tutors are always in attendances in T-TEL PDS. This is a good start for the mathematics tutors towards preparing themselves and building up their tutoring skills and competences for teaching the Diploma in Basic Education and for the implementation of the new 4-year B.Ed. mathematics curriculum.

Data on Table 5 show how punctual Mathematics tutors were to PD sessions they had attended.

Table 5 Mathematics tutors' punctuality to PD sessions attended

How punctual were you to PDS	**No. of tutors**	**Percentage (%)**
I was sometimes late and missed the first 30 minutes	3	8.1
I was two or three times late and missed the first 15 minutes	10	27.0
I was always present at the PDS venue before it begins	24	64.9
Total	**37**	**100**

From Table 5, 8.1% (n = 3) of the tutors indicated that they were sometimes late and missed the first 30 minutes of PD sessions while 27.0% (n = 10) tutors stated that they were two or three times late and therefore missed the first 15 minutes of PD sessions they had attended. As many as 64.9% (n = 24) of the tutors indicated they were always present at the PD session venue they had attended before the session began.

Even though over 60% of the mathematics tutors in the study were punctual to PD sessions they had attended (Tables 5), there were over 35.0% of tutors who were either late for three times hence missed the first 15 minutes or were sometimes late and therefore missed the first 30 minutes of PD sessions they had attended. This suggests that these tutors might not have benefitted enough from the T-TEL PDS by way of acquisition of knowledge and skills and implementation of acquired knowledge and skills.

The interviews on how punctual participants were at PDS generally indicated that they were always there before time or on time as evidenced from three mathematics tutors' responses to the question: 'How punctual are you to the professional development sessions?'

> *As I told you earlier, it is included in the school timetable, so since I know that this particular time we are supposed to be there, I have to always be there on time because when they starts before I get there, I won't understand anything(*FT*2).*
>
> *I have to at times even get there and help in the arrangement of the tables for my colleagues to come, so I have to always be there early enough to assist the coordinator and his subordinates (MT4).*
>
> *I go on time and always regular (MT5).*

Mathematics tutors' interview responses, from the above excerpts, generally indicated that they were always at the T-TEL PDS before time or on time confirming over 60% of the Mathematics tutors' claimed that they were punctual and regular to PDS. However, above excerpts disagreed with the 35.1% tutors who indicated they were either late for three times hence missed the first 15 minutes or were sometimes late and therefore missed the first 30 minutes of PDS.

Items 8a to 8k of the questionnaire sought information about mathematics tutors' actual level of participation by way of their engagement in the main activities of PDS. Mathematics Tutors' level of participation by way of their engagement in the main activities were measured on a five-point Likert type scale as follows: 1= Very Low, 2= Low, 3= Average, 4= High and 5= Very High. The Mathematics Tutors' responses on the items were analysed using descriptive statistics and presented in Table 6, Table 7 and Table 8. The interpretation (I) of Means and mean of Means for Table 6, Table 7 and Table 8 are: 5 = Very High (VH), 4 - 4.99 = High (H), 3 - 3.99 = Average (A), 2 - 2.99 = Low (L) and 1 - 1.99 = Very Low (VL).

Table 6 Mathematics tutor's level of engagement in T-TEL PDS activities

T-TEL PD Activities	VH	H	A	L	VL	M	St. D
a. Individual Reflections before the main activities	6	12	14	4	1	3.49	.99
b. Individual studying of examples of the Mathematics teaching strategies	5	17	12	3	0	3.65	.82
c. Group discussions and Presentations	14	20	2	1	0	4.27	.69
d. Think-Pair and share	10	20	5	2	0	4.03	.80
e. Plan and Practice Together	7	19	9	2	0	3.84	.80
f. Teach-Reflect Together	5	16	13	2	1	3.59	.90
g. Whole group discussions	15	17	4	1	0	4.24	.76
h. Cross-cutting issues, such as Equity and Inclusivity, Transferable Skills, ICT, and Assessing Pupils' Learning and Progress	8	15	13	1	0	3.81	.81
i. Plan mathematics lessons for each teaching strategy for implementation using the Activity Plan.	3	14	16	4	0	3.43	.80
j. Building teaching portfolio	1	17	13	4	2	3.30	.91
k. Writing in learning journal	2	8	13	11	3	2.86	1.03

Mean of Means = 3.68 Standard Deviation = .84

The mathematics tutors in their responses on their level of engagement in the T-TEL professional development activities, indicated that their engagement in group discussions and presentations during PDS was high (mean score = 4.27, standard deviation = .69). The mathematics tutors also stated a high level of engagement for whole group discussions activities (mean score = 4.24, standard deviation = .76). Again, mathematics tutors in the Colleges of Education in Northern Ghana affirmed that their level of engagement in the think-pair-share activities during PDS was high (mean score = 4.03, standard deviation = .80). The mathematics tutors' responses showed that their level of engagement in plan and practice together activity (mean score = 3.84, standard deviation = .80) and cross-cutting issues, such as equity and

inclusivity, transferable skills, ICT, and assessing pupils' learning and progress (mean score = 3.81, standard deviation = .81) was average during PDS. Similarly, there was average engagement by the mathematics tutors during activities such as teach-reflect together, individual reflections before the main activities, individual studying of examples of the mathematics teaching strategies, building teaching portfolio and planning mathematics lessons for each teaching strategy for implementation using the activity plan in PD sessions.

However, mathematics tutors in the Colleges of Education in recorded a low engagement in the writing in learning journal activity during the PD sessions (mean score = 2.86, standard deviation = 1.03).

Generally, the level of engagement of mathematics tutors in the Colleges of Education in T-TEL PDS activities could be described as average (mean of means score of 3.68, standard deviation of .84) (Tables 6).

The interview responses of the seven mathematics tutors on their level of engagement in the teaching strategies of the various themes during the activities of PDS showed that they actively engaged as can be seen in what five of the interviewees said in response to: Can you explain your level of engagement in the teaching strategies of the various themes under the T-TEL development sessions?

> *When it comes to anything, we have the idea first, so when it comes to activities, I think we lead, so I can say my level of engagement is high (*FT1*).*
>
> *If it is group work, I participate. If it is something that is think-pair-share, we do it. Sometimes it is participatory, everybody must think, and after that, we share in our various groups, whatever we are supposed to do, we all participate. Provided you are there to learn, I think there is the need for you to engage yourself in everything (*FT2*).*

> *I can say I have been actively involved in them anytime am there because it appears each of them always presents an excitement and so generally, I find some fulfillment when am there and am involved in each of them. So I have always virtually played a role, either in a group, you will find me making my contributions and at the end of the day, making a presentation on behalf of the group or the group will pick a representative and then when it comes to projecting some of our positions, I have really participated in that(MT1)*
>
> *My level of engagement, if you want to measure it, I will say am very active in it. Usually, they put us in groups and whatever activity that is brought on board we sit as a group, then we appoint secretary and chairperson. Sometimes, I am the chairperson or the secretary to chair the activities, so I will say I am very active (MT3).*
>
> *Most of the time, they put us in groups to work. At the group level, I contribute the little that I know or that I can (MT5).*

It could be deduced from the responses of *(FT1), (FT2), (MT1)*, *(MT3) and (MT5)* that mathematics tutors actively engaged in think-pair-share, group discussions and presentations and whole group discussions in learning the teaching strategies of the various themes. It could also be inferred from their responses that there is no gender difference in their level of engagement in the teaching strategies of the various themes during the activities of PDS. This is particularly important because both female and male mathematics tutors have had equal opportunities in developing their tutoring skills, thereby addressing gender equality gaps in participation and acquisition of student-focused pedagogies from T-TEL PDS. The implication is that both female and male mathematics tutors have most likely used these approaches in teaching their Diploma in Basic Education students and would most likely apply these strategies in teaching the new 4-year B.Ed. mathematics curriculum.

In determining the mathematics tutors' level of engagement in the learning of cross-cutting issues, the following question was asked of them: 'What was your level of engagement during the learning of concepts such as equity and inclusivity, assessing students' learning and progress, ICT, transferrable skills etc…?'

In responding to the question, the mathematics tutors had these to say:

> *I think the emphasis here, I will say, is this gender something, inclusivity and this diversity in trying to build those gaps between slow learners and what knots. It has been helpful because personally, I am really practicing it. Certain things that I did not know, through this PD sessions, I have been able to incorporate that in my teaching (*FT1*).*

> *Well, some of these concepts were already part of our training to a little extent, but I have realized that this time the task is to actually implement them. Is not just about learning but the emphasis now is to implement them in our daily teachings. So, I think I have been reawakened to them and I have tried on a number of occasions to implement them in my classes (MT4).*

It can be deduced from the responses of *(*FT1*)* and *(MT4)* that they actively participated and learnt gender and inclusivity issues. They are also implementing these concepts in their teaching which are in line with the UN Sustainable Development Goal (SDG) 4, which is meant to ensure inclusive and equitable quality education and promote life-long learning opportunities for all (Ministry of Education, 2017) adopted by the Ministry of Education.

In responding to the same question, MT2 states:

> *I have even learned in my background in the formation houses and all that, so is something that has already been part of me. So when it comes to talking about equity and equalities, I have already a fair idea what it's all about before this thing came in. So when it came, it kind of a refresher for me to look at people in that line. You see when you are dealing with students, you know that people at different levels, their personalities are completely different, their backgrounds are different because somebody probably coming from educational background or the parents are well educated and they are interested in education, that person's response to education will be different from somebody who doesn't trust so much of education and even want to use the child for other activities at home instead of study. So you have to consider all these things and I think all those things form part and parcel of the equity and I mean the equality that we are talking about every day. So somehow I try to put all those things into perspective when I am delivering my lessons.*

Similarly, MT3 responded to the same question as:

> *My level of engagement is active in it to the extent that when it comes to issues of the cross-cutting issues, issues of gender, inclusiveness, mix training and those kinds of things, I come from a development background and those issues are more dear to me. So am actively involved into it (*MT3).

It can be inferred from MT2 and MT3 responses that they already had some training and knowledge on issues of gender, equity and inclusivity before the T-TEL training. It can also be assumed that they were using gender responsive teaching strategies, and would most likely implore these teaching strategies in implementing the new 4-year B.Ed. mathematics curriculum.

Nonetheless, from the interview responses, the mathematics tutors looked at cross-cutting issues only in terms of issues on gender, equity and inclusivity without considering core and transferable skills, professional values and attitudes, assessment strategies and the use of ICT which are part of cross-cutting issues. Perhaps, it is because of the attention being given to issues on gender, equity and inclusivity in all spheres of life in this 21st century.

4.2.1 Mathematics tutors' level of engagement in acquisition of knowledge and skills and implementation of knowledge and skills gained in T-TEL PDS

The researcher also looked at level of engagement of mathematics tutors in the T-TEL PDS in terms of engagement that led to acquisition of knowledge and skills and participation that led to implementation of the knowledge and skills acquired. Level of engagement in acquisition of knowledge and skills involved activities of T-TEL PDS that mathematics tutors undertook to acquire innovative student-centred instructional strategies and knowledge of cross-cutting issues whereas level of participation in implementation of the knowledge and skills acquired involved activities that mathematics tutors undertook that led to the use of the innovative student-centred instructional strategies and knowledge of cross-cutting issues during T-TEL PDS and/or during classroom practice. Items 'b', 'c', 'd', 'e', 'g' and 'h' were used to measure level of engagement that led to acquisition of knowledge and skills

while items 'a', 'f', 'i', 'j' and 'k' were used to measure level of engagement that led to implementation of knowledge and skills. Tutors' responses were summarised as shown in Tables 7 and 8.

Table 7 Mathematics tutors' level of engagement in acquiring knowledge and skills in T-TEL PDS

T-TEL PD Activities	**Very High**	**High**	**Average**	**Low**	**Very Low**	**Mean**	**Standard Deviation**
b. Individual studying of examples of the Mathematics teaching strategies	5	17	12	3	0	3.65	.82
c. Group discussions and Presentations	14	20	2	1	0	4.27	.69
d. Think-Pair and share	10	20	5	2	0	4.03	.80
e. Plan and Practice Together	7	19	9	2	0	3.84	.80
g. Whole group discussions	15	17	4	1	0	4.24	.76
h. Cross-cutting issues,	8	15	13	1	0	3.81	.81

Mean of Means = 3.97 Standard Deviation = .78 Source: data, 2019

Tables 7 indicates that the mathematics tutors stated a high level of engagement in acquisition of knowledge and skills (LPAKS) in 'think-pair and share' (mean score = 4.03, standard deviation = .80), 'group discussions and presentations' (mean score = 4.27, standard deviation = .69) and 'whole group discussions' (mean score = 4.24, standard deviation = .76) activities during PDS. On the contrary, the mathematics tutors recorded an average level of engagement in acquisition of knowledge and skills in 'individual studying of examples of the mathematics teaching strategies'(mean score = 3.65, standard deviation = .82), 'plan and practice together' (mean score = 3.84, standard deviation = .80) and 'cross-cutting issues, such as equity and inclusivity, transferable skills, ICT, and assessing pupils' learning and progress' (mean score = 3.81, standard deviation = .81) activities during PDS. The data in

Tables 7 suggest that the mathematics tutors prefer to actively engage in collaborative activities to acquire knowledge and skills during PDS. Generally, the mathematics tutors' stated an average level of engagement in acquisition of knowledge and skills in T-TEL PDS (mean of means score of 3.97, standard deviation of .78) (see Tables 7).

The mathematics tutors' responses on their level of engagement in the implementation of knowledge and skills (LPIKS) gained during the activities of T-TEL PDS are presented in Table 8.

Table 8 Mathematics tutors' level of engagement in implementing knowledge and skills acquired in T-TEL PDS

T-TEL PD Activities	**Very High**	**High**	**Average**	**Low**	**Very Low**	**Mean**	**Standard Deviation**
a. Individual Reflections before the main activities	6	12	14	4	1	3.49	.99
f. Teach-Reflect Together	5	16	13	2	1	3.59	.90
i. Plan mathematics lessons for each teaching strategy for implementation using the Activity Plan.	3	14	16	4	0	3.43	.80
j. Building teaching portfolio	1	17	13	4	2	3.30	.91
k. Writing in learning journal	2	8	13	11	3	2.86	1.03

Mean of Means = 3.33 Standard Deviation = .93 Source: data, 2019

The results in Table 8 revealed that mathematics tutors in their responses indicated an average level of engagement in implementing knowledge and skills gained during the activities of T-TEL PDS in 'individual reflections before the main activities'(mean score = 3.49, standard deviation = .99) and 'teach-reflect together'(mean score = 3.59, standard deviation = .90). In the same way, the mathematics tutors stated in their responses, average level of engagement in implementing knowledge and skills gained during the activities of T-TEL PDS in 'plan mathematics lessons for each teaching strategy for implementation using the activity plan' and 'building teaching portfolio'. On the other hand, mathematics tutors recorded a low level of engagement in

implementing knowledge and skills gained during the activities of T-TEL PDS in the 'writing in learning journal' activity during PDS (mean score = 2.86, standard deviation = 1.03).

On the whole, mathematics tutors sampled in this study indicated average level of engagement in implementing knowledge and skills gained during the activities of T-TEL PDS.

Table 7 and Table 8 clearly suggest that mathematics tutors level of engagement in knowledge and skills acquisition activities during of T-TEL PDS is higher than that of their implementing knowledge and skills gained during the activities of T-TEL PDS. The implication is that the participating mathematics tutors may acquire knowledge and skills during the activities of T-TEL PDS but may fail to fully implement all of them in their classrooms to bring about positive and improved learning outcomes of their pre-service teachers which would result in improved learning outcomes of basic school pupils in Ghana.

4.3 Mathematics tutors' perceived self-efficacy beliefs for teaching mathematics

Section C of the questionnaire involved 12 items that required participants to rate their perceived self-efficacy beliefs to implement the new 4-year B.Ed. mathematics curriculum measured on a five-point Likert type scale as follows: 1=Not at All, 2=Very Little, 3=Little, 4=Quite A Bit, 5=A Great Deal. Participants were to rate their perceived abilities to teach mathematics in the new 4-year B.Ed. mathematics curriculum.

The mathematics tutors' responses were analysed using descriptive statistics. Responses of negatively written statements were reversed at the beginning of the

analysis to ensure consistency between the positively and negatively worded items. This means that higher mean scores on negatively worded items reflects positive perceived self-efficacy for teaching mathematics and the vice versa. The interpretation of Means and mean of Means in Table 9, Table 10 and Table 11 are 5 = Very High (VH), 4 - 4.99 = High (H), 3 - 3.99 = Average (A), 2 - 2.99 = Low (L) and 1 - 1.99 = Very Low (VL).

Table 9 presents results on the mathematics tutors' general perceived self-efficacy beliefs for teaching mathematics (SEBTM) in the new 4-year B.Ed. mathematics curriculum while Table 10 and Table 11 present results on their perceived self-efficacy beliefs for teaching mathematics using 'professional knowledge and practice' and using 'cross-cutting issues' respectively.

Table 9 Mathematics tutor's perceived self-efficacy beliefs in teaching mathematics

Items	A Great Deal	Quite A Bit	Little	Very Little	Not At All	Mean	Standard Deviation
i. I can implement the teaching strategies I learned in the various themes in teaching mathematical concepts in the new mathematics curriculum in my classroom.	23	11	3	0	0	4.54	.650
ii*. I can use a range of formal and informal assessment procedures to modify teaching and learning activities to improve my pre-service teachers' mathematics attainment.	13	13	7	2	2	3.89	1.13
iii. I can do much to control disruptive behaviour of Pre-service teachers in my classroom	16	19	2	0	0	4.38	.594
iv*. I can do much to get both female and male pre-service teachers to believe they can do well in mathematics.	19	9	3	5	1	4.08	1.19
v. I can do much to use gender responsive classroom practices in implementing the new mathematics curriculum.	19	11	5	0	2	4.22	1.06
vi. I can use my reflective practice to vary my teaching to improve my pre-service teachers' learning of mathematics.	13	19	4	1	0	4.19	.739
vii. I can use action research to improve my pre-service teachers learning outcomes.	16	16	3	1	1	4.22	.917
viii*. I can do much to strengthen my pre-service teachers' pedagogical content knowledge in mathematics.	17	12	5	3	0	4.16	.958
ix. I can do much to strengthen my pre-service teachers' subject and curriculum knowledge in mathematics.	18	16	1	2	0	4.35	.789
x*. I can use modern technology to improve teaching and learning in mathematics.	14	11	7	4	1	3.89	1.13
xi. I can produce and use varied resources in teaching and learning to enhance my pre-service teachers' learning of mathematics.	18	15	4	0	0	4.38	.681
xii. I can use a wide range of communication, verbal and non-verbal to enhance my pre-service teachers' engagement in lessons.	18	17	2	0	0	4.43	.603

*** reversed items. Mean of Means = 4.23 Standard Deviation = .87**

From Table 9, a total of 23(62.2%) and 11(29.7%) of the mathematics tutors indicated that they could do a great deal and quite a bit respectively to implement the teaching strategies learned in the various themes in teaching mathematical concepts in the new

mathematics curriculum in their classrooms as oppose to 3(8.1%) who indicated that they could do little to implement the teaching strategies learned in the various themes in teaching mathematical concepts in the new mathematics curriculum in their classrooms. Similarly, 51.4% and 43.2% of the tutors said they could do quite a bit and a great deal respectively to control disruptive behaviour of Pre-service teachers in their classroom. Moreover, a total of 78.3% of the tutors responded that they could do a great deal and quite a bit to strengthen their pre-service teachers' pedagogical content knowledge in mathematics. In responding to their use of a range of formal and informal assessment procedures to modify teaching and learning activities to improve their pre-service teachers' mathematics attainment, 35.1% each of the tutors believed that they could do a great deal and quite a bit.

Also, 37.8% and 29.7% of mathematics tutors stated in their response to item 9x that they could do a great deal and quite a bit respectively to (use modern technology to improve teaching and learning in mathematics. More than one-half of the tutors 19(51.4%) agreed that they could do a great deal to get both female and male pre-service teachers to believe they could do well in mathematics while 9(24.3%) said they could do quite a bit to get both female and male pre-service teachers to believe they could do well in mathematics. In the same manner, a total of 94.4% of the mathematics tutors agreed that they could do a great deal and quite a bit to use a wide range of communication, verbal and non-verbal to enhance they pre-service teachers' engagement in lessons. Similarly, more than 81% of the mathematics tutors stated they could to a great deal and quite a bit to use gender responsive classroom practices in implementing the new mathematics curriculum, use their reflective practice to vary their teaching to improve their pre-service teachers' learning of mathematics, use action research to improve their pre-service teachers learning outcomes, strengthen

their pre-service teachers' subject and curriculum knowledge in mathematics and produce and use varied resources in teaching and learning to enhance their pre-service teachers' learning of mathematics.

From Table 9, mathematics tutors' responses on their perceived self-efficacy beliefs for implementing the new 4-year B.Ed. mathematics curriculum in the Colleges of Education, indicated that their self-efficacy for implementing the teaching strategies they learned in the various themes in teaching mathematical concepts in the new mathematics curriculum in their classrooms is high (mean score = 4.54, standard deviation = .65). The tutors' responses further showed that they had high self-efficacy beliefs for, using a wide range of communication, verbal and non-verbal to enhance their pre-service teachers' engagement in lessons (mean score = 4.43, standard deviation = .603), controlling disruptive behaviour of pre-service teachers in their classroom (mean score = 4.38, standard deviation = .594) and producing and using varied resources in teaching and learning to enhance their pre-service teachers' learning of mathematics (mean score = 4.38, standard deviation = .681). In the same way, mathematics tutors indicated in their responses, high self-efficacy beliefs for, strengthening their pre-service teachers' subject and curriculum knowledge in mathematics, using action research to improve their pre-service teachers learning outcomes, using gender responsive classroom practices in implementing the new mathematics curriculum, using their reflective practice to vary their teaching to improve their pre-service teachers' learning of mathematics, strengthening their pre-service teachers' pedagogical content knowledge in mathematics as well as getting both female and male pre-service teachers to believe they can do well in mathematics

Nonetheless, mathematics tutors in the study recorded average self-efficacy beliefs for, using modern technology to improve teaching and learning in mathematics (mean score = 3.89, standard deviation = 1.125) and using a range of formal and informal assessment procedures to modify teaching and learning activities to improve their pre-service teachers' mathematics attainment (mean score = 3.89, standard deviation = 1.125). Generally, the mean of means (M=4.23) and the mean of standard deviations (SD =.87) indicate that the overall mathematics tutors' perceived self-efficacy beliefs for teaching mathematics is high. This suggests that mathematics tutors' perceived self-efficacy beliefs to implement the new 4-year B.Ed. mathematics curriculum are high.

To add-on to the quantitative findings of the mathematics tutors' perceived self-efficacy beliefs for teaching mathematics in the new B.Ed. mathematics curriculum, the researcher asked seven of mathematics tutors the following interview question: 'How far do you think you can apply the following creative or innovative teaching strategies, games, talk for learning, jig-saw, questioning to support mathematics learning and any other strategy you can think of, in the implementation of new B.Ed. mathematics curriculum?'

The interview results of mathematics tutors collaborated their high self-efficacy beliefs for implementing the new B.Ed. mathematics curriculum using creative teaching strategies.

Two of the mathematics tutors, *FT2* and *MT1* indicated that:

> *Yes, if the topic involves participation where the pupils are supposed to play games include games in it, like if it is the statistics and probability where they have to toss and those things are there, I can help them to do the practicality themselves. So if the topic that I am treating involves games, I will make sure I involve them. For the questioning, there is no way you will teach mathematics*

without using questions. For questioning, even from the beginning, the RPK, you have to involve questioning, so the beginning, within and at the end of the lesson, you must involve students with questions. If there is no question how do you measure the extent to which your objectives are achieved? As for jig-saw I do it in class most of the time. As for talk-for-learning, that is most of the things that we do a lot. So as for talk-for-learning l have been doing it (FT2).
If am teaching algebra, I can coin a question involving games with regards to football, playing cards, and playing ludo. I can use Jig-saw in teaching triangular, squares, perfect numbers and all those things. Talk for learning….good….. I believe in discussion, so when I get to the class I create a scenario, like today in problem solving, I wanted to teach place value. I don't know what place value is, so I just went into the class and wrote down a question 53 + 28 …and this was what the answer he gave 311. So the question I asked is what is wrong with the result? What is wrong with the child? How do you help the child to solve it? Go on brainstorm… so I try to create such a scenario for us to discuss. Then the whole concept comes out (MT1).

The above remarks suggested that mathematics tutors are conversant with the use of games, Jig-saw, questioning to support learning and talk-for-learning strategies. Their comments also suggested that they have been using these strategies in teaching mathematics already. This, therefore, means that mathematics tutors' use of these teaching strategies, especially games, keep students engaged in activities, give them hands-on experience, and help them learn quicker without even realising that they are learning.

The interviewees also mentioned that they use questioning and intent to use it to introduce lessons, determine the progress of students' learning, assess students' learning and to get students participate in their lessons as contained in the remarks below:

… I think I have used questioning to support learning. Questioning is a technique I find myself using almost every time. I use it to introduce my lessons. I also use it to determine the progress of my lesson and then eventually, I use it to also assess my students' learning, so I think I have often used that. I also used it to get my students involved in my lessons (MT2).
… With the questioning, you have to ask questions… At times when you ask questions, your questions should be in such a way that it geared towards the concept. You don't ask ambiguous questions, so questions can be used to

support the learning of mathematics. In fact I do it. As for the questioning, I cannot have a whole lesson without asking questions. So I can use questions to enhance the learning of mathematics especially this B.Ed. program (FT1).

The above responses generally suggest that mathematics tutors are using questioning to support their students' learning and would continue to use questioning because they viewed the strategy as a very important aspect of the mathematics teaching and learning process that support student learning.

Perceived self-efficacy beliefs for teaching mathematics using professional knowledge and practice involve mathematics tutors' beliefs about their ability to use their knowledge of educational curriculum and students to manage the learning environment and use variety innovative instructional strategies as well as authentic assessment strategies to support learning of their student teachers.

Mathematics tutors' responses on their perceived self-efficacy beliefs for teaching mathematics using professional knowledge and practice were organized and presented in Table 10.

Table 10 Mathematics tutor's perceived self-efficacy beliefs in teaching mathematics using professional knowledge and practice

Item	A Great Deal	Quite A Bit	Little	Very Little	Not At All	Mean	Standard Deviation
i. I can implement the teaching strategies I learned in the various themes in teaching mathematical concepts in the new mathematics curriculum in my classroom.	23	11	3	0	0	4.54	.650
ii*. I can use a range of formal and informal assessment procedures to modify teaching and learning activities to improve my pre-service teachers' mathematics attainment.	13	13	7	2	2	3.89	1.13
iii. I can do much to control disruptive behaviour of Pre-service teachers in my classroom	16	19	2	0	0	4.38	.594
vi. I can use my reflective practice to vary my teaching to improve my pre-service teachers' learning of mathematics.	13	19	4	1	0	4.19	.739
vii. I can use action research to improve my pre-service teachers learning outcomes.	16	16	3	1	1	4.22	.917
viii*. I can do much to strengthen my pre-service teachers' pedagogical content knowledge in mathematics.	17	12	5	3	0	4.16	.958
ix. I can do much to strengthen my pre-service teachers' subject and curriculum knowledge in mathematics.	18	16	1	2	0	4.35	.789

*** Reversed items Mean of Means = 4.25 Mean of Standard Deviations =.83**

Mathematics tutors, from Table 10, indicated average self-efficacy beliefs for using a range of formal and informal assessment procedures to modify teaching and learning activities to improve their pre-service teachers' mathematics attainment (mean score = 3.89, standard deviation = 1.13) as oppose to high self-efficacy beliefs for 'using their reflective practice to vary their teaching to improve their pre-service teachers' learning of mathematics' (mean score = 4.19, standard deviation = .739), 'using action research to improve their pre-service teachers learning outcomes (mean score = 4.22, standard deviation = .917). Likewise, they stated high self-efficacy beliefs for

implementing the teaching strategies they learned in the various themes in teaching mathematical concepts in the new mathematics curriculum in and their classroom. They also declared high self-efficacy beliefs for items ix,viii, and iii.

Generally, mathematics tutors' responses on their perceived self-efficacy beliefs for teaching mathematics using professional knowledge and practice is high (mean of means = 4.25, mean of standard deviations = 0.83). This suggests that mathematics tutors' perceived self-efficacy beliefs about their ability to implement the new 4-year B.Ed. mathematics curriculum using professional knowledge and practice is high. The implication is that mathematics tutors would strive to improve their pre-service teachers learning outcomes by using their pedagogical content knowledge, authentic assessment procedures, reflective practice and action research.

As part of finding out mathematics tutors' perceived self-efficacy beliefs for implementing the new 4-year B.Ed. mathematic programme, the researcher asked the Mathematics tutors the following interview question: 'What do you think you can do to influence your pre-service teachers mathematics learning outcomes in implementing the new 4-year B.Ed. mathematics programme?'

MT3 in responding to the question states:

> *First of all, what I think, I can do, is to implement the various concepts that we have learned during T-TEL sessions in the instructional period during teaching and learning of mathematics. I think that, if I implement the teaching strategies, it will influence pre-service learning and teaching of mathematics. I will use these teaching strategies, so that the students will be able to see mathematics as a practical subject or everyday life situational subject that will enhance the understanding of mathematics, by the students and also they will be able to use it in their daily life activities (MT3)*

Moreover, FT2 response to the same question was:

> *I consciously ensure, that I employ these new strategies we have been taught because I have the feeling that this is the demand of the new curriculum and so I have ensured that or resolved to ensure that I revise all of these strategies, and determine their suitability to the various topics that I have on my course outline and try to use them anytime I have lessons to deliver. That's the resolve I have gotten to. Because I believe that very often these things will be monitored as we have always had a team coming round to monitor and evaluate, so whichever way you go about it, they tend to get to find out what you are doing, because they interview the students and then will interview you as well. And so, is good to be found to have been implementing the new rather than still doing the same old thing (FT2*).

Likewise, MT4 in responding to the same question says:

> *...So here, my main dream is to teach them very well using a blend of the concepts and student-centered methods I learnt during T-TEL and the university so that at the end of the 4-year programme they should be able to impart that mathematical knowledge through critical thinking, self-directed learning, problem-solving skills, which I will instill in them during this B.Ed. ...pro…curriculum. I am confident that my students would be able to deliver well because of the professional practice and knowledge, I will instill in them (MT4)*

From these responses mathematics tutors would improve the learning outcomes of their student teachers through the use of active pedagogies advocated by T-TEL

Perceived self-efficacy beliefs for teaching mathematics using cross-cutting issues involve mathematics tutors' beliefs about their ability to use their Knowledge of Equity and Inclusivity to handle the diversity in the classrooms, assessment for, as and of learning to assess their student teachers learning and progress, Transferable Skills and ICT to improve their student teachers' learning outcomes. Table 11 contains mathematics tutors' responses on their perceived self-efficacy beliefs for teaching mathematics using 'cross-cutting issues'.

Table 11 Mathematics tutor's perceived self-efficacy beliefs in teaching mathematics using cross-cutting issues

Item	A Great Deal Quite A Bit	Little	Very Little	Not At All	Mean	Standard Deviation
iv*. I can do much to get both female and male pre-service teachers to believe they can do well in mathematics.	19 9	3	5	1	4.08	1.19
v. I can do much to use gender responsive classroom practices in implementing the new mathematics curriculum.	19 11	5	0	2	4.22	1.06
x*. I can use modern technology to improve teaching and learning in mathematics.	14 11	7	4	11	3.89	1.13
xi. I can produce and use varied resources in teaching and learning to enhance my pre-service teachers' learning of mathematics.	18 15	4	0	0	4.38	.681
xii. I can use a wide range of communication, verbal and non-verbal to enhance my pre-service teachers' engagement in lessons.	18 17	2	0	0	4.43	.603

***reversed items Mean of Means = 4.20 Standard Deviation = .93**

From Table 11, mathematics tutors' responses on their perceived self-efficacy beliefs for teaching mathematics using cross-cutting issues, showed high self-efficacy beliefs for using gender responsive classroom practices in implementing the new mathematics curriculum (mean score = 4.22, standard deviation = 1.06) and using a wide range of communication, verbal and non-verbal to enhance their pre-service teachers' engagement in lessons (mean score = 4.43, standard deviation = .603). Similarly, mathematics tutors indicated in their responses, a high self-efficacy beliefs for getting both female and male pre-service teachers to believe they can do well in mathematics and for producing and using varied resources in teaching and learning to enhance their pre-service teachers' learning of mathematics. However, they recorded average self-efficacy beliefs for using modern technology to improve teaching and learning in mathematics (mean score = 3.89, standard deviation = 1.13).

Overall, mathematics tutors held high self-efficacy beliefs for teaching mathematics using cross-cutting issues in their responses (mean of means = 4.20, mean of standard deviations = 0.93). This means that mathematics tutors' perceived self-efficacy beliefs about their ability to implement the new 4-year B.Ed. mathematics curriculum using cross-cutting issues is high. This suggests that mathematics tutors would most likely go all out to use gender-sensitive instructional strategies, mixed abilities instructional strategies as well as inclusive instructional strategies in teaching mathematics in the new 4-year B.Ed. mathematics curriculum.

As part of determining the mathematics tutors' perceived self-efficacy beliefs for teaching in the new 4-year B.Ed. mathematics curriculum, they were asked the following interview question: 'Do you normally take note of gender issues when you are teaching mathematics?'

The interviewees' mentioned that they took note of gender issues when they are teaching mathematics with regards to questioning, use of names in examples, formation of group work and presentations.

This was clearly expressed by FT1 and FT2who states:

> *Personally, yes. … Engaging students, this time you know that sort of male domineering if you look at mathematics , but with this knowledge or idea I try to break that gap by involving ladies, especially … as team leaders, using my examples, are no more one way examples that we use in class. This time we try … especially when it comes to use of names and other examples, we also add female names in our questioning, and setting questions and even when we are asking questions. We don't try to throw … the supposed high order questions to only the men but we try to give equal chances … to both sexes to answer. So am applying it. Am really applying, I will say that that is a good this thing, am now (*FT1)
>
> *Yes … if there is the need for me to. …When I am giving some examples of questions, I include both male and female; I don't use only the names of male to give examples or only female. Like maybe I am trying to form something like word problems where I have to use names, I make sure I use the name of female and the name of male. And if it is something to work on the chalkboard or is it the maker board, I made sure that I have time for both male and female and when I give them group presentations, I made sure that the group that are*

> *coming to present, not only males will or not only females but both sexes will be there. So I involved them a lot (*FT2).

In responding to the same question, *MT3, MT4* and *MT4* indicated they give equal opportunities for class participation and proportionally representation in group work as captured in their responses:

> *Yes, for example, I given equal opportunities to both males and females in terms of the classroom participation, regarding questioning and responses as well as group work, and so all those things are taking care of (*MT3*).*
> *Yes, I do normally take notice. I do in terms of distributing of questions. I think I have always done so. I think it's also at the back of my mind when am giving a group work, trying to ensure that the ladies are distributed quiet proportionally among the various groups (*MT4*).*
> *Yes, I do. when I ask questions and I see that most of the time boys are raising up their hands or try to answer, I try to find out from the girls' their point of view and I try to encourage them to take active part. I encourage everybody to learn and I believe that they are all doing well. In relative terms, both sexes are doing well (*MT5*).*

The above responses showed that mathematics tutors used gender-responsive classroom practices and also confirm their high self-efficacy beliefs for gender responsive classroom practices in implementing the new mathematics curriculum from their questionnaire responses.

4.4 Relationship between mathematics tutors' level of participation in T-TEL PDS, and their perceived self-efficacy beliefs for teaching mathematics

A Pearson product-moment correlation was run to determine the relationship between mathematics tutors' level of participation in T-TEL PDS and their perceived self-efficacy beliefs for teaching mathematics in the new 4-year B.Ed. mathematics curriculum. Kothari (2004) suggested that if the correlation coefficient is greater than .3 but less than .5, then the relationship is moderate. The relationship is weak if the correlation coefficient is less than .3; and strong if the correlation coefficient is .5 or

greater was used to interpret the strength of the correlation coefficient. The results of the analysis are presented in Table 12.

Table 12 Pearson correlation between level of participation and perceived self-efficacy beliefs

	Self-efficacy for using professional knowledge	Self-efficacy for using cross-cutting issues	Combined Perceived self-efficacy beliefs
Level of Participation for acquiring knowledge	.524** (.001)	.423** (.009)	.507** (.001)
Level of Participation for implementing knowledge	.458** (.004)	.373** (.023)	.444**(.006)
Combined Level of participation	.543** (.001)	.444** (.006)	.526** (.001)

n=37 **Correlation is significant at p< .01 level (2-tailed). NB: p-values are in parentheses

The Pearson correlation results in Table 12 revealed that, there was a strong, positive relationship between mathematics tutors' level of participation for acquiring knowledge in T-TEL PDS and their perceived self-efficacy beliefs for teaching mathematics using professional knowledge in the new 4-year B.Ed. mathematics curriculum *(r =.524, n = 37, p <.01).* Likewise, there was a moderately strong, positive relationship between mathematics tutors' level of participation for acquiring knowledge in T-TEL PDS and their combined perceived self-efficacy beliefs for teaching mathematics in the new 4-year B.Ed. mathematics curriculum *(r = .507, n = 37, p <.01).* Moreover, the correlation results in Table 12 indicated a strong, positive relationship between Mathematics tutors' combined level of participation in T-TEL PDS and their perceived self-efficacy beliefs for teaching mathematics using professional knowledge in the new 4-year B.Ed. mathematics curriculum. This means that as the mathematics tutors' level of participation for acquiring knowledge in T-TEL PDS increases, their perceived self-efficacy beliefs for teaching mathematics

using professional knowledge in the new 4-year B.Ed. mathematics curriculum also increase in corresponding amount.

However, the results showed a moderate positive relationship between level of participation for implementing knowledge and self-efficacy for teaching mathematics using professional knowledge, Self-efficacy for teaching mathematics using cross-cutting issues and combined perceived self-efficacy beliefs for teaching mathematics in the new 4-year B.Ed. mathematics curriculum *(r* = . .458, *r* = .373 and *r* = .444*)* respectively.

Nevertheless, the results in Table 12 clearly revealed that, generally, there was a Moderately strong, positive relationship between mathematics tutors' level of participation in T-TEL PDS and their perceived self-efficacy beliefs for teaching mathematics in the new 4-year B.Ed. mathematics curriculum *(r = .526).* This implies that mathematics tutors' level of participation in T-TEL PDS has a direct bearing on their perceived self-efficacy beliefs for teaching mathematics in the new 4-year B.Ed. mathematics curriculum. Therefore, this study concluded that level of participation in T-TEL PDS was a critical determinant of perceived self-efficacy beliefs for teaching mathematics in the new 4-year B.Ed. mathematics curriculum among mathematics tutors of Colleges of Education in Northern Ghana.

Further analysis to determine the significance of the relationship between mathematics tutors' level of participation in T-TEL PDS and their perceived self-efficacy beliefs for teaching mathematics in the new 4-year B.Ed. mathematics curriculum was done using the null hypothesis:

H_o: There is no significant relationship between mathematics tutors' level of participation in T-TEL PDS, and their perceived self-efficacy beliefs about their ability to implement the new 4-year B.Ed. mathematics curriculum.

In Table 12, the Pearson correlation results showed that the p-value (.001) is less than the set alpha value (.01) and *(r = .526)*. Therefore, the null hypothesis is rejected and the alternative hypothesis accepted. This implies that there is a statistically significant relationship between mathematics tutors' level of participation in T-TEL PDS, and their perceived self-efficacy beliefs to implement the new 4-year B.Ed. mathematics curriculum.

4.5 Discussion

The first research question investigated the level of participation of College of Education mathematics tutors in T-TEL PDS. Level of participation in T-TEL PDS was seen as 1) mathematics tutors' attendance to T-TEL PDS, 2) mathematics tutors' punctuality to T-TEL PDS and 3) mathematics tutors' engagement in the activities of T-TEL PDS.

Attending and participating in effective PD programmes is critical to upgrading teachers' pedagogical content knowledge and offering them the opportunity to acquire new knowledge, improve competency, enhance teaching skills and gain confidence in teaching their subject areas effectively. The study found that out of an average of 8 PDS per semester, majority of the mathematics tutors who participated in this study affirmed that they attended between 6 – 8 PD sessions in a semester.

More than half of participants said they never missed PDS within a semester, implying that these tutors attended all PDS in a semester. The results is in consonance with the results of the Teaching and Learning International Survey (TALIS), conducted by the Organization for Economic Co-operation and Development (OECD) in 2009, which showed that lower secondary school teachers' rate of participation(number of day attended) in PD activities in the 23 participating countries was 89% on average. Likewise the result confirms the findings of T-TEL (August, 2017) that 68% tutors (average ranging from 44% to 84%) are attending the PDS.

However, the finding disagreed with Ozer (2004) discovery that only 31.3% of Turkish teachers were willing to participate in the in-service training programs, while the rest of the teachers (68.7%) were not willing to attend such programs. In this present study, majority of mathematics tutors have always avail themselves to take advantage of T-TEL's aim of equipping them with innovative students-focused teaching strategies to bring about improved classroom practices.

Although, mathematics tutors' attendance to professional development programmes does not guarantee their full participation in the activities and motivating to learn from the activities to change their teaching practices, it serves as starting point for their willingness to upgrade their knowledge and abilities to teach. As a mathematics tutor and T-TEL PDC, the researcher's personal observation during PDS, interactions with tutors and colleagues PDCs indicated that majority of the mathematics tutors always actively participated in the activities. This might be due to the interactive and collaborative nature of the PDS. However, there were a small number of tutors who would be present and not actively participate in the activities either because they

might have believed that, there was nothing new to learn and/or they needed only to be present since every tutor was supposed to attend the programme.

Participating in T-TEL PDS afford mathematics tutors the opportunity to acquire and use effective, engaging and student-focused instruction-methods which lead to production of well-trained teachers resulting into improvement of learning in the classrooms. The study investigated the level of participation of mathematics tutors' in terms of their level of engagement in activities of T-TEL PDS and found high level of participation in acquisition of knowledge and skills in 'group discussions and presentations', 'whole group discussions' and 'think-pair and share' activities during T-TEL PDS.

The study also found, from the interview results, that both female and male mathematics tutors actively participated, and learnt about issues of gender and inclusivity during the PDS and are implementing these concepts in their teaching as well. This research finding is similar to Hill (2015). According to Hill (2015) a PD participant, was an attentive, inquisitive, and involved explorer, paid attention, asked questions, involved herself in the small and large group discussions and tasks, and explored connections. In the same vain Hill (2015) found a second PD participant as a conversationalist who paid attention, was involved in doing the tasks in the small and whole group discussions as well as asking questions, prompting others to share, or sharing himself.

The findings of this study supported T-TEL (2018) results of the classroom competency observation scores which indicated that across competency areas evaluated tutors' use of gender-responsive strategies to challenge gender roles and gender norms had the most significant net gain (65.9 %) from midline to endline. The

findings also supported those of T-TEL's stories of change T-TEL (2016. November) in which one tutor of Holy Child College of Education says:

> *T-TEL's interventions are helping tutors prepare student teachers for improved classroom teaching and greater interaction and participation of pupils in lessons. With T-TEL, we have been better equipped on a number of teaching strategies such as games, role play, storytelling, pair work and small group activities to promote quality learning. These strategies create a lively environment, where student teachers learn better. They are helping to re-shape the attitudes of student teachers and deepening their experiences of teaching practice. Moreover, tutors and student teachers are learning the importance of being gender-aware in the classroom and ensuring male and female pupils are given equal chances to learn and succeed.*

The above suggests T-TEL's priority of equipping mathematics tutors' with teaching and learning strategies that are gender-responsive, student-centred, and inclusive are being fulfilled. The current experience in colleges showed that these strategies are helping mathematics tutors prepare pre-service teachers for improved classroom teaching and greater interaction and participation of pupils in lessons. Moreover, through T-TEL's interventions, mathematics tutors' and their student teachers are learning the importance of being gender-sensitive in the classroom and ensuring male and female pupils are given equal chances to learn and succeed in mathematics. Majority of mathematics tutors no long stick to traditional methods of lecturing with aim of completing college syllabus and preparing students-teachers for examinations only.

Nevertheless, mathematics tutors generally recorded average level of participation in the activities of T-TEL PDS. The findings also indicated that mathematics tutors stated average level of participation in 'acquisition of knowledge and skills' and 'implementation of knowledge and skills' gained. This means that there is more room for improvement for mathematics tutors' level of participation in the activities of T-TEL PDS.

Teacher efficacy is a significant predictor of mathematics instructional strategies, and highly efficacious teachers are more effective mathematics teachers than teachers with a lower sense of efficacy (Swars, 2005).

In investigating mathematics tutors' perceived self-efficacy beliefs to implement the new 4-year B.Ed. mathematics curriculum as a result of their participation in T-TEL PDS, this study found that mathematics tutors' perceived self-efficacy beliefs to implement the new 4-year B.Ed. mathematics curriculum using professional knowledge and practice and cross-cutting issues are high. In addition, this study revealed that the overall mathematics tutors' perceived self-efficacy beliefs for teaching mathematics is high. After several studies, Bandura (1982, 1986, 1993, 1996, and 1997) developed and defended the idea that people's beliefs in their capabilities powerfully affect their behaviour, motivation, and ultimately their success or failure.

The present findings suggest that mathematics tutors' would implement the knowledge and skills gained during T-TEL PDS in teaching the new 4-year B.Ed. mathematics curriculum since they portray high efficacy to implement and assess their instruction. They are also likely to embrace difficult tasks, set high personal goals, fully commit to these goals and appear to be calm and relaxed when encountering difficulties.

The findings of this study are in line with the findings of Unsal, Korkmaz, and Percin (2016) and Dede's (2008) who found that mathematics teachers have high self-efficacy beliefs concerning their teaching process. Nevertheless, the findings of this study contradicted Butts's (2016) finding where the sample of teachers in the study indicated the lowest perceived efficacy in their ability to implement instructional strategies.

In the Ghanaian context, mathematics tutors' high self-efficacy beliefs for teaching mathematics have led to mathematics tutors using new approaches to questioning, group work and other strategies to promote individual and small group discussions. These have led to increase student teachers' participation, communication and information gathering skills. The mathematics tutors' use of these approaches have also created a more positive and inspiring learning environment for student-teachers in the classrooms of colleges. Consequently, the use of these teaching approaches by pre-service teachers during their teaching practice and teaching after successful completing the programmes would bring about improved learning outcomes in the basic school. The learning settings of Ghanaian basic school would, therefore, gradually change from pupils' listening to their teachers and writing down mathematical facts to pupils' actively participating and constructing mathematical knowledge.

This study also found out that there was strong, positive relationship between mathematics tutors' level of participation in T-TEL PDS and their perceived self-efficacy beliefs for teaching mathematics and this relationship was statistically significant. Research from midline to endline survey reports has shown that mathematics tutors have shown a good level of performance in student-focused teaching methods which are indicative of improved pedagogical practices could portray mathematics tutors' methods of teaching have produced positive results and have the potential to produce enhanced results (T-TEL, 2018).

The finding of this study supported earlier research conducted on teachers' participation in professional development programmes to increase self-efficacy as related to: increased use of inquiry-based practices (Powell-Moman & Brown-Schild,

2011); higher confidence levels (Ross & Bruce, 2007); positive long term teaching behaviors (Watson, 2006); greater willingness to differentiate instruction (Dixon, et al., 2014); and improving instructional practices with real world scenarios (Morrison & Estes, 2007). Also, Kober and Rentner (2011) finding of a correlation between the professional development received and a teacher's sense of positive self-efficacy is not dissimilar to the finding of this study. Research has demonstrated a correlation between the professional development received and a teacher's sense of positive self-efficacy (Kober & Rentner, 2011). Moreover, this finding agreed with Tran (2014) who found that teacher's efficacy ratings were influenced by their participation of professional development experiences. Similarly, Addah (2015) discovered in his study that 88.2% of respondents affirmed that continuous professional development programmes enabled them to gain self-efficacy beliefs which gave them the confidence in whatever they were doing.

The implication is that mathematics tutors would most likely implement the student-centred teaching methods they have learnt through participation in T-TEL PDS in teaching mathematics in the new 4-year B.Ed. mathematics curriculum in Colleges of Education in Northern Ghana. Implementing these innovative strategies in their classroom practices would most likely bring about positive learning outcomes of student-teachers. The student-teachers during their off-campus teaching practice and teaching after completing college would in turn most likely implement the pupil-centred teaching methods. This would lead to improved learning outcomes of basic school learners in Ghana which are the main aims of T-TEL, Ministry of Education and other stake holders in education. The learning settings in Ghanaian basic schools would gradually change from teacher-centerd pedagogies to innovative student-

centred strategies which allow learners to have more control over their own learning, to think analytically and critically and to work collaboratively.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.0 Overview

This chapter constitutes the conclusion of the study. It provides the summary of the study and the major findings. It also highlights the implications for practice and the conclusion based on the findings. Moreover; it contains the recommendations based on the study findings and areas for further study.

5.1 Summary of Study

The purpose of the study was to examine the level of participation of mathematics tutors in T-TEL professional development sessions (PDS). The study also examined mathematics tutors' perceived self-efficacy beliefs to implement the new 4-year B.Ed. mathematics curriculum in the Colleges of Education in Northern Ghana as a result of their participation in T-TEL continuing professional development programme. In addition, it examined the relationship between Colleges of Education mathematics tutors' level of participation in T-TEL PDS and their perceived self-efficacy beliefs to implement the new 4-year B.Ed. mathematics curriculum. To accomplish this purpose, three research questions and one hypothesis were formulated for the study.

The following were the research questions and hypothesis formulated to guide the study:

1. What is the level of participation of College of Education mathematics tutors in T-TEL professional development sessions?
2. What are mathematics tutors' perceived self-efficacy beliefs to implement the new 4-year B.Ed. mathematics curriculum as a result of their participation in T-TEL PDS?

3. What is the relationship between mathematics tutors' level of participation in T-TEL PDS, and their perceived self-efficacy beliefs to implement the new 4-year B.Ed. mathematics curriculum?

The hypothesis is as follows:

H_o: There is no correction between mathematics tutors' level of participation in T-TEL PDS, and their perceived self-efficacy beliefs to implement the new 4-year B.Ed. mathematics curriculum.

The study adopted the mixed methods survey approach that involves concurrent triangulation of data. Using the convenience, purposive, and simple random sampling techniques, 39 mathematics tutors comprising 2 females and 37 males were selected to participate in the study. However, data from 37 participants who returned the questionnaire where used for the study.

Closed-ended questionnaire was used to collect quantitative data while semi-structured interview guide was used to collect the qualitative data on mathematics tutors' level of participation in T-TEL PDS, and their perceived self-efficacy beliefs to implement the new 4-year B.Ed. mathematics curriculum. These instruments were piloted to ensure their validity and reliability before data collection commenced. The quantitative data was analyzed using descriptive statistics such as mean, frequency, percentages, standard deviation. The Pearson Product Moment correlation was also used to analysis the quantitative data after generated them from the items using the IBM Statistical Package for Social Sciences (SPSS, version 21.0.). The qualitative data, on the other hand, were transcribed word-for-word and analyzed according to themes that emerged from level of participation in T-TEL PDS, and perceived self-

efficacy beliefs. Ethical considerations such as permission to collect data, informed consent, confidentiality, and anonymity were addressed and adhered to

5.2 Summary Major Findings

The major findings of the study are summarized and presented in line with the research questions and research hypothesis.

- The study found that majority of the mathematics tutors who participated in this study affirmed that they attended between 6 – 8 PDS out of 8 sessions in a semester.
- Generally, mathematics tutors were mostly, punctual and regular to T-TEL PDS and their level of participation in the activities during T-TEL PDS was average.
- More than two-thirds of the mathematics tutors were always present at the PDS venue before the session begins. This gave them to opportunity to fully participate in all the activities to acquire new knowledge and enhanced their tutoring skills.
- Mathematics tutors in the Colleges of Education in Northern Ghana recorded a low level of participation in learning journal writing activity.
- Both female and male mathematics tutors actively participated in think-pair-share, group discussions and presentations and whole group discussions in learning the teaching strategies of the various themes.
- Both female and male mathematics tutors actively participated and learnt gender and inclusivity issues and are implementing these concepts in their teaching as well.

- Generally, there was average level of participation of mathematics tutors in 'acquisition of knowledge and skills' and in implementing knowledge and skills gained during the activities of T-TEL PDS.
- Generally, mathematics tutors' perceived self-efficacy beliefs for teaching mathematics using professional knowledge and practice and using cross-cutting issues in the new 4-year B.Ed. mathematics curriculum are high.
- Mathematics tutors used gender-responsive classroom practices which confirm their high self-efficacy beliefs for gender responsive classroom practices in implementing the new mathematics curriculum from their questionnaire responses.
- Mathematics tutors were conversant with the use of games, Jig-saw, questioning to support learning and talk-for-learning strategies.
- Generally, mathematics tutors' perceived self-efficacy beliefs to implement the new 4-year B.Ed. mathematics curriculum are high.
- Mathematics tutors' have been using teaching strategies such as games, think-pair-share and Jig-saw in their classroom practices
- There was a strong, positive relationship between mathematics tutors' level of participation in T-TEL PDS and their perceived self-efficacy beliefs for teaching mathematics in the new 4-year B.Ed. mathematics curriculum *(r = .526).*
- A strong positive statistically significant correlation between mathematics tutors' level of participation in T-TEL PDS, and their perceived self-efficacy beliefs to implement the new 4-year B.Ed. mathematics curriculum which resulted in positive influence on their classroom practices.

5.3 Implications of the Study

Findings of this study showed that generally, mathematics tutors were mostly, punctual and regular to T-TEL PDS and their level of participation in the activities during T-TEL PDS was average. However, over 35.0% of tutors were either late for three times hence missed the first 15 minutes or were sometimes late and therefore missed the first 30 minutes of PD sessions. The implication is that organizers and authorities should put in place measures to address this because over 35.0% of mathematics tutors not being punctual and regular to PDS, is too large a number to be ignored. These tutors would not have the opportunity to fully participated in all the activities and acquire T-TEL students-focused teaching strategies. These mathematics tutors mighty still stick to traditional methods of lecturing with aim of completing the college syllabus and preparing students-teachers for examinations. The students-teachers would not be challenged beyond traditional approaches to learn modern innovative methods of teaching. Consequently, these mathematics tutors would not be able to transform their classroom practices to bring about improved learning outcomes for their student-teachers and pupils in the basic schools.

The study found that both male and female mathematics tutors had high level of participation in in 'group discussions and presentations', 'whole group discussions' and 'think-pair and share' activities during T-TEL PDS. They also actively participated, learnt gender and inclusivity issues during the PDS and are implementing these concepts in their teaching as well. T-TEL's priority aim of equipping mathematics tutors' with teaching and learning strategies that are gender-responsive, student-centred, and inclusive are being achieved. These strategies are helping mathematics tutors prepare pre-service teachers for improved classroom teaching and greater interaction and participation of pupils in lessons. The implication

is that the learning settings of Ghanaian basic school are changing from pupils' listening to their teachers and writing down mathematical facts to pupils' actively participating and constructing mathematical knowledge.

However the study found that mathematics tutors in the Colleges of Education in Northern Ghana recorded a low level of participation in learning journal writing. T-TEL's aim of incorporating learning journal in PDS is to allow mathematics tutors keep record of their thoughts on their learning and teaching experiences with regards to the T-TEL innovative student-focused pedagogies. This is idea would likely not be accomplished. This implies that mathematics tutors might not be reflective practitioners and might not use research to enhance their student-teachers learning outcomes since research topics can be derived from teachers' reflections. The mathematics tutors might not be able to help student-teachers' keep proper teaching practice journals. These journals allow mathematics tutors to better analysis student-teachers experiences, mentor and monitor their progress in the use of some innovative pupil-focused strategies and address their learning needs during on and off-campus teaching practices

The study has shown that mathematics tutors are conversant with the use of games, Jig-saw, questioning to support learning and talk-for-learning strategies and are imploring them in their teaching already. The T-TEL's weekly college-based PDS have equipped mathematics tutors with innovative student-focused teaching strategies which are helping them prepare student teachers for improved classroom teaching and active participation of Basis school pupils in lessons. As a result, Ghanaian classroom experience of mathematics is changing from being boring and teacher domineering to

being fun, full of hands-on activities and enjoyable for student-teachers and pupils. This leads to improved mathematics learning outcomes in basic schools.

This study revealed that mathematics tutors used gender-responsive classroom practices which confirm their high self-efficacy beliefs for gender responsive classroom practices in implementing the new mathematics curriculum from their questionnaire responses. Mathematics tutors in implementing the new B.Ed. mathematics curriculum would heed to T-TEL's call for College of Education tutors and beginning teachers to use gender-responsive teaching and learning strategies. Consequently, equal opportunities are being given to both male and female student-teachers and pupils to actively participate, collaborate and improve their Mathematics learning outcomes in Colleges of Education and basic schools in Ghanaian

Generally, mathematics tutors' perceived self-efficacy beliefs to implement the new 4-year B.Ed. mathematics curriculum were high. Mathematics tutors' have the potential to produce enhanced students-teachers' mathematics learning outcomes in the new 4-year B.Ed. mathematics curriculum through the use of the student-focused methods acquired during the T-TEL PDS. Improved mathematics learning outcomes of student-teachers would eventually lead to improved mathematics learning outcomes of basic school pupils.

5.4 Conclusion

Based on the findings of this study, it can be concluded that T-TEL's weekly college-based PDS offer equal opportunity to both female and male mathematics tutors to attend, participate, acquire and used innovative student-focused teaching methods, gender and inclusion teaching strategies and cross-cutting issues in teaching mathematics in the Colleges of Education.

Mathematics tutors' level of participation in T-TEL PDS is a critical determiner of their perceived self-efficacy beliefs to implement the new 4-year B.Ed. mathematics curriculum.

The present study primarily confirms previous findings that there is a correlation between the professional development received and a teachers' sense of positive self-efficacy.

The T-TEL PDS equips college mathematics tutors with essential active pedagogies, cross-cutting issues and other relevance concepts/knowledge to successful implement the new 4-year B.Ed. mathematics curriculum which is aligned with the National Teachers' Standards and informed by the National Teacher Education Curriculum Framework of which the mathematics tutors should have enough knowledge and understanding.

5.5 Recommendations

The following recommendations are made based on the findings and conclusions of the study:

- Ministry of Education, National Teaching Council, National Council for Tertiary Education, T-TEL and other relevant stakeholders in teacher education should encourage and motivate mathematics tutors to regularly and punctually attend and actively participate in the PDS of the remaining T-TEL themes so as to fully benefit from PDS.
- Stakeholders in teacher education should encourage and motivate mathematics tutors by way of material and non- material rewards to regularly implore the student-focused teaching methods, gender and inclusion teaching strategies

and cross-cutting issues learnt during the T-TEL PDS in teaching in the new 4-year B.Ed. mathematics curriculum.

- Stakeholders in teacher education should assist PDCs and other mathematics tutors to organize the T-TEL PDS for existing basic school teachers to assist them acquire and use innovative student-focused teaching methods, gender and inclusion teaching strategies and cross-cutting issues in teaching mathematics in the basic schools'
- Stakeholders in teacher education should put mechanisms in place for regular assessment of mathematics tutors' implementation of the student-focused teaching methods, gender and inclusion teaching strategies and cross-cutting issues learnt during the T-TEL PDS in teaching in the new 4-year B.Ed. mathematics curriculum.
- Stakeholders in teacher education should compile books/reports on T-TEL PDS in colleges showing pictures of mathematics tutors discussions and presentations regularly and made available for use by tutors and Stakeholders in teacher education.

5.6 Areas for Further Research

The researcher suggests that future researchers should replicate this in Colleges of Education in other regions to see if similar findings could be arrived at. Also, a study of how mathematics tutors are implementing the T-TEL's intervention strategies in their classroom practice in the new 4-year B.Ed. mathematics curriculum is recommended for further study. A study to measure student-teachers, whose mathematics tutors are implementing T-TEL innovative strategies, achievement in mathematics is recommended for further study as well.

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APPENDICES

APPENDIX A

UNIVERSITY OF EDUCATION, WINNEBA

FACULTY OF SCIENCE EDUCATION

DEPARTMENT OF MATHEMATICS

Questionnaire ID

Questionnaire for Mathematics Tutors of College of Education

Dear Tutor,

This questionnaire is mainly for research purposes only. It is meant to solicit views on your level of participation in T-TEL professional development sessions and perceived self-efficacy beliefs to implement the new 4-year B.Ed. mathematics curriculum in the Colleges of Education. You are assured that all responses will be treated as confidential as possible. It will therefore be appreciated if you give sincere and honest response.

SECTION A: Personal Data

Please tick [√] applicable one

1. Gender? 1. Male [ ] 2. Female [ ]
2. Your age?.....
3. How long have you been teaching in the College of Education?.....
4. Underline (or write where applicable) your academic qualification(s)

First Degree: B.Sc. Maths., B.Sc. Maths. Education, B.Ed. Maths., B.Ed. Statistics

Others (please specify)……

Master's Degree: M.Ed. Maths., M.Phil. Maths., M.Phil. Maths. Education, M.Phil. Statistics, Others (please specify)……

P.hD.: Ph.D. Maths. Education, Ph.D. Maths, Ph.D. Statistics.

Others (please specify)……

5. What mathematics course(s) do you teach in the College of Education?
   a. ……
   b. ……

c. ……

d. ……

SECTION B: Level of Mathematics Tutors' Participation in T-TEL Professional Development Sessions (PDS)

6. There were eight (8) units and eight (8) professional development sessions (PDS) in theme 8 in the previous semester. How many PDS did you attend in theme 8, last semester? ……..
7. How punctual were you at the PDS you have attended from themes 1 to 8? (Please, tick one of the options below)

   j) I was **always late** and missed the first 30 minutes ☐

   k) I was **sometimes late** and missed the first 30 minutes ☐

   l) I was **two or three times late** and missed the first 15 minutes ☐

   m) I was **always present** at the PDS venue before it begins. ☐

8. Read the statements numbering **a** to **k**. On a scale of (**1**to **5**), **1 = Very Low, 2** = **Low, 3 = Average, 4 = High, 5 = Very High**, rate the extent to which you agree with the statement on your engagement in the T-TEL Professional Development Sessions (PDS) for teachers of Colleges of Education by ticking [√] in the appropriate cell (or box)

No.	T-TEL professional development activities	Rating of level of engagement				
		Very Low	Low	Average	High	Very High
a.	Individual Reflections before the main activities.					
b.	Individual studying of examples of the mathematics teaching strategies.					
c.	Group discussions and Presentations.					
d.	Think-Pair and share.					
e.	Plan and Practice Together.					
f.	Teach-Reflect Together.					

g.	Whole group discussions.					
h.	Cross-cutting issues, such as Equity and Inclusivity, Transferable Skills, ICT, and Assessing Pupils' Learning and Progress.					
i.	Plan mathematics lessons for each teaching strategy for implementation using the Activity Plan.					
j.	Building teaching Portfolio.					
k.	Writing in Learning Journal.					

SECTION C: Mathematics Tutors' Perceived Self-Efficacy Beliefs

9. Read the statements numbering **i** to **xii.** On a scale of (**1to 5**), **1=Not at All, 2=Very Little, 3=Little, 4=Quite A Bit, 5=A Great Deal,** rate the extent to which you agree with the statement in the implementation of the new B.Ed. mathematics curriculum for Colleges of Education as a result of your participation in the T-TEL Professional Development Sessions, by ticking [√] in the appropriate box (or cell) that best reflects your Self-Efficacy Beliefs.

No.	**Statements about the extent to which you think you can implement the new mathematics curriculum**	**Not at all**	**Very Little**	**Little**	**Quite A Bit**	**A Great Deal**
i.	I can implement the teaching strategies I learned in the various themes in teaching mathematical concepts in the new mathematics curriculum in my classroom.					
ii.	I cannot use a range of formal and informal assessment procedures to modify teaching and learning activities to improve my pre-service teachers' mathematics attainment.					
iii.	I can do much to control disruptive behaviour of Pre-service teachers in my classroom.					
iv.	I cannot do much to get both female and male pre-service teachers to believe they can do well in mathematics.					
v.	I can do much to use gender responsive classroom practices in implementing the new mathematics curriculum.					
vi.	I can use my reflective practice to vary my teaching to improve my pre-service teachers' learning of mathematics.					

vii.	I can use action research to improve my pre-service teachers learning outcomes.					
viii.	I cannot do much to strengthen my pre-service teachers' pedagogical content knowledge in mathematics.					
ix.	I can do much to strengthen my pre-service teachers' subject and curriculum knowledge in mathematics.					
x.	I cannot use modern technology to improve teaching and learning in mathematics.					
xi.	I can produce and use varied resources in teaching and learning to enhance my pre-service teachers' learning of mathematics.					
xii.	I can use a wide range of communication, verbal and non-verbal to enhance my pre-service teachers' engagement in lessons.					

Thank You. I am most grateful!!

APPENDIX B

UNIVERSITY OF EDUCATION, WINNEBA

FACULTY OF SCIENCE EDUCATION

DEPARTMENT OF MATHEMATICS

Interview Guide for Mathematics Tutors of College of Education

This interview is to solicit responses on your level of participation in T-TEL professional development sessions and your perceived self-efficacy beliefs to implement the new 4-year B.Ed. mathematics curriculum in the Colleges of Education. Your responses will be used for this research purpose only and will remain confidential. The interview shall last for about 20 minutes. I seek your permission to record your responses for later transcription. You may ask for clarification if you are in doubt.

Part I: Level of Participation in T-TEL Professional Development Sessions

1. How often do you attend T-TEL Professional Development Sessions?
2. How punctual are you to T-TEL Professional Development Sessions?
3. Explain your level of **Participation in T-TEL Professional Development Sessions (PDS)** with regards to;
    d. The Teaching Strategies/Approaches of various Themes,
    e. Example-Plan and Practice,-Teach-Reflect
    f. Cross-cutting issues, such as Equity and Inclusivity, Transferable Skills, ICT, and Assessing Pupils' Learning and Progress

Part II: Self-Efficacy Beliefs

1. Do you normally take note of gender issues when you are teaching mathematics?

    If yes, how ?

2. How far do you think you can apply the following creative/innovative teaching strategies to the new B.Ed. mathematics curriculum

    a. Games

    b. Talk for learning

    c. Jigsaw

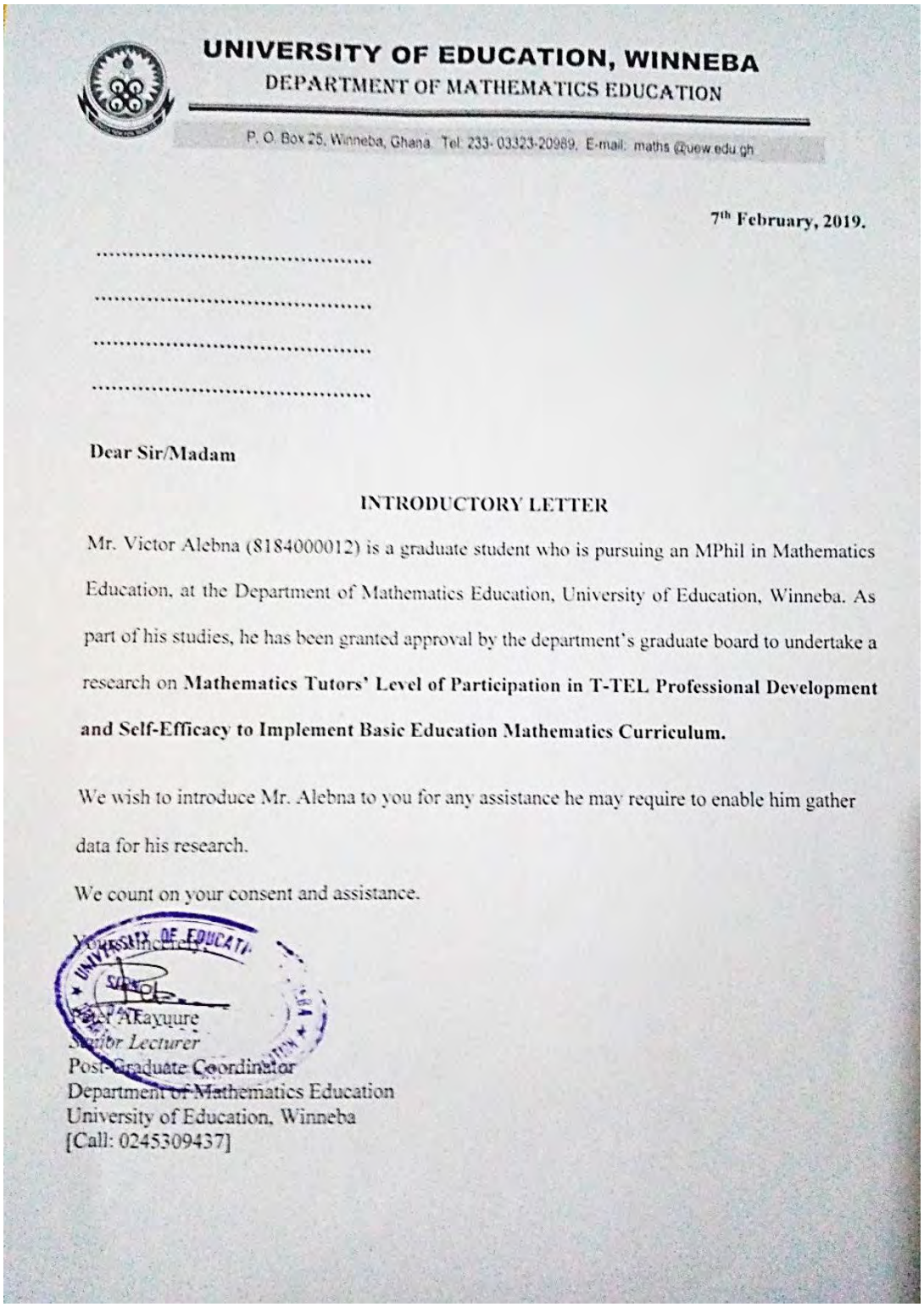
    d. Questioning to Support mathematics Learning

3. What can you do to influence your pre-service teachers' mathematics learning outcomes in implementing the new 4-year B.Ed. mathematics curriculum?

Thank You. I am highly grateful!!!

APPENDIX C

Introductory Letter from the Department of Mathematics Education



UNIVERSITY OF EDUCATION, WINNEBA
DEPARTMENT OF MATHEMATICS EDUCATION
P. O. Box 25, Winneba, Ghana. Tel: 233- 03323-20989, E-mail: maths @uew.edu.gh

7th February, 2019.

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.....
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Dear Sir/Madam

INTRODUCTORY LETTER

Mr. Victor Alebna (8184000012) is a graduate student who is pursuing an MPhil in Mathematics Education, at the Department of Mathematics Education, University of Education, Winneba. As part of his studies, he has been granted approval by the department's graduate board to undertake a research on **Mathematics Tutors' Level of Participation in T-TEL Professional Development and Self-Efficacy to Implement Basic Education Mathematics Curriculum.**

We wish to introduce Mr. Alebna to you for any assistance he may require to enable him gather data for his research.

We count on your consent and assistance.

Yours sincerely,

Peter Akayuure
Senior Lecturer
Post-Graduate Coordinator
Department of Mathematics Education
University of Education, Winneba
[Call: 0245309437]

APPENDIX D

Interview Responses of Participants

FT 1

Researcher: How often do you attend the TTEL professional development sessions?

FT 1: *I am even one of the PDCs, so unless…eerr my absence in the college am always present.*

Researcher: How punctual are you to the professional development sessions?

FT 1: *We the PDCs normally get there before everybody. Because we need to go and arrange the place for others to come in… so am always very punctual.*

Researcher: Can you explain your level of engagement in the teaching strategies of the various themes under the TTEL development sessions?

FT 1: *…When it comes to anything, we have the idea first, so when it comes to activities, I think we lead, so I can say my level of engagement is high.*

Researcher: What is your level of engagement in plan, practice, teach and reflect activities?

FT 1: Yes…. *At times I do it but not quite often anyway, but at least I do it once a while, I try to look back to see whether what we have gone through for the day whether I have been able to implement it throughout the week. It's not all the time, but I do reflect.*

Researcher: What was your involvement or your level of engagement during the learning of concepts such equity and inclusivity, assessing students' learning and progress, ICT, transferrable skills etc…?

FT 1: *I think the emphasis here I will say is this gender something, inclusivity and this diversity in trying to build those gaps between slow learners and what knots. It has been helpful because …eerr…. personally, I am really practicing it. Certain things that I did not know, through this PD sessions, I have been able to incorporate that in my teaching.*

Researcher: Do you normally take note of gender issues when you are teaching Mathematics?

FT 1: *Personally, yes. … Engaging students, this time you know that sort of male domineering if you look at mathematics, but with this knowledge or idea I try to break that gap by involving ladies, especially … as team leaders, using my examples, are no more one way examples that we use in class. This time we try … especially when it comes to use of names and other examples, we also add female names in our questioning, and setting questions and even when we are asking questions. We don't try to throw … the supposed high order questions to only the men but we try to give equal chances … to both sexes to answer. So am applying it. Am really applying, I will say that that is a good this thing, am now*

Researcher: How far do you think you can apply the following creative or innovative teaching strategies to the new B.Ed. Mathematics curriculum, games, talk for learning, jig-saw, questioning to support Mathematics learning and any other strategy you can think of?

FT 1: *Yes, I can use it. I can use games to implement the new B.Ed. mathematics curriculum. This mathematics curriculum is not very different from what we were doing. So I can use games. Yes, you can use the jig-saw but in fact I have never used it before, but I can use it especially in methodology. Especially we can use it, for instance, when it comes to maybe a concept, verifying a formula, you can allow children/ students to go their own way to see whether they will come out with the things they've got.*

… With the questioning, you have to ask questions…. At times when you ask questions, your questions should be in such a way that it geared towards the concept. You don't ask ambiguous questions, so questions can be used to support the learning of mathematics. In fact I do it. As for the questioning, I cannot have a whole lesson without asking questions. So I can use questions to enhance the learning of mathematics especially this B.Ed. program.

Researcher: What can you do to influence your teacher trainees Mathematics learning outcomes in implementing the new 4-year Mathematics programme?

FT 1: *I have realized that this think-pair-share is helping, because, if you look at it, they have come with different backgrounds. You think that they are coming to do the same program, but they are not all...eerr… the same. We are trying to influence the learning of Mathematics by using the think-pair-share, because some of them even learn better from peers than we the teachers and so that is the strategy that mostly I use. I will also use investigation to let them discover instead of giving them concepts. I am going use investigation to develop their thinking skills, and once you develop their thinking skills you are enhancing or influencing mathematics learning. Instead of just always telling them, at times you let them discover for themselves through the activity method. So I try to make my lesson student-centered by allowing them to discover for themselves some of these concepts instead of just telling them off hand. Motivation is very important, because the scores of some of the students from quiz show that most of them are really drowning, and so we need to council them, we need to motivate them, we need to let them know that they have just come and they have the chance to learn, so encouragement is also one thing I do. Even though at this stage we think that they are adults but some of them really need counseling, so the counseling will also help. Apart from the teaching strategies, counseling is also one of the strategies; I think I can use to influence my students learning outcomes.*

FT 2

Researcher: How often do you attend the TTEL professional development sessions?

FT 2: *I go any time we have professional development. Unless… eerr…I have a programme which is official, I have to be there because it is in the timetable that every Wednesday you have to be there.*

Researcher: How punctual are you to the professional development sessions?

FT 2: *As I told you earlier, it is included in the school timetable…eerr…so since I know that this particular time we are supposed to be there, I have to always be there on time because when they starts before I get there, I won't understand anything.*

Researcher: Can you explain your level of engagement in the teaching strategies of the various themes under the TTEL development sessions?

FT 2: *If it is group work, I participate. If it is something that is think-pair-share, we do it. Sometimes it is participatory, everybody must think, and after that, we share in our various groups, whatever we are supposed to do, we all participate. Provided you are there to learn, I think there is the need for you to engage yourself in everything.*

Researcher: What is your level engagement in plan, practice, teach and reflect activities?

FT 2: *If we are to plan in a classroom, let's assume that …eerr…we have been given something to do, you always try to do and when you come back, they try to find out whether we really did it. It is not all the time that all the teaching strategies are employed in the classroom because of maybe the type of topic that I want to teach. Whenever it is supposed to be used, we use it and when we are not able to apply it, we say that yes, because of this and that we couldn't apply what you wanted us to do. But when it is applicable where I am supposed to teach I do*

Researcher: What was your involvement or your level of engagement during the learning of concepts such equity and inclusivity, assessing students' learning and progress, ICT, transferrable skills etc…?

FT 2: *….During the lesson, there were some teachers that they portrayed to show us the differences between equity and inclusivity, so we also took part and we were asked to also give examples and discuss in our groups, so we all try to do something like that.*

Researcher: Do you normally take note of gender issues when you are teaching Mathematics and how do you do that?

FT 2: *Yes…yeah, if there is the need for me to… When I am giving some examples of questions, I include both male and female; I don't use only the names of male to give examples or only female. Like maybe I am trying to form something like word problems where I have to use names, I make sure I use the name of female and the name of male. And if it is something to work on the chalkboard or is it the maker board, I made sure that I have time for both male and female and when I give them group presentations, I made sure that the group that are coming to present, not only males will or not only females but both sex will be there. So I involved them a lot.*

Researcher: How far do you think you can apply the following creative or innovative teaching strategies to the new B.Ed. Mathematics curriculum, eerr…such as games, talk for learning, jig-saw, questioning to support Mathematics learning and any other strategy you can think of?

FM 2: *Yes, if the topic involves …eerr…participation where the pupils are supposed to play games include games in it, like if it is the statistics and probability where they have to toss and those things are there, I can help them to do the practicality themselves. So if the topic that I am treating involves games, I will make sure I involve them.*

For the questioning, there is no way you will teach mathematics without using questions. For questioning, even from the beginning, the RPK, you have to involve questioning, so the beginning, within and at the end of the lesson, you must involve students with questions. If there is no question how do you measure the extent to which your objectives are achieved?

As for jig-saw I do it in class most of the time. As for talk-for-learning, that is most of the things that we do a lot. So as for talk-for-learning l have been doing it.

Researcher: What can you do to influence your pre-service teachers' Mathematics learning outcomes in implementing the new 4-year Mathematics programme?

FT 2: *I consciously ensure, that I employ these new strategies we have been taught because I have the feeling that this is the demand of the new curriculum and so I have ensured that or resolved to ensure that I revise all of these strategies, and determine their suitability to the various topics that I have on my course outline and try to use them anytime I have lessons to deliver. That's the resolve I have gotten to. Because I believe that very often these things will be monitored as we have always had a team coming round to monitor and evaluate, so whichever way you go about it, they tend to get to find out what you are doing, because they interview the students and then will interview you as well. And so, is good to be found to have been implementing the new rather than still doing the same old thing.*

MT 1

Researcher: How often do you attend the TTEL professional development sessions?

MT 1: *If am not sick and nothing takes me off, I don't miss T-TEL*

Researcher: How punctual are you to the professional development sessions?

M T 1: *Very punctual. Am the type who believes in, if am late, I don't come.*

Researcher: Can you explain your level of engagement in the teaching strategies of the various themes under the TTEL development sessions?

MT 1: *I can say I have been actively involved in them anytime am there because it appears each of them always presents an excitement and so generally, I I, I, I, find some fulfillment when am there and am involved in each of them. So I have always virtually played a role, either in a group, you will find me making my contributions and at the end of the day, making a presentation on behalf of the group or the group will pick a representative and then when it comes to projecting some of our positions, I, I have really participated in that.*

Researcher: What is your level engagement in plan, practice, teach and reflect activities?

MT 1: *I will say reflect, plan and execute, that's what I do.*

Researcher: What was your involvement or your level of engagement during the learning of concepts such equity and inclusivity, assessing students' learning and progress, ICT, transferrable skills etc…?

MT 1: *The cross-cutting issues especially inclusivity, gender balance and all those integration and all of that, there had been problems discussing them. When it came to T-TEL most of tutors are of the view that there are some of them (concepts) you cannot inculcate in your lesson but, I don't see why you can't do that. Imagine that you have one of them in your class; at least, he is not probably up to the rest. You should find a way out, you can do segregation teaching. You attend to him individually even though is in the same class, you can have special time for him, so that he learns at his own pace. In any particular case all these things that we are talking about can be done during lessons.*

Researcher: Do you normally take note of gender issues when you are teaching Mathematics?

MT 1: *Seriously, the way I set questions, that's one of them, the way I ask questions, the way I approach some of them. I Like walking around and when I walk to you, ladies probably in their particular situation you might see that she is not fine, get close to her, you will find out why she is not active, at least you've designed a plan in engaging her but you just don't saying that all of them are the same and you go, she might not be paying attention*

Researcher: How far do you think you can apply the following creative or innovative teaching strategies to the new B.Ed. Mathematics curriculum, eerr…such as games, talk for learning, jig-saw, questioning to support Mathematics learning and any other strategy you can think of?

MT 1: *If am teaching algebra, I can coin a question involving games with regards to football, playing cards, and playing ludo.. I can use Jig-saw in teaching triangular, squares, perfect numbers and all those things. Talk for learning….good….. I believe in discussion, so when I get to the class I create a scenario, like today in problem solving, I wanted to teach place value. I don't know what place value is, so I just went into the class and wrote down a question 53 + 28 ...and this was what the answer he gave 311. So the question I asked is what is wrong with the result? What is wrong with the child? How do you help the child to solve it? Go on brainstorm… so I try to create such a scenario for us to discuss. Then the whole concept comes out.*

Researcher: What do you think you can do to influence your pre-service teachers Mathematics learning outcomes in implementing the new 4-year Mathematics programme?

MT 1: *Your personality is vulnerable. How you will carry yourself in the classroom. How you will go through your practice and principles of teaching Mathematics ...is another one, I will mainly use activity methods to teach my students, and not just pouring out the knowledge. I will allow them to interact with their environment and create the knowledge for themselves. I will encourage them and let them take the lead through my guidance to create the knowledge for themselves.*

MT 2

Researcher: How often do you attend the TTEL professional development sessions?

MT 2: *I had been in the session for the past eight months, I think I have missed only two but, even the present one, I haven't missed any session.*

Researcher: How punctual are you to the professional development sessions?

M T 2: *As much as possible very punctual.*

Researcher: Can you explain your level of engagement in the teaching strategies of the various themes under the TTEL development sessions?

MT 2: *I enjoy the activities, so…err…I am always actively involved in them.*

Researcher: What was your level of engagement in plan, practice, teach and reflect activities?

MT 2: *As I said earlier, I …err… I participate actively in group work, and at the beginning of the every time we meet…I tell my colleagues my experience of using the strategy.*

Researcher: What was your involvement or your level of engagement during the learning of concepts such equity and inclusivity, assessing students' learning and progress, ICT, transferrable skills etc…?

MT 2: *Well... you see, it has been …eerrm…something I have even learned in my background …in the formation houses and all that so is something that has already been part of me. So when it comes to talking about equity and equalities, I have already a fair idea what it's all about before this thing came in. So when it came, it kind of a refresher for me to look at people in that line, you see… when you are dealing with students, you know that people at different levels, their personalities are completely different, their backgrounds are different because somebody probably coming from…eerr…eerr… educational background or the parents are well educated and they are interested in education, that person's response to education will different from somebody who doesn't trust so much of education and even want to use the child for other activities at home instead of study. So you have to consider all these things and I think all those things form part and parcel of the equity and …I mean the equality that we are talking about every day. So somehow I try to put all those things into perspective when I am delivering my lessons.*

Researcher: Do you normally take note of gender issues when you are teaching Mathematics and how do you do that?

MT 2: *Very much so. When I am teaching, I make sure I don't allow the young men to dominate in answering the questions, so I give room for the ladies to ask questions and also prompt them to speak in the classroom, and ask any question they want to, if they don't understand. Even if they are not asking the questions, somehow I throw questions to them, I mean to the ladies in the classroom. Sometimes even giving examples, it shouldn't be only relating to the female but male as well. I tell them… … you see one thing that our ladies are not always good in Maths is….when we are buying things for our children…teddy bear is for the girl. But when we are buying something for the men, we have a machine gun or a car, a modeled car … a modeled machine gun, you know…so already … we are telling them that they …they…don't think twice, so somehow you encourage them to get these for the girls as well so that it will encourage them in their mathematics level and I think that's what I do in terms of gender issues.*

Researcher: How far do you think you can apply the following creative or innovative teaching strategies to the new B.Ed. Mathematics curriculum, eerr…such as games, talk for learning, jig-saw, questioning to support Mathematics learning and any other strategy you can think of?

MT 2: *So as far as the games are concern, what I do now is to teach the courses using games, because it helps. Jig-saw issue that you talked about, I think it's something that I can also do in methodology, So and I believe T-TEL's intent is to make people to participate more in the lesson delivery, be part of the lesson delivery and somehow enjoy it. You know, if they don't enjoy mathematics then they think that mathematics is a difficult course and they will not be interested in doing it. So these are some of the things I believe that I can do as mathematics teacher to encourage my students in their understanding of the mathematics.*

I think I have used questioning to support learning. Questioning is a technique I find myself using almost every time. I …I… I use it …to…to….to…to introduce my lessons, eerr…I also use it to determine eerr…the progress of my lesson and then eventually, eerr…I…I use to also assess my students' learning, so I think I have often used that. I also used it to get my students involved in my lessons.

Researcher: What can you do to influence your pre-service teachers' Mathematics learning outcomes in implementing the new 4-year Mathematics programme?

MT 2: *Well …I suppose, for me personally, what I can do is to encourage them to feel that mathematics is not difficult, once they themselves have that idea; they can impart it on the children. I will encourage them to use TLMs as much as possible. I will encourage them to improvise abacus, Cuisenaire rods, Dienes multi-based materials and so on and use them in their lessons presentation. I think that is the bottom line, if they use TLMs all the time to do their lesson presentation and delivery, then the mathematics becomes so practical and becomes so easy and everybody would enjoy teaching and learning mathematics. It becomes a daily routine, like today, I was teaching, I gave them examples about the use of the number line, the use of the Cuisenaire rods, the use of the abacus. Once I use …eerr…TLMs and games, I am sure the B.Ed. programme would be a success for all of us.*

MT 3

Researcher: How often do you attend the TTEL professional development sessions?

MT 3: *Very often*

Researcher: How punctual are you to the professional development sessions?

M T 3: *Over here, usually we do it on Mondays after assembly. After we have met the students, so somewhere, so am punctual.*

Researcher: Can you explain your level of engagement in the teaching strategies of the various themes under the TTEL development sessions?

MT 3: *My level of engagement, if you want to measure it, I will say am very active in it. Usually, they put us in groups and whatever activity that is brought on board we sit as a group, then we appoint secretary and chairperson. Sometimes, I am the chairperson or the secretary to chair the activities, so I will say I am very active.*

Researcher: What is your level engagement in plan, practice, teach and reflect activities?

MT 3: *Sometimes, we do the planning, specifically, when it comes to presentation, I do presentation, so am more involved in it.*

Researcher: What was your involvement or your level of engagement during the learning of concepts such equity and inclusivity, assessing students' learning and progress, ICT, transferrable skills etc…?

MT 3: *My level of engagement is active in it to the extent that when it comes to issues of the cross-cutting issues, issues of gender, inclusiveness, mix training and those kinds of things, I come from a development background and those issues are dearer to me. So am actively involved into it.*

Researcher: Do you normally take note of gender issues when you are teaching Mathematics and how do you do that?

MT 3: *Yes, for example, I given equal opportunities to both males and females in terms of the classroom participation, regarding questioning and responses as well as group work, and so all those things are taking care of.*

Researcher: How far do you think you can apply the following creative or innovative teaching strategies to the new B.Ed. Mathematics curriculum, eerr…such as games, talk for learning, jig-saw, questioning to support Mathematics learning and any other strategy you can think of?

MT 3: *If you say how I think I can…. apply, already, we have been applying them, but to enhance the participation of the students, in the teaching and learning of mathematics as far as games are concerned, I would be focusing on using games to make teaching and learning of mathematics practicable. For jigsaw, I have not done so, but I think going into the future, I should be looking at using the jigsaw. I think I should also look at other strategies and concepts going into the future to be able to use them. I also believe that apart from these strategies, allowing the students themselves to be creative and innovative in terms of teaching concepts is also another thing I should be looking at.*

Researcher: What can you do to influence your pre-service teachers' Mathematics learning outcomes in implementing the new 4-year Mathematics programme?

MT 3: *First of all, what I think, I can do, is to implement the various concepts that we have learned during T-TEL sessions in the instructional period during teaching and learning of mathematics. I think that, if I implement the teaching strategies, it will influence pre-service learning and teaching of mathematics. I will use these teaching*

strategies, so that the students will be able to see mathematics as a practical subject or everyday life situational subject that will enhance the understanding of mathematics, by the students and also they will be able to use it in their daily life activities.

MT 4

Researcher: How often do you attend the TTEL professional development sessions?

MT 4: *As at the time I was given opportunity to teach at Bagabaga College of Education, I have never missed any PD sessions and that was since 2017 up to date.*

Researcher: How punctual are you to the professional development sessions?

M T 4: *I have to at times even get there and help in the arrangement of the tables for my colleagues to come, so I have to always be there early enough to assist the coordinator and his subordinates.*

Researcher: Can you explain your level of engagement in the teaching strategies of the various themes under the TTEL development sessions?

MT 4: *Anytime we are to start, tutors are picked at random to just read introduction or activity column. They will be telling us what we have for the day in terms of activities. they have to say that we should brainstorm and think about it. Two people can think and try to share ideas before later on the group participation would now take place. So I can say that we are applying the various methods that we use in teaching the students there.*

Researcher: What is your level engagement in plan, practice, teach and reflect activities?

MT 4: *Most often, I write for the group. And when I write for the group, they may ask that because I have written everything down, I should do the presentation, so I have to get up and do presentation on behalf of the group.*

Researcher: What was your involvement or your level of engagement during the learning of concepts such equity and inclusivity, assessing students' learning and progress, ICT, transferrable skills etc…?

MT 4: *Well, some of these concepts were already part of our training to a little extent, but I have realized that this time the task is to actually implement them. Is not just about learning but the emphasis now is to implement them in our daily teachings. So, I think I have been reawakened to them and I have tried on a number of occasions to implement them in my classes.*

Researcher: Do you normally take note of gender issues when you are teaching Mathematics and how do you do that?

MT 4: *Yes, I do normally take notice. I do in terms of distributing of questions. I think I have always done so. I think it's also at the back of my mind when am giving a group work, trying to ensure that the ladies are distributed quiet proportionally among the various groups.*

Researcher: How far do you think you can apply the following creative or innovative teaching strategies to the new B.Ed. Mathematics curriculum, eerr…such as games, talk for learning, jig-saw, questioning to support Mathematics learning and any other strategy you can think of?

MT 4: *You see, all these teaching strategies that you have mentioned, depend on the topic you are teaching. There are some concepts that if you don't introduce games as your way of interaction or even during the teaching process, then it will become difficult for students to really understand the concepts. For instance, the students have been even playing games at home, but they don't know the impact of that in learning probability, so games are very important in teaching mathematics, but am telling you that, it depend on the topic. Now when you come to jig-saw, we have been implementing that one and I will continue to use it.*

Talk-for-learning, that's even the usual way of our teaching process, so once in a while, I let them brainstorm, so if they are brainstorming, they are talking for learning and they will come out with issues. I use talk-for-learning strategies to introduce, monitor and evaluate my lessons so, I will use these strategies in our new B.Ed. curriculum.

Researcher: What can you do to influence your pre-service teachers' Mathematics learning outcomes in implementing the new 4-year Mathematics programme?

MT 4: *In teaching mathematics, everything boils down to the pedagogical content knowledge of the tutor, and as a tutor, no matter how good you are with the content but you shouldn't forget the fact that these are students that you are teaching to go and also teach at the basic level, so you must let them understand what they are doing and how to also impart what they have understood to pupils. So here, my main dream is to teach them very well using a blend of the concepts and student-centered methods I learnt during T-TEL and the university so that at the end of the 4-year programme they should be able to impart that mathematical knowledge through critical thinking, self-directed learning, problem-solving skills, which I will instill in them during this B.Ed. ...pro…curriculum. I am confident that my students would be able to deliver well because of the professional practice and knowledge, I will instill in them Curriculum knowledge and professional practice is very…very important, so these are the things that I am trying to instill in these students, so that at least, we can also be proud that we have indeed trained them very well and own children at the basic level would also be able to acquire that knowledge that they can move higher in their educational level.*

MT 5

Researcher: How often do you attend the TTEL professional development sessions?

MT 5: *Am always around, except when…I travel out… I have always taken part.*

Researcher: How punctual are you to the professional development sessions?

M T 5: *I go on time and always regular.*

Researcher: Can you explain your level of engagement in the teaching strategies of the various themes under the TTEL development sessions?

MT 5: *Most of the time, they put us in groups to work. At the group level, I contribute the little that I know or that I can.*

Researcher: What is your level engagement in plan, practice, teach and reflect activities?

MT 5: *During the sessions we work mostly in groups. When I am supposed to lead or present, I do but if it someone's turn he/she does but I try as much as possible to participate.*

Researcher: What was your involvement or your level of engagement during the learning of concepts such equity and inclusivity, assessing students' learning and progress, ICT, transferrable skills etc…?

MT 5: *Actually, as far as that particular theme is concerned, I was not on campus. I don't even have that manual. But at least I have some fair ideas because we have been talking about it. I have some fair knowledge about it.*

Researcher: Do you normally take note of gender issues when you are teaching Mathematics and how do you do that?

MT 5: *Yes, I do. when I ask questions and I see that most of the time boys are raising up their hands or try to answer, I try to find out from the girls' their point of view and I try to encourage them to take active part. I encourage everybody to learn and I believe that they are all doing well. In relative terms, both sexes are doing well.*

Researcher: How far do you think you can apply the following creative or innovative teaching strategies to the new B.Ed. Mathematics curriculum, eerr…such as games, talk for learning, jig-saw, questioning to support Mathematics learning and any other strategy you can think of?

MT 5: *If it is possible for me to organize a game that will bring about the introduction of the lesson, I do it sometimes. But where I find it difficult too, I ignore.*

As for talk-for-learning, it is through questions and answers and when they are doing presentations. Even though, I have never done any presentation because the nature of the course doesn't permit that. I can let somebody come to solve a problem on the board and I will see, and whilst he is doing it he explains, so once in a while somebody will explain something. I think that's what I understand it to be

For jig-saw, it is when I was teaching methodology that the idea came and I try to find out from students whether they know anything about it and if they didn't know anything about it, I just explained but I have not applied it in the teaching per say, but if the topics require applying jig-saw, I will apply it.

Researcher: What can you do to influence your pre-service teachers' Mathematics learning outcomes in implementing the new 4-year Mathematics programme?

MT 5: *Normally, I encourage them that apart from what we teach in the class, they should also explore, read, go to the library, also visit the internet and get information. I have often told them relying on only what we teach in the classroom is not enough, so when they learn on their own, it will also help them. I have always used an example such as learning to ride a bicycle. If you teaching someone how to ride a bicycle and you are riding around and coming to stop, after an hour or two, the person who is there to learn will not know how to ride. So I have always associated learning mathematics and any other subject that they must also learn how to ride bicycle by learning on their own. That's what I have often told my students.*