USE OF LEARNER-CENTRED APPROACHES IN THE TEACHING OF MATHEMATICS IN TEACHER EDUCATION

MASTER OF EDUCATION (PRIMARY) THESIS

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UNIVERSITY OF MALAWI

CHANCELLOR COLLEGE

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By

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DECLARATION

I the undersigned hereby declare that this thesis is my own original work which has not been submitted to any other institution for similar purposes. Where other people's work has been used acknowledgements have been made.

PASCHAL WATSON BENJAMIN KAYANGE

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Signature

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Date

CERTIFICATE OF APPROVAL

The undersigned certify that this thesis represents the student's own work and effort and has been submitted with our approval.

Signature _____ Date_____

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Main Supervisor

Signature: _____Date:_____

Dorothy C. Nampota, PhD (Associate Professor)

DEDICATION

To my dear wife Mariana and my children Placidia, Ignatius, Mercy, Faustina, Emma and Maximillian for their patience, support and encouragement during the hard times I went through in producing this work. It was long time that they waited for me while I was studying for this Master's degree. This is a dedication to them.

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ABSTRACT

The Initial Primary Teacher Education (IPTE) programme was reformed to adopt the outcomes based education which encourages the use of learner-centred approaches as a way of addressing the lowering education quality in Malawi. For this reason, this study was undertaken to determine the extent of the use of these approaches in the teaching of mathematics at one public TTC in Malawi. The study used mixed method approach which combines quantitative and qualitative data collection methods. The quantitative methods involved the use of a questionnaire to gather data from 160 students while the qualitative methods involved the use of interviews and lesson observations to obtain data from 7 mathematics teacher educators. The study established that learner-centred approaches were used to a large extent in the teaching of mathematics despite some difficulties that students as well as teacher educators experienced during the process of teaching and learning. Both students and teacher educators contended that these approaches offer more opportunities for learning mathematics as opposed to the traditional approaches such as lecturing which were also used in teaching some mathematics lessons. This study recommends a review of IPTE mathematics handbooks in which the instructions for most activities promote the use of few teaching methods such as group work and discussion as revealed by the study findings.

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LIST OF ABBREVIATIONS AND ACRONYMS

CERT	:	Centre for Educational Research and Training
EFA	:	Education for All
IPTE	:	Initial Primary Teacher Education
LCA	:	Learner Centred Approaches
MASTEP	:	Malawi Special Teacher Education Programme
MIE	:	Malawi Institute of Education
MIITEP	:	Malawi Integrated In-Service Teacher Education Programme
OBE	:	Outcomes Based Education
ODL	:	Open and Distance Learning
PTCE	:	Primary Teachers Certificate Examinations
SACMEQ	:	Southern and Eastern Africa Consortium for Monitoring Educational Quality
TALULAR	:	Teaching and Learning Using Locally Available Resources
TTC	:	Teachers Training College

CHAPTER 1

INTRODUCTION

1.0 Chapter overview

The chapter presents the contextual background to the study by discussing IPTE Programme, the adoption of outcomes based education and the use of learner-centred approaches in teaching. This is followed by the statement of the problem, purpose of the study, research questions and significance of the study. Finally, the chapter gives definitions of some terms as they have been used in this thesis.

1.1 Background

1.1.1 IPTE Programme and Outcomes Based Education (OBE)

The Initial Primary Teacher Education (IPTE) programme was introduced in Malawi in 2005 in order to align teacher education with the reformed primary school curriculum which was introduced in 2008 (Mizrachi, Padilla & Susuwele-Banda, 2010). The aim of reforming the primary and teacher education curricula was to address the lowering standards of education in Malawi and to respond to the current trends in the education sector (InWent, 2008).The reform led to the adoption of outcomes based education (OBE) which promotes the use of active learning pedagogies as the means to achieve the intended learning outcomes in the teaching and learning process (Mizrachi et al., 2010).

OBE defines clearly what learners are to learn, measures their progress based on actual achievement and meets their needs through various forms of mediated learning experiences (MIE, 2007). In OBE, the quality of teaching and decisions are driven by outcomes that are displayed by the learner at the end of the teaching and learning process (Chirwa & Naidoo, 2014).

It is important to note that Malawi did not adopt OBE as it practiced in other countries such as Australia, South Africa and the United States. Usually, OBE does not have prescribed textbooks and rigid timetables because the emphasis is not in content from one source (Kaambankadzanja, 2012). In Malawi, the OBE was modified to suit the situation in the education system. Currently, the teaching process in primary schools and teacher education follows some prescribed textbooks and timetable.

1.1.2 Learner-centred approaches in primary and teacher education

Prior to the reform of primary and teacher education curricula, teachers used to occupy the centre position in the teaching and learning process while learners were taken as passive recipients of information transferred by the teacher. The OBE emphasizes the use of learner-centred approaches to promote active learning by students (MIE, 2007). These approaches shift the emphasis of teaching from the teacher's goals and methods of delivery to the knowledge and skills that learners develop in the lesson (Brackenbury, 2012). The main aspect of learner-centred approach is the role of student as an active participant in the process of the teaching and learning (Chiphiko & Shawa, 2014). The

use of variety of learner-centred methods in a lesson helps to promote active participation of all students which is ideal for their attainment of meaningful learning.

1.1.3 Learner-centred approaches in the teaching of mathematics

Mathematics teaching requires the use of appropriate teaching and learning methods and resources in order to help all student teachers to acquire relevant knowledge and skills which are necessary for effective teaching of mathematics in primary schools. According to Shulman (1986), teachers need to have three categories of knowledge which are essential for effective teaching of mathematics. Firstly, they need to have subject matter content knowledge in order to understand the fundamental concepts in mathematics. Secondly, they need pedagogical content knowledge to enable them to interpret and transform the subject-matter knowledge into the context which facilitates learning in the classroom. Finally, they need curricular knowledge for them to know the full range of the content to be taught to learners at a given level. Therefore, it requires high quality teacher education for student teachers to acquire all the three categories of knowledge which are essential for the effective teaching of mathematics.

Many educationists argue that learner-centred teaching approaches help to promote meaningful learning by students as opposed to the traditional delivery of information (Zain, Rasidi & Abidin, 2012; Vavrus, Thomas & Bartlett, 2011; Weimer, 2002). For instance, Zain et al. (2012) contends that the best way to learn is by having students construct their own knowledge instead of having someone construct it for them. The current teacher education encourages the use of variety of learner-centred teaching

methods as a way of allowing students to construct their own knowledge through variety of learner-centred activities.

Various learner-centred methods are included in IPTE syllabuses and other IPTE handbooks. However, not all of them are used in the teaching process. For this reason, teacher educators in public Teachers Training Colleges (TTCs) together with Demonstration Primary School teachers participated in the college-based training on the use of learner-centred approaches from 2011 to 2013 with the aim of building the institutional capacity to implement and fully utilise these approaches in TTCs and Demonstration primary schools (InWent, 2008). In this way, student teachers would be able to appreciate the practical aspects of various teaching methods and be able to use them in their own classrooms after finishing their training.

Prior to the training, some teacher educators, Demonstration School teachers and some officials from the Ministry of Education went to Germany to observe how the learner-centred approaches were being implemented in schools in that country. Their experiences from Germany acted as basis for the training in which participants practiced the use of several learner-centred teaching methods and shared their teaching experiences.

Despite the effort to promote the use of learner-centred approaches, various study findings reveal some challenges that hinder the effective use of these approaches in the classrooms such as large classes, inadequate resources and infrastructures in most schools and lack of pedagogic skills by teachers (CERT, 2015; Chiphiko & Shawa, 2014;

Mizrachi et al., 2010). Nevertheless, with proper training and support most teachers can be able to use learner-centred approaches which have the potential to help students to attain meaningful learning with less dependency on their teacher as the only source of knowledge in the classroom.

Since learner-centred approaches are entrenched in the IPTE curriculum, it is important to learn more about the extent to which these approaches are used in the teaching of mathematics which is one of the subjects in teacher education and to get the views of students and teacher educators regarding the use of these approaches in teaching and learning process.

1.2 Statement of the problem

Although there has been relentless effort by the government and its development partners to improve the quality of basic education in Malawi, the performance of primary school learners in mathematics is still poor as compared to learners in other countries in the region. This is evidenced by the results of standardized international learning assessment which is administered by Southern and Eastern Africa Consortium for Monitoring Educational Quality (SACMEQ). The results show that Malawian learners perform poorly with regard to proficiency in both reading and mathematics as compared to all SACMEQ countries (Ravishankar, El-Kogali, Sankar, Tanaka & Rakoto-Tiana, 2016; Selemani-Meke & Rembe, 2014). The poor achievement of learners in primary schools is a result of a number of factors ranging from inadequate resources and infrastructures to inappropriate teaching approaches that teachers use (Chiphiko & Shawa, 2014; Mizrachi

et al., 2010). Currently, the government of Malawi is striving to promote the use learner-centred approaches in primary schools as well as teacher education as a way of improving the quality of education in the country.

The current IPTE programme requires all teacher educators to use learner-centred approaches as opposed to teacher-centred approaches in order to achieve meaningful learning by students in TTCs. The effective use of learner-centred approaches in teacher education could result in the trainee teachers being able to apply the same approaches in their own classrooms after finishing their training. To this effect, some studies have been carried out, mainly in primary schools, to investigate the use of learner-centred approaches. For example, Chiphiko and Shawa (2014) investigated how primary school teachers implemented learner-centred approaches in Kasungu District in Malawi. Mizrachi et al. (2010) conducted a case study to get perceptions of teachers and other stakeholders on the policy and practice of active-learning pedagogies or learner-centred methodologies. Generally, the results of these studies reveal more challenges than successes regarding the use of learner-centred approaches in the classroom.

To the best of my knowledge, documentation of how learner-centred approaches are used in primary teacher education institutions is minimal. This means that little is known about the extent to which these approaches are being implemented in the TTCs where primary school teachers obtain their initial training. It is against this background that this study sought to find out the extent of the use of learner-centred approaches in the teaching of

mathematics and to get the views of students and teacher educators regarding the use of these approaches at the TTC.

1.3 Purpose of the study

The purpose of this study was to investigate the use of learner-centred approaches in promoting students' learning of mathematics in teacher education programme.

1.4 Research question

The study was guided by the following research questions:

1.4.1 Main research question

To what extent does the use of learner-centred approaches promote learning of mathematics in teacher education?

1.4.2 Specific research questions

1. To what extent are learner-centred methods being used in the teaching of mathematics?
2. What are the views of students regarding learning mathematics in a learner-centred environment?
3. What are the views of teacher educators regarding the use of learner-centred approaches in teaching of mathematics?

1.5 Significance of the study

It is anticipated that the results of this study would bring to light the extent of the use of learner-centred approaches in the teaching of mathematics. For a long time, mathematics has been taught using the traditional approaches which are characterised by memorising the procedures for solving mathematical problems. Hence, the findings of this study would shed more light on the use of the new approaches in the teaching of mathematics.

In addition, the result of the study would provide empirical basis for further research on the use of learner-centred methods in teacher education.

1.6 Definition of terms

Some terms can have different interpretations depending on the context in which they are used. This section contains definitions of some terms as they have been used technically in this thesis.

Active learning pedagogies: These are teaching and learning methods which allow students to participate actively during the teaching and learning process.

Activities: These refer to hands-on and minds-on manipulations that students carry out in the lesson.

Initial Primary Teacher Education: The current programme for training teachers at TTC which was introduced in 2005 after the Malawi Integrated In-service Teacher Education Programme.

Learner-centred approach: This is the teaching approach which is characterized by the use of active learning methods such as group work, project activities and pair work.

Outcomes based education: This is the educational approach that is based on learners' achievement in which they build knowledge based on their prior knowledge**.**

Student: This is a person who is enrolled in teacher education institution for the purpose of receiving instruction. The similar term which used is learner.

Teacher education: These are policies and procedures designed to equip prospective teachers with the knowledge, values, attitude and skills that are required to perform the task of teaching in the classroom.

Teacher educator: This is the teacher who has been entrusted to train the students at the TTC. The other name used is tutor.

Teacher-centred approaches: This is the traditional passive view of learning which involves situations where information is delivered to students mostly through lecturing.

1.7 Chapter summary

This chapter has briefly discussed the background to the study which includes the adoption of outcomes based education in teacher education which encourages the use of learner-centred approaches in the teaching and learning process. It has also discussed the statement of the problem, purpose of the study, research questions and the significance of the study. Chapter 2 presents a review of related literature on the use of learner-centred approaches in the teaching and learning process.

CHAPTER 2

REVIEW OF RELATED LITERATURE AND RESEARCH

2.0 Chapter overview

This chapter presents a review of literature on the use of learner-centred approaches in the teaching and learning process. The chapter contains seven sections. The first one gives an overview of teacher education programmes in Malawi. The second one describes learner-centred and teacher-centred approaches. The third one discusses theories that explain the concept of learner-centred approaches. The fourth section gives a review of some studies on the use of learner-centred approaches in other countries. The fifth one discusses some studies on the use of learner-centred approaches in Malawi. The sixth one discusses mathematics teaching and the use of learner-centred approaches. Finally, the seventh section gives the theoretical framework that guided this study.

2.1 Teacher education programmes in Malawi

In Malawi, teacher education has undergone several changes since independence in 1964. Various teacher education programmes have been used to train primary school teachers such as two-year and one-year residential programmes, Malawi Special Teacher Education Programme (MASTEP), Malawi Integrated In-Service Teacher Education

Programme (MIITEP), Open and Distance Learning (ODL) and the current Initial Primary Teacher Education (IPTE).

The IPTE programme is a mixed mode which consists of one year college-based training and one year school-based practicum (MIE, 2006). During the college-based year, student-teachers acquire knowledge, skills and attitudes through various content, pedagogical and practical courses (Mwanza, Moyo & Maphosa, 2015). Subsequently, they write the Primary Teachers Certificate Examinations (PTCE) and must pass in all the ten learning areas in order to proceed to second year which is school-based in form of teaching practice. During the second year, students are placed in some selected primary schools where they practice what they learn during the college-based year (Mizrachi et al., 2010). At the end of the two-year training, the new teachers are expected to demonstrate relevant knowledge and skills for teaching learners in primary schools.

2.2 Teaching approaches

The primary purpose of teaching at any level of education is to bring fundamental change in the learner (Tebabal & Kahssay, 2011). Teachers use different approaches in order to help learners to acquire knowledge and skills which are required in their daily life. There are two notable approaches which teachers use in the process of teaching and learning, namely learner-centred and teacher-centred approaches.

2.2.1 Learner-centred approaches

The students of today are expected to acquire necessary skills and abilities that would enable them to think critically and analytically, solve real-life complex problems and reflect on what they learn (Aliusta, Özer & Kan, 2015). Recently, there has been a gradual shift of education practices in many countries from prevailing traditional or teacher-centred towards learner-centred approaches. Brackenbury (2012) describe learner-centred approach as a collection of instructional practices that shifts the emphasis of teaching from the teacher's goals and methods of delivery to the knowledge and skills that students develop. In other words, learner-centred approach places students at the centre of all activities in the teaching and learning process. This is in line with the view of Weimer (2002) that learner-centred approaches focus on how students learn instead of how teachers teach.

In Malawi, the primary and teacher education curricula were reformed in order to adopt the outcomes based education (OBE) which promotes the use of learner-centred approaches in the teaching and learning process (Kaambankadzanja, 2012; Mizrachi et al., 2010). For this reason, all primary school teachers and teacher educators are encouraged to use learner-centred approaches in order to achieve meaningful learning by all students.

Learner-centred approaches are often associated with the attainment of quality education as opposed to teacher-centred approaches where the teaching process often focuses on the teacher's knowledge and the unilateral transmission of information to students (Metto &

Makewa, 2014; Vavrus et al., 2011). In a learner-centred classroom, the focus of teaching is on the role of every student as an active participant in the process of teaching and learning. In a typical learner-centred teaching, students influence the content, activities, materials and pace of learning (Froyd & Simpson, 2008). This means that the effective use of learner-centred approaches can help to meet the needs, abilities, interests and preferences of all students in class (Aliusta & Bekir, 2013). According to Mwangi, Barchok and Ogola (2015), the effective use of learner-centred approaches in mathematics teaching encourages students to collaborate and compete with others in order to form an active part in the acquisition of their own mathematical knowledge.

Brackenbury (2012) points out three applied features of learner-centred approaches in the classroom situation. The first one is the constructive basis of learning. In learner-centred classroom, the teaching and learning process aims at encouraging all students to actively participate in all lesson activities other than being mere passive listeners. In this way, students are able to construct meaningful knowledge and acquire relevant skills which can be used in real life. This is in line with the core of constructivism that learners actively construct their own knowledge and meaning from their experiences (Kalpana, 2014).

The second feature is the purposefulness, relevance and transferable of the knowledge and skills that are constructed by learners (Brackenbury, 2012). Generally, the knowledge which is encoded by students themselves is more flexible, transferable and useful than the knowledge that is encoded and transmitted to them by their teacher (Chisholm & Leyendecker, 2008). The main purpose of teacher education is to prepare students to

teach effectively in their own classrooms after finishing their training. With learner-centred approaches, students can be able to develop creativity, critical thinking and ability to apply complex ideas in real-life situations (Vavrus et al., 2011). For this reason, teacher education needs to offer quality teaching to ensure that all students develop the knowledge and skills that are required for effective teaching.

The third applied feature of learner-centred teaching is the change that occurs when shifting from traditional to learner-centred approaches (Brackenbury, 2012). The adoption of IPTE curriculum in Malawi necessitated the change of teaching from traditional to learner-centred approaches. The effective use of learner-centred approaches helps teachers to shift the focus of instruction from the teacher to students. In this case, the teacher assumes the role of facilitator and contributor rather than director and source of knowledge in learner-centred teaching (Weimer, 2002).

2.2.1.1 Learner-centred teaching methods

Effective teaching is characterized by appropriate teaching approaches that are used in the teaching process (Rahman et al., 2011). Nowadays, it is claimed that effective teaching takes place through the use of learner-centred approaches which help students to participate actively in a variety of learning experiences (InWent, 2009). The learner-centred approaches entail the use of learner-centred methods in the teaching and learning process. Mizrachi et al. (2010) describe learner-centred methods as active learning pedagogies that put students at the centre of the learning process. These methods are based on the constructivist view that learners are not “blank slates” but active participants

who are able to construct their own knowledge in given situation basing on their past experiences and cultural factors (Khalid &Azeem, 2012).

The constructivist teaching encourages the use of collaborative or cooperative teaching and learning methods which involve joint intellectual participation among students or between students and teacher educators (Mwangi, et al., 2015). This means that through learner-centred methods, students are able to discover knowledge on their own with less dependency on their teacher educator. For this reason, the education systems strive to encourage the use learner-centred teaching methods which promote interest, analytical research, critical thinking and enjoyment in students (Ganyaupfu, 2013).

In Malawi, the new primary and teacher education curricula are designed to be implemented by teachers using learner-centred or active-learning methods (Kaambankadzanja, 2012; Mizrachi et al., 2010; Chulu & Chiziwa, 2010). For this reason, both primary and IPTE curricula have some suggested methods for teaching each topic in the syllabus. For instance, the common teaching methods in the IPTE mathematics syllabus and other IPTE handbooks include brainstorming, card collecting and clustering, conversation circle, demonstration, discussion, explanation, flashlight, focus ball, gallery walk, games, group work, individual work, investigation, jigsaw, making a stand, concept mapping, observation, pair work, poster making, project work, question and answer, research, role play, silent participant, singing, speaking chain and think-pair-share (MIE, 2014; MIE, 2006; MIE, 2005). Teacher educators are required to

use variety of these teaching methods in a learner-centred way for all students to achieve the intended learning outcomes.

Usually, student teachers learn about teaching methods in Foundation Studies course. However, they learn more about the applicability of each method during the process of teaching and learning at TTC and Demonstration Primary School.

2.2.2 Teacher-centred approaches

Mgeni (2013) defines teacher-centred approach as the traditional passive view of learning which involves situations where information is delivered to students mostly through lecturing. The teacher asserts control over the materials that students study and the way in which they study them. In most cases, the teacher is the most active person in the classroom and he/she does most of the talking through lecturing and demonstrating concepts to students. In this case, the role of students is mainly to listen and take down notes as the teacher gives oral presentation of facts in the classroom.

Both primary school and IPTE curricula do not encourage the use of teacher-centred approaches which are considered to be less demanding of pupils and responsible for "stifling critical and creative thinking among learners" (Mtika & Gates, 2010, p. 396). Teacher-centred approaches are commonly used in large classes where teacher's contact with each individual learner is minimal (MIE, 2006). Generally, most teachers use these approaches to ensure that all learners receive the information at the same time. Sometimes, they use the approaches in order to cover a lot of work within a short time.

Consequently, this encourages students to cram the information which gets forgotten easily. In most cases, the use of teacher-centred approaches forces students to memorize the provided information mainly for the sake of examinations.

2.3 Theories of learner-centred approaches

Learner-centred approaches are linked to the theory of constructivism which stipulates that students learn best by actively constructing and assimilating knowledge rather than through passive addition of discrete facts to their existing knowledge (Mtika & Gates, 2010). Basing on this theory, meaningful learning takes place when teachers use constructivist methods which are learner-centred and typically involve more active learning experiences through student-student and student-teacher interactions (Shumba, 2011).

Constructivism is associated with prominent education scholars such as Jean Piaget and Lev Vygotsky (Mensah & Somuah, 2014; Brackenbury, 2012; Chisholm & Leyendecker, 2008). Piaget's cognitive constructivism provides a two pronged approach to knowledge construction. Firstly, he posits that individuals construct new knowledge from their own experiences through the processes of accommodation and assimilation (Mensah & Somuah, 2014). Assimilation means incorporating new information in terms of pre-existing concepts, information or ideas while accommodation is the modification of pre-existing concepts in terms of new information or experience (Kalpana, 2014). This means that learners construct knowledge by mentally transforming or reorganising their previous knowledge during the teaching and learning process.

Secondly, Piaget states that learning occurs when an individual passes through the four stages of cognitive developments which are sensory-motor, pre-operational, concrete and formal operational stages (Mwanda, Odundo, Midigo & Mwanda, 2016). This means that at each stage of their cognitive development, learners construct knowledge when new information is actively assimilated and accommodated into their existing knowledge base (Fosnot & Perry, 1996). Hence, the understanding of Piaget's cognitive theory helps teachers to align their teaching strategies with their students' cognitive level.

The social constructivist learning theory which was propounded by Vygotsky (1978) regards learning as socially mediated exercise where learners construct knowledge through interactions with social and cultural environment. This theory recognizes learners' diverse socio-cultural background as central to their cognitive development. According to this theory, learning occurs by means of peer interaction (collaboration), students' ownership of the curriculum and educational experiences that are authentic to students (Bay, Bagceci & Cetin, 2012). As Vygotsky points out, "every function in the child's cultural development appears twice: first, on the social level, and later, on the individual level" (1978, p.57). The use of collaborative teaching methods such as group discussions encourages social interactions which help students to have a shared understanding of the given tasks. In mathematics teaching, the use of learner-centred approaches provides students with opportunity to construct knowledge at social levels during group discussions and individually through individual tasks.

Within the social constructivism, there is the concept of Zone of Proximal Development (ZPD) which refers to the distance between the actual development of a student as determined by the independent problem solving and the level of potential development under adult guidance or in collaboration with other students (InWent, 2009; Slavin, 2006). In most cases, students who do not perform to the expected standards in class require assistance from more capable persons such as teachers or peers for them to work within their ZPD. In learner-centred teaching, teachers assist slow learners by using various strategies such as scaffolding and group problem-solving. Mensah and Somuah (2014) define scaffolding as a form of adult assistance that enables learners to carry out some given tasks that would be beyond their unassisted effort. Scaffolding helps students with learning problems to be able to achieve the intended learning outcomes. Through collaborative methods, more capable students scaffold slow learners in the lesson activities for them to succeed.

Generally, students in learner centred classroom are not taken as passive recipients of information but active participants in the construction of their own knowledge. Khalid and Azeem (2012) contend that students bring to school their past experiences and cultural factors which help them to construct new knowledge in the given situation. This means that with proper support, all students are able to construct knowledge either individually basing on their prior experiences or collaboratively by working with others (Kalpana, 2014). In this case, the role the teacher is to guide and support students in developing new insights and connecting them with their previous experiences.

Despite the potential benefits of learner-centred approaches in promoting meaningful learning by students, there are various barriers that affect the effective use of these approaches in the classroom situation. This is evidenced by some study findings which have been conducted in and outside Malawi.

2.4 Learner-centred teaching in other countries

2.4.1 Learner-centred teaching outside Africa

Learner-centred teaching is known through research to enhance effective learning by students. In developed countries such as the United States America (USA) and most European countries, learner-centred approaches are practiced to a large extent as compared to several developing countries (Metto & Makewa, 2014). Teachers and students in these countries have been exposed to learner-centred approaches from real-life experiences in the classrooms. The government provides significant resources to promote learner-centred approaches in the classrooms at all levels of education (de la Sablonnière Taylor, & Sadykova, 2009).

In USA, Stefaniak and Tracey (2015) carried out a study to examine how undergraduate students experienced learning in a learner-centred teaching environment in an Introductory to Public Speaking course. The findings indicates that students who were engaged in learner-centred activities within the course demonstrated higher levels of motivation towards the course and were more actively engaged in the learning process. This agrees with constructivist view that learner-centred teaching "helps students to learn

'how to learn' which fosters critical thinking, motivation and independence" (Kalpana, 2014, p. 28).

Likewise, in Pakistan the results of an experimental study by Khalid and Azeem (2012) gives evidence that learner-centred approaches help to improve students' learning achievement. The study was carried out to find out the effects of constructivist instruction on students' academic achievement in elementary school. The findings indicate that constructivist teaching helped students to learn better and their rate of proficiency was higher than those who learnt through the traditional approaches. Hence, it can be said that constructivist teaching, which is learner-centred, supports the development of higher order thinking as well as performance skills in students (de la Sablonnière Taylor, & Sadykova, 2009).

However, despite the benefits of learner-centred approaches, teaching in many parts of the world is still characterised by teacher-centred approaches (InWent, 2008). For example, study findings in primary schools in Ireland reveal that teachers eagerly embraced constructivism at the outset but realities in their classrooms such as large number of learners, the breadth of the curriculum and the wide range of learners' abilities impact the successful transition to learner-centred approaches (Oshea & Leavy, 2013). The realities in the Irish primary schools are apparent in several other countries, especially in developing countries and they hinder the effective use of learner-centred approaches at all levels of education.

2.4.2 Learner-centred teaching in African countries

From 1990s to early 2000s, several African countries instituted reforms in the education system to enable teachers to move away from the traditional teaching approaches to learner-centred approaches (Vavrus et al., 2011). However, study findings in most Sub-Saharan African countries show that the idea of learner-centred approaches has not taken root in the classrooms (Schweisfurth, 2013; Mtika & Gates, 2010).

In Botswana, Major and Tiro (2012) carried out a study to investigate the perceptions of student teachers regarding the teacher education program. The findings indicate that the students were taught a lot of theory and did less practice. Major and Tiro (2012) argue that pre-service teachers need the application skills more than the content. Through learner-centred approaches, student teachers participate in various learner-centred activities such as micro teaching as opposed to learning about teaching methods theoretically. It is through participatory activities that students can be able to acquire necessary teaching skills which can be applied easily in their own classroom. This agrees with the argument by Bunyi, Wangia, Magoma and Limboro (2013) that the skill of teaching should be developed from the context of practice for students to understand real classroom challenges. Even though teacher educators can lecture about the teaching methods, students cannot understand the applicability of the methods in the classroom. Generally, student teachers learn better through integration of theory and practice.

At Kericho Teachers' Training College (TTC) in Kenya, teacher educators adopted teacher-centred approaches in their teaching. The findings of an action research by

Willitter, Ahmed and Kipng'etich (2013) at the institution indicate that most student teachers performed poorly in the Primary Teachers Examinations (PTE) as compared to their counterparts in other public TTCs. However, after attending trainings on the use of learner-centred approaches, the teacher educators started using the approaches in their lessons and the quality of teaching and performance of students improved.

According to Chisholm and Leyendecker (2008), learner-centred approaches can take root in the African contexts if teachers can be able to understand the underlying idea, be motivated to change their practices and have the capacity to do it. In this case, it requires thorough and continuous training of teachers on the use of learner-centred approaches as a way of improving the quality of teaching and learning in the education institutions.

2.5 Learner-centred teaching in Malawi

2.5.1 Learner-centred teaching in primary schools

The emphasis of the new primary school curriculum is on quality and relevance (MIE, 2009). When student teachers finish their initial primary teacher education, the society expects them to apply quality teaching in their own classrooms basing on what they learn at the college. The quality of teaching in the classroom has significant impact on the quality of learning. Nowadays, most educators argue that effective teaching is achieved when learners actively participate in a variety of learning experiences (InWent, 2008). For this reason, the current primary school education requires all teachers to use learner-centred teaching approaches which promote active participation and interactions among all learners in the classroom (Mizrachi et al., 2010).

However, like in most African countries, some study findings show that the use of learner-centred approaches has not materialised in most schools in Malawi. For instance, the findings of a study by Mizrachi et al. (2010) to explore the effort to shift to active-learning approaches in primary schools indicate factors such as lack of teaching and learning resources, large class sizes and inadequate facilities that hinder the effective use of learner-centred approaches in the classroom. Similarly, the qualitative study by Chiphiko and Shawa (2014) which involved some primary school teachers in Kasungu district reveals similar challenges in the use of learner-centred approaches such as large class sizes, inadequate teaching and learning materials, inadequate learning facilities and in some cases, lack of pedagogic knowledge.

Basing on the findings of the two studies, it can be noted that the use of learner-centred approaches in primary schools in Malawi is mostly hindered by large classes which is compounded by inadequate teaching and learning resources and infrastructures. The issue of large classes is a result of free primary education (FPE) which was triggered by the Education for All (EFA) initiative in a number of Sub-Saharan countries leading to increase in the enrolments of learners in primary schools with implications on classroom spaces and class sizes (Miles & Singal, 2010; Mtika & Gates, 2010).

The influx of learners into the education system resulted in high teacher/learner ratio in most primary schools causing various challenges in the teaching process as well as assessment. Consequently, many teachers find it difficult to use learner-centred approaches in large classes. According to Mizrachi et al. (2010), most primary school

teachers understand the benefits of using learner-centred pedagogies, but the realities in their classrooms tend to push them towards using teacher-centred approaches. Obviously, noise level can be inevitably high in large classes and this may affect classroom management and participation of most learners.

However, Mgeni (2013) argues that teachers can still apply learner-centred approaches in large classes because what count is the quality of teaching and not the size of the class. According to Mgeni, the key to effective instruction and student learning, regardless of the class size, is engaging students in active learning. This means that primary school teachers need to be creative and tactful in using learner-centred approaches in order to achieve meaningful learning amidst various challenges in the classrooms.

It is important to note that having small class size and adequate resources does not guarantee positive learning outcomes in the lesson. The study by Chiphiko and Shawa (2014) indicates lack of pedagogic knowledge and skills as one of the factors that impede the effective use of learner-centred approaches by most primary school teachers in Malawi. Nowadays, effective teaching requires the use of appropriate teaching methods using adequate resources as required in the outcomes based education. Hence, primary school teachers need to be regularly updated on the use of learner-centred approaches which help to promote meaningful learning by students through active participation in all lesson activities.

Generally, most learners participate actively in the lesson activities when they are well motivated. This helps to stimulate their conceptual understanding and interest in the lesson activities (Ampandu, 2014). This was evidenced in the study findings by the Centre for Educational Research and Training (CERT) of the University of Malawi which indicate that learners in the primary schools under study in Mulanje, Lilongwe, Kasungu and Mzimba were motivated to learn through the use of participatory teaching methods such as group work and pair work accompanied by positive and varied reinforcements that teachers used (CERT, 2015). These strategies help to sustain learners' interest in the lesson. In mathematics, motivating students is critical to successful learning of its content which most students find to be abstract, mechanical and difficult (Rudhumbu, 2014)

Despite various challenges in most primary schools, the outcomes based education in primary and teacher education still requires the use of learner-centred teaching approaches. According to CERT (2015), teachers in the study schools were able to use learner-centred approaches successfully after undergoing training on the use of learner-centred approaches prior to the study. This means that the successful implementation of learner-centred approaches requires adequate training of teachers since these approaches are fairly new to most of them. This can be done through regular in-service trainings through continuous professional development (CPD) meetings in order to improve teachers' pedagogic knowledge and skills.

2.5.2 Learner-centred approaches in teacher education

Sanyal (2013) defines teacher education as the policies and procedures designed to equip prospective teachers with the knowledge, values, attitude and skills that are required to perform their tasks effectively in the classroom, school and wider community. Teacher Education is an important component of education which influences the aspects of learning at different levels. To a good extent, the trainee teachers' instructional practices are influenced by the practices of their trainers in teacher education (Bunyi et al., 2013). This means that the quality of teaching that takes place in TTCs may have impact on the quality of teaching that takes place in primary schools.

In Malawi, primary school teachers are trained in various public and private TTCs. With the introduction of outcomes based education in 2005, the teaching approach in TTCs changed towards constructivist teaching. This means that teacher educators had to move away from teacher-centred to learner-centred approaches which place greater emphasis on the learning outcomes that are broader than basic recall of facts and information (Mtika & Gates, 2010). Following the change of the teaching approaches, all teacher educators are required to use learner-centred methods in the teaching of all subjects in order to promote active participation and students' autonomy in the learning process. This is in line with constructivist theory which takes students as active participants in constructing their own meaning of information (Kalpana, 2014)

Just like in other African countries, some study findings indicate that the promotion of learner-centred approaches in teacher education institutions in Malawi has not resulted in

widespread change in classroom practice. Mtika and Gates (2010) point out that there is an imbalance between pedagogical theory and pedagogical practices in teacher education The findings of the study which involved four secondary trainee teacher reveal that teacher educators were using teacher-centred approaches in their own teaching but expected student teachers to use learner-centred approaches in their classrooms (Mtika & Gates, 2010). These findings agree with the view of Schweisfurth (2011) that teacher education in developing countries is rarely learner-centred and does not provide suitable models upon which fledgling teachers can base their practices, and sometimes it is too theoretical. Without appropriate and adequate pedagogical knowledge and skills, most student teachers may end up using the teaching approaches that their teacher educators use as a model for their own teaching.

The teacher education requires quality teaching for students to understand the content and be able put into practice what they learn. For this reason, teacher educators in public TTCs and the Demonstration School teachers in Malawi participated in the college-based trainings on the use of learner-centred approaches from 2011 to 2013 with the support from InWent in collaboration with the Ministry of Education. The aim of the trainings was to ensure that all teacher educators and Demonstration school teachers were able to use various learner-centred approaches in their classrooms. In this way, student teachers can emulate the skills of using the teaching methods in the classroom situation.

2.6 Mathematics teaching and learner-centred approaches

Effective teaching and learning requires the use of appropriate approaches to meet the demands of the current generation of students and the ever-changing educational environments. In the last few decades, many countries have adopted learner-centred approaches which encourage independent thinking, interest in learning and development of competencies in students (InWent, 2009). In mathematics, these may act as the foundation for the development of problem solving competencies as well as enhancing students' interest and positive attitude towards mathematics.

Mathematics is regarded as the foundation for higher technological and scientific knowledge that is essential in socio-economic development of any economy in a society (Mwangi, et al., 2015). Therefore, it requires mathematics teacher educators to ensure that their teaching is effective in order to prepare competent teachers who can teach mathematics successfully in primary schools. The teaching approaches must enable students to acquire the teaching and problem solving skills, positive attitude and values that are necessary for the effective teaching of mathematics.

Moody and DuCloux (2015) claim that learner-centred approaches offer more opportunities for learning mathematics through students' active participation in meaningful discourse and reflecting on the processes of solving mathematics problems. This is in line with constructivist's view that meaningful knowledge is constructed by learners themselves through active involvement in the learning process (Vavrus et al., 2011; Mizrachi, et al., 2010). Through active participation, students are able to

acquire meaningful knowledge and skills which are necessary for the successful teaching of mathematics.

According to Shulman (1986), effective mathematics teachers need to have three categories of content knowledge namely subject matter content knowledge, pedagogical content knowledge and curricular knowledge. The combination of these categories of knowledge helps teachers to have mastery of mathematical content as well as appropriate strategies to be employed when teaching mathematics (Luna & Aclan, 2015). Mapolelo and Akinsola (2015) argues that the knowledge that a teacher has influences what is done in the classroom and what students learn. For this reason, it is imperative to use appropriate teaching approaches for student teachers to acquire sufficient knowledge and skills which are necessary for effective teaching of mathematics in primary schools. This can be achieved when students are engaged in a variety of participatory activities in which they can practice some teaching methods.

2.7 Theoretical framework

This research used constructivism as the theoretical framework. This theory assumes that learners actively construct their own knowledge and meaning from their experiences (Kaplana, 2014; Vavrus et al., 2011). The theory emphasizes the learner's critical role in constructing meaning from new information and prior experience. The current IPTE curriculum emphasizes the effective use of various learner-centred approaches in teaching in order to promote active participation of students as a way of promoting construction of knowledge. For this reason, the researcher wanted to investigate the

extent to which teacher educators used learner-centred approaches to promote students learning of mathematics.

The adoption of IPTE curriculum necessitated some changes in the process of teaching and learning. These changes were made in order to move away from teacher-centred to learner-centred teaching approaches which promote construction of meaningful knowledge by students. Weimer (2002) outlines five key features that depict changes towards learner-centred teaching as follows:

- **The function of content:** Content should be used to build students' knowledge base and to develop their learning skills and self-awareness.
- **The responsibility for learning:** The teacher creates learning environments that motivate students to accept responsibility for learning.
- **The balance of power:** Shifting the balance of classroom power from teacher to student.
- **The role of the teacher:** The teacher is a facilitator and contributor rather than director and source of knowledge
- **The processes and purposes of evaluation:** Assessment activities should be used to promote learning and to develop self and peer-assessment skills.

Learner-centred approach is susceptible to misinterpretations by some teachers. According to Schweisfurth (2013), the risk with this approach is that anyone can call any teaching method learner-centred without due attention to its potential for cognitive development of students. In some cases, the use of some teaching methods in a lesson

may not depict learner-centred teaching. For this reason, the researcher used Weimer's five premises of learner-centred teaching as lenses when observing some mathematics lessons.

2.8 Chapter summary

This chapter has described learner-centred approaches that place students at the centre of the teaching process. This is in line with the constructivist learning theory which has also been discussed in the chapter. In addition, various research studies on the use of learner-centred approaches in Malawi, Africa and outside Africa have been reviewed. Most study findings indicate various challenges that hinder the effective use of the teaching approaches at different levels of education. The chapter has also described constructivism as the theoretical framework which guided this study.

Chapter 3 focuses on the design and the methods that were employed in carrying out this study.

CHAPTER 3

RESEARCH DESIGN AND METHODOLOGY

3.0 Chapter overview

The chapter provides the research design that underpinned this study. It also describes the population, sampling procedures and data collection methods. Furthermore, it presents the findings from the pilot study and how the data collection instruments were modified as a result of the lesson learnt from the pilot study. Finally, the chapter discusses how the collected data were analysed.

3.1 Research design

The study was carried out using mixed method research design which brings together quantitative and qualitative methods and data within the same phase of the study (Punch, 2005). This involved collecting different but complementary data from participants on the use of learner-centred approaches in mathematics teaching. The approach attempts to consider multiple viewpoints, perspectives, positions and standpoints on the same topic (Johnson, Onwuegbuzie & Turner, 2007). In this way, the researcher was able to gather detailed information using a variety of data collection procedures. The systematic integration of two research methods in this study helped to provide a more elaborate understanding of the use of learner-centred approaches in the teaching of mathematics by

merging the broad numeric trends with detailed views from different participants on the same issue.

The quantitative method involved the use of a survey through questionnaires which were administered to students at the TTC. According to Creswell (2009), the survey design provides a plan for quantitative or numeric description of trends, attitudes or opinions of the population by studying a sample of the population. The quantitative approach was employed in the study because it describes data that can be counted or measured and can therefore be considered objective (Wallace, 1998).

On the other hand, the qualitative method involved a case study strategy using interviews and lesson observation. Punch (2005) defines case study as a research strategy which focuses on an in-depth, holistic and in-context study of one or more cases. The use of qualitative method helped the researcher to learn from teacher educators and real classroom situation about the use of learner-centred approaches in the teaching of mathematics.

The study followed a concurrent triangulation strategy. This means that both quantitative and qualitative data were collected simultaneously and the results compared to determine the point of convergence (Creswell, 2009). The purpose of using this strategy was to gain broader perspective of the population than could be gained by using only one research method. The data from quantitative and qualitative methods were integrated during

interpretation or discussion of findings by transforming the qualitative data into counts and compare them with descriptive quantitative data.

3.2 Sampling procedures

3.2.1 Study population

Creswell (2003) defines population as an aggregate of individuals of interest from which the sample is drawn for study. In this study, the population consisted of all mathematics teacher educators and first year students at one public teachers training college (TTC) in Malawi. At the time of the study, there were 7 mathematics teacher educators and 324 students.

The college was selected for the purposes of convenience and was also the college of interest to the researcher. Teacher educators were targeted because they use learner-centred approaches when teaching in the classroom; hence it was necessary to learn from their experience on the use of these approaches. On the other hand, the first year students were targeted because they were on campus and were learning mathematics through learner-centred approaches as required by outcomes based education. The second year students were doing teaching practice in different primary schools; hence, it was difficult to reach them in their respective schools. The views of teacher educators and students assisted the researcher to learn more about the extent to which learner-centred approaches were used in the teaching of mathematics at the TTC.

3.2.2 Study sample

Generally, it is not feasible to involve the whole population in the study. Therefore, the researcher used a small number of participants to represent the population. Gay (1987) defines sampling as the process of selecting a number of individuals for a study in such a way that the selected individuals represent the larger group from which the sample is taken. The interest in this study was to learn from teacher educators and students on the use of learner-centred approach. For this reason, the study participants comprised mathematics teacher educators and a sample of students.

To determine the number of participants, the researcher adopted a purposive sampling method. According to Punch (2005), purposive sampling is a deliberate method in which a sample is drawn from the population in a deliberate or targeted way according to the logic of the research. In this study, mathematics teacher educators participated because of their experiences in the teaching of mathematics. Since the number was small, all 7 of them participated in the study.

At the same time, 6 classes of students were purposefully sampled from the 12 classes at the TTC because they were taught by different mathematics teacher educators. The six classes included class A which had 27 students, class C had 27, class E had 27, Class F had 26, Class G had 26 and class L had 27 students. This means that 160 students took part in the study. This was about half of the population of students at the TTC. The sample comprised 79 females and 81 males.

3.3 Data collection procedures

3.3.1 Data collection methods

In this study, both quantitative and qualitative research methods were used to collect data from participants. Quantitative method is an empirical research which employs the language of numbers and represents data in numerical values (Kura & Sulaiman, 2012). This method is characterized by the collection of data which can be analyzed numerically and the results presented using statistics, tables and graphs. In this study, the quantitative method involved the use of a questionnaire to collect data from students regarding the use of learner-centred approaches in the teaching of mathematics at the TTC.

On the other hand, qualitative research method was used to collect data from mathematics teacher educators. Creswell (2009) defines qualitative method as means of exploring and understanding meanings that individuals or groups ascribe to a social or human problem. It provides a forum for participants to express their diverse beliefs and views on the problem (Myers, 1997). The method involved the use of interviews in order to learn from mathematics teacher educators about the use of learner-centred approaches in the teaching of mathematics. In addition, qualitative method involved the use of lesson observation to explore the use of learner-centred approaches further from real classroom experience.

3.3.2 Data collection instruments

In this study, three instruments were used to collect data from participants namely the questionnaire, interview guide and lesson observation form.

3.3.2.1 Questionnaire

Adams and Cox (2008) define a questionnaire as a paper-based tool which contains a set of questions for individuals to complete (see Appendix 3). It is suitable for gathering data especially for small-scale research involving a large number of cases undertaken by one person (Bell, 1999). In this study, the questionnaire was used to gather the views of students on the use of learner-centred approaches in the teaching and learning of mathematics at the TTC (research questions 1 and 2). The advantage of questionnaire is that it is easy and mostly inexpensive to use.

3.3.2.2 Semi-structured interview guide

This instrument was used during interviews with mathematics teacher educators. It consisted of several key questions that helped to define the areas to be explored in the study (see Appendix 4). The semi-structured interview guide allows the interviewer to pursue the responses in more details in order to gain a deeper understanding of the issue. In this study, it helped to get the views of teacher educators on the use of learner-centred approaches in mathematics teaching (questions 1 and 3).

The advantage of using an interview guide is to keep the interview focused on specific issues in order to get the expected results.

3.3.2.3 Lesson Observation form

This form was used as a guide during lesson observations. It had five main items and some indicators to measure the learner-centredness of each lesson (See Appendix 5). The

five items were the five features of learner-centred teaching which were suggested by Weimer (2002). The lesson observation form helped the researcher to observe the approaches that teacher educators used in the teaching of mathematics. Through lesson observation, the researcher was able to record events and activities by looking at them rather than asking participants (Walliman, 2006).

3.4 Piloting data collection instrument

3.4.1 Piloting the questionnaire

Before the main data collection, the researcher administered the questionnaire to few students as pilot study. Blaxter, Hughes and Tight (2001) describe piloting as the process whereby the researcher tries out the research techniques and methods to see how well they work in practice. In this study, piloting the questionnaire was done to check its validity which Gay (1987) defines as the degree to which an instrument measures what it is supposed to measure. This assisted the researcher to check if there were any problems with the questionnaire which might affect the results. The lesson from the pilot study guided the researcher in planning for the main data collection.

The pilot study involved six students who comprised three females and three males. These students belonged to two classes namely B and K which were randomly selected from the 12 classes at the TTC. The students were selected from the two classes by picking the names from the class registers. Actually, the issue of gender was considered when selecting the names to ensure equal representation of female and male students. The

two classes did not participate in the main data collection. On average, it took about 45 minutes for all the 6 students to complete the questionnaire working at their own pace.

3.4.2 Analyzing pilot data

The pilot data was processed using the computer software called Microsoft Office Excel to generate frequencies and percentages. The questionnaire had both open-ended and closed-ended questions. The open-ended questions required students to use their own words in answering them. On the other hand, students answered the closed-ended questions by selecting options such as very good, good, average, poor and very poor.

After collecting data, the researcher studied the responses for the open-ended questions and grouped them according to the message that they portrayed. Thereafter, the grouped responses were coded and processed using Microsoft Office Excel to generate frequencies and percentages. The options for the closed ended questions were also coded and processed in the same way to generate frequencies and percentages.

Generally, the results from the pilot study indicated that the questionnaire was able to get the expected responses from students. All the six students identified the options of their choices for the closed-ended questions. However, some of them did not answer the open-ended questions correctly. For instance, some students did not give clear explanations or reasons for the selected options. Two of them did not answer all open-ended questions. This meant that the some items on the questionnaire needed to be improved before the main data collection.

3.5 Modifying the data collection instruments

3.5.1.1 The questionnaire

The researcher modified the questionnaire by refining some question items to simplify them and ensure that they provided valid responses to the research questions. For example, the question "Which methods of teaching do you like most in mathematics learning?" was rephrased as "Which methods in question 1 above do you enjoy most when learning mathematics?" (refer to Appendix 3). This helped students to refer to the teaching methods that they had identified in question 1. At the same time, this question required students to reflect on their learning of mathematics. Furthermore, some ambiguous questions such as "State the difficulties that you experience" were improved to be "State any difficulties that you experience in learning mathematics through leaner-centred approaches".

During pilot study, students were asked to write down the teaching methods that were used in the teaching of mathematics. The results indicated that some students wrote down any teaching methods that they knew even though they had never been used in the teaching of mathematics. For this reason, the researcher identified the common teaching methods for mathematics teaching and included them in the modified questionnaire (refer to Appendix 3). This helped to simplify the questionnaire since students had to select from the teaching methods that were provided instead of coming up with their own.

3.5.1.2 Interview guide

Following the modification of questionnaire, the interview guide had to be modified as well because the questions items were similar (refer to Appendix 4). Modifying the interview guide helped to align the question items with those in the questionnaire. This means that both students and teacher educators had to answer the same questions on the same issue for the results to be easily integrated during discussion of findings.

3.5.1.3 Observation form

Likewise, the observation form was also modified to make it focus on students' response to learner-centred approaches in the lesson (refer to Appendix 5).

3.6 Main data collection

The results of the pilot study helped the researcher to plan thoroughly for the main data collection. The data were collected through three different sources namely questionnaire, interviews and lesson observation.

Through collaboration with mathematics teacher educators, administering the questionnaire was done within mathematics lessons. The researcher started by giving verbal instructions to guide students on how to complete the questionnaire. For anonymity purpose, they were asked not to write their names on the questionnaires. The students completed the questionnaire by working at their own pace. Most of them took about 30 minutes to complete the modified questionnaire which had been simplified by

including the teaching methods within the questionnaire for students to select by ticking instead of writing down the methods themselves.

The modified interview guide was used during the interviews with teacher educators which took place in pre-arranged places such as tutorial rooms and mathematics section office. The interviews took place mainly when the teacher educators were free from other duties to avoid disturbing college activities. All seven teacher educators were interviewed willingly. The researcher had to listen very carefully to their views and experiences in order to learn from them about the use of learner-centred approaches in teaching mathematics. The researcher asked some probing questions to explore further on some important ideas. The collected data was handwritten in a diary during the interview process and recorded electronically in the computer using Microsoft Word after each interview session.

After conducting the interviews, the researcher observed some mathematics lessons using the observation form as a guide. The data from each lesson observation was recorded electronically in the computer using Microsoft Word. In total, six lessons were observed. The seventh scheduled lesson was not observed because the mathematics teacher educator was out of the college for other duties.

3.7 Analysing main data

The activity that followed after collecting data involved analysing them to identify the main themes. Cohen, Manion and Morrison (2007) defines data analysis as making sense

of data in terms of participants' definitions of the situation and noting patterns, themes, categories and regularities. The researcher used different methods to analyze quantitative and qualitative data.

3.7.1 Analyzing quantitative data

The quantitative data were collected using the questionnaires. The data mainly focused on the views of students regarding the use of learner-centred approaches in the teaching of mathematics (research question 1 and 2). The collected data were analyzed using descriptive statistics in order to present the results in terms of frequencies and percentages (Cohen et al., 2007). First of all, the completed questionnaires were coded as S1, S2, S3 … for easy identification since students did not write their names on them. Thereafter, the data were typed electronically using the computer software called Microsoft Office Excel. Finally, the data were statistically analyzed to obtain the results which were coded and tallied to generate frequencies of the responses to each category of the research questions.

The main themes that emerged from the quantitative data are as follows: methods that were used in mathematics teaching, methods that students enjoyed most in the learning of mathematics, methods that helped students learn mathematics better, ineffective teaching methods, students' performance in learner-centred teaching environment and the difficulties that students experienced in learner-centred classroom.

3.7.2 Analysing qualitative data

The qualitative data were analyzed starting from the first day of data collection and was continuous throughout the data collection process. The researcher collected large amount of textual data in the form of transcripts and observational notes. The data mainly focused on learner-centred approaches that were used in the teaching of mathematics and the views of teacher educators regarding the approaches (research questions 1 and 3).

3.7.2.1 Interview data

The data generated through interviews were handwritten in a diary and thereafter typed and edited electronically using the computer Microsoft Word. The researcher used thematic data analysis to analyze interview data. Braun and Clarke (2006) define thematic analysis as a method for identifying, analyzing and reporting patterns (themes) within data. This approach involved searching across the collected data to identify repeated patterns of meaning.

The researcher started by reading through the collected data in order to identify outstanding themes and patterns as well as differences that emerged in the data. It was observed that the teacher educators gave various explanations to each question basing on their experiences in mathematics teaching. The researcher followed the approach to thematic analysis by Braun and Clarke (2006) which has six phases as follows: familiarizing with the data, generating initial codes, searching for themes, reviewing potential themes, defining and naming themes and producing the report. The themes that emerged from interview data were put together to form a comprehensive picture of the

collective views of teacher educators on the use of learner-centred approaches in mathematics teaching.

The major themes that emerged from the interview data were as follows: methods that were used in mathematics teaching, effective teaching methods, ineffective teaching methods, students' performance in learner-centred mathematics teaching and difficulties that teacher educators experienced when using learner-centred approaches.

3.7.2.2 Lesson observation

The researcher used the observation form to collect data during lesson observation. He studied the collected data to identify the methods that were used and the key features that emerged from the lesson. The data was analyzed basing on the indicators to depict the five features of learner-centred teaching according to Weimer (2002). The result from lesson observation helped the researcher to have a further understanding on the use of learner-centred approaches in the teaching of mathematics. He was able to compare what was reported in the questionnaire and interviews to what was observed in the lessons.

3.8 Triangulation

The trustworthiness of this study was achieved through triangulation of data from different sources. Lacey and Luff (2001) describe triangulation as gathering and analyzing data from more than one source to a full perspective on the issue which is being investigated. This study involved concurrent triangulation approach whereby the researcher compared the quantitative and qualitative databases to determine the convergence, differences and some combination (Creswell, 2009). During discussion, the

findings were compared and grouped into categories according to their similarities in relation to the research questions.

The reason for collecting both quantitative and qualitative data was to ensure reliability of the collected data. The use of multiple sources of data in this study helped to overcome the weaknesses that might emerge from using one data source. In other words, this helped to build a coherent justification for the study.

3.9 Access negotiations

Before the commencement of data collection, a letter of introduction was sought from the office of the Dean of Education at Chancellor College and presented to the principal of the TTC to allow the researcher to collect data from mathematics teacher educators and students at the college (see Appendix 1). Cohen et al. (2007) point out that it is important to have consent from the responsible persons in order to conduct research in education institutions or any other organisation. Upon presentation of the letter of introduction, permission was granted to conduct the research from January 2016 to mid-March 2016 (2½ months).

In addition, the researcher had to seek consent from participants before the commencement of the study. The seven mathematics teacher educators were briefed on the purpose and importance of the study. All of them willingly accepted to participate in the study by signing in the letter of introduction and informed consent (see Appendix 2).

The researcher, with the help of mathematics teacher educators, sought the consent from students in each of the six classes before administering the questionnaires. All students willingly accepted to participate in the study. The researcher granted them freedom to withdraw anytime if they so wished.

All participants in this study were guaranteed that their identity would be protected throughout the study period. They were assured that the information obtained from the study would be confidential and used solely for the purpose of academic research.

3.10 Chapter summary

The chapter has presented the methodological framework that was used in the study. It has described the research design, population and sampling procedures, data collection procedures and analysis. The use of various sources of data ensured reliability of the findings on the extent to which learner-centred approaches were used in the teaching of mathematics. Finally, the chapter has described the process that the researcher followed in order to access information from participants at the college successfully.

Chapter 4 presents the findings from the collected data on the use of learner-centred approaches together with the discussion of the findings in relation to the available literature.

CHAPTER 4

RESULTS AND DISCUSSIONS OF THE FINDINGS

4.0 Chapter overview

In this chapter, the collected data are presented, analyzed and discussed according to the themes that were identified in relation to the purpose of the study. To ensure reliability of the collected data, the researcher used different sources to obtain relevant information from participants on the use of learner-centred approaches in mathematics teaching. Quantitative data was collected from students through the use of a questionnaire while qualitative data was collected from teacher educators through the use of interviews and lesson observations. The findings are presented in response to the research questions which are given in chapter one.

4.1 Teaching experiences of teacher educators

The study findings reveal that the seven teacher educators who participated in this study had different experiences regarding mathematics teaching and the use of learner-centred approaches. Table 4.1 shows the number of years that each teacher educator had been teaching mathematics in TTCs and their participation in the college-based training on the use of learner-centred approaches (LCA) which were conducted from 2011 to 2013.

Table 4.1: Teacher educators' teaching experiences (N=7)

Teacher educator	No. of years as mathematics teacher educator	Attended training on the use of LCA
T1	29	yes
T2	8	yes
T3	8	yes
T4	7	yes
T5	1	no
T6	6	yes
T7	5	yes

The information in Table 4.1 shows that only one teacher educator had one year teaching experience in TTCs and did not attend the college-based training on the use of learner-centred approaches. The rest had been teaching mathematics in TTCs for 5 or more years and had attended the training. Nonetheless, the teacher educator was able to learn about the use of the approaches from his colleagues through daily interactions and by observing some lessons.

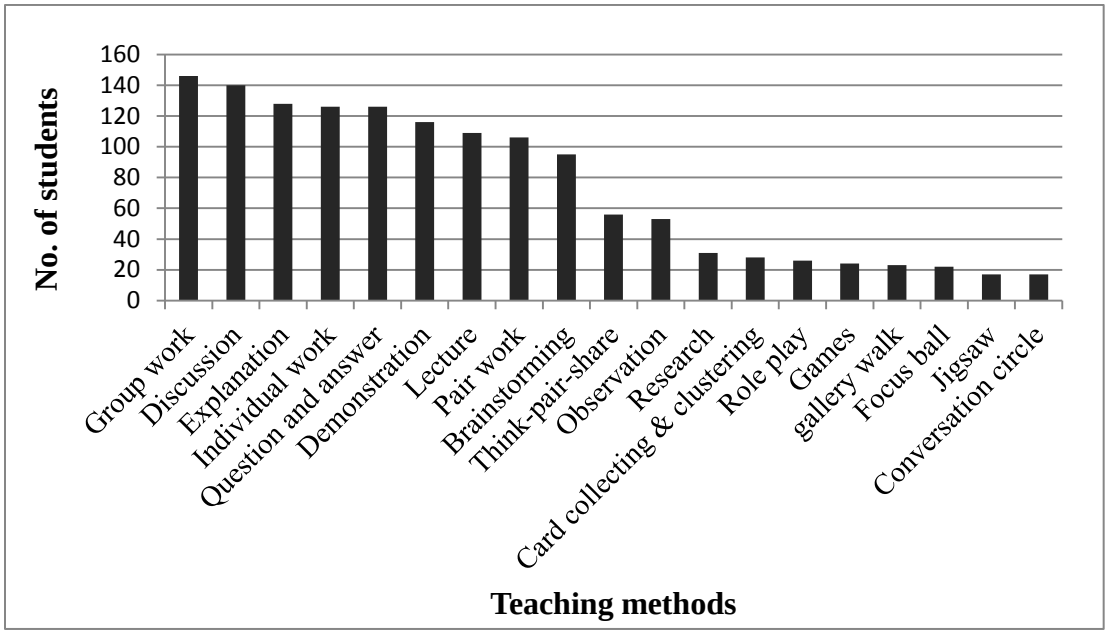
4.2 Methods used in mathematics teaching

Learner-centred approaches entail the use of appropriate learner-centred methods during the teaching and learning process. To determine the extent of the use of learner-centred methods in the teaching of mathematics, the researcher asked both students and teacher educators to indicate the methods that were actually used in the teaching of mathematics. Students responded the by ticking against the common teaching methods which were included in the questionnaire while teachers identified the methods through interviews.

4.2.1 Teaching methods identified by students

Basing on the findings from the questionnaire, students identified various teaching methods which were used in the teaching of mathematics as shown in Figure 4.1.

Figure 4.1: Mathematics teaching methods identified by students (n =160)



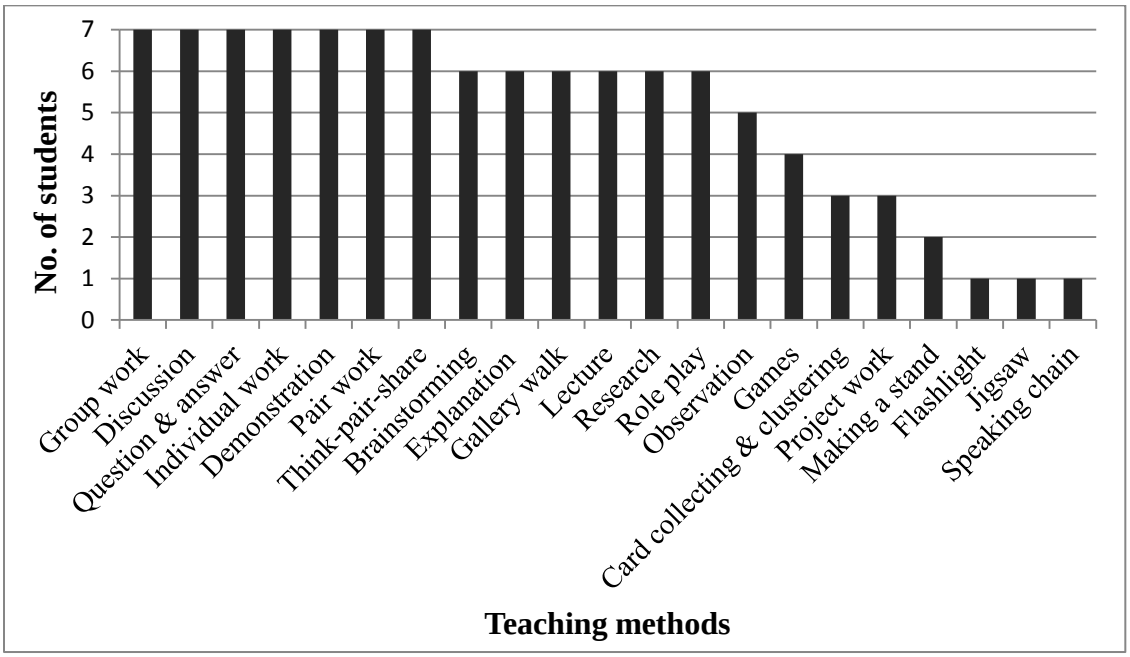
The results in Figure 4.1 show some teaching methods that were commonly used in the teaching of mathematics such as group work, discussion, explanation, individual work and question and answer. It can be noted that lecture method, which is mostly teacher centred, was also used to some extent in mathematics teaching.

4.2.2 Teaching methods identified by teacher educators

To validate the findings from students, the researcher interviewed all seven mathematics teacher educators to find out more about the methods that were actually used in the

teaching of mathematics. Most of them concurred with students by identifying some teaching methods that students had identified as indicated in Figure 4.2.

Figure 4.2: Teaching methods identified by teacher educators (N = 7)



The results in Figure 4.2 show that most teacher educators were using methods such as group work, discussion, question and answer and individual work in mathematics teaching. These methods were also identified by most students. This indicates that the methods, which are mostly learner-centred, were used extensively in mathematics teaching at the college. However, the results in Figure 4.2 also show that six teacher educators were using lecture method in addition to other teaching methods. This means that both learner-centred and teacher-centred methods were used in the teaching of mathematics at the TTC.

Basing on the results in Figure 4.2 it can be noted that more than half of teacher educators were using some methods such as think-pair-share, gallery walk, research and role play in mathematics teaching. However, Figure 4.1 shows that very few students identified them as the methods that were used in mathematics teaching. This means that most students were not conversant with all the methods that were used in the teaching of mathematics. For this reason, teacher educators are encouraged to discuss each method with students after using it in the lesson. Eventually, this would help students to be conversant with a variety of teaching methods during their initial training.

It can also be noted in Figures 4.1 and 4.2 that some teaching methods were not used frequently in the teaching of mathematics. For example, methods such as jigsaw, conversation circle, flashlight and speaking chain were identified by very few students as well as teacher educators. One could suggest that only few teacher educators were using the methods in mathematics teaching. Some teacher educators pointed out the following reasons for not using some suggested teaching methods in mathematics teaching:

> ñ I have not at one time used some of these methods, hence, I find it difficult to use some methods which (T5)
>
> ñ Some teaching methods are difficult to (T6). how to use them ò

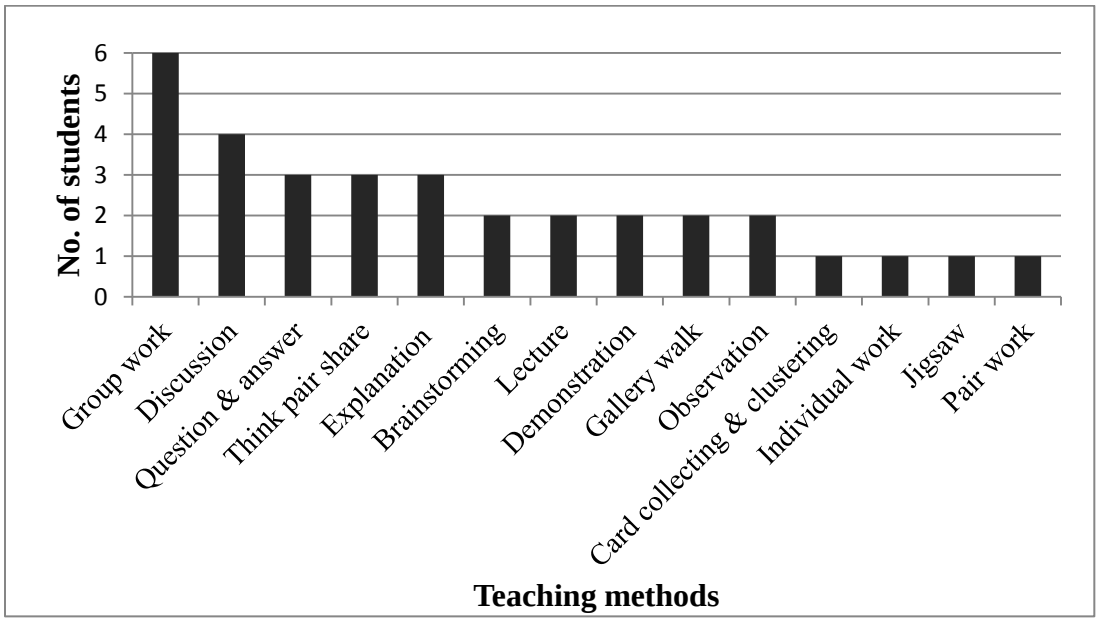
This agrees with the study findings by Chiphiko and Shawa (2014) which show that most teachers fail to plan for learner-centred approaches due to challenges such as inadequate resources and lack of pedagogic knowledge and skills. In most cases, the choice of the teaching methods to use in a lesson depends on the nature of the lesson activity, needs of students, the availability of resources and the pedagogical skills on how to use the

methods. For these and other possible reasons, it can be noted that teaching methods such as group work, discussion, question and answer, individual work and explanation were used frequently in mathematics teaching as compared to other teaching methods. Generally, these teaching methods are easy to organize and do not require a lot of resources.

4.2.3 Teaching methods identified during lesson observation

To establish further the extent of the use of learner-centred approaches in the teaching of mathematics, the researcher observed 6 lessons in which teacher educators used various teaching methods as shown in Figure 4.3.

Figure 4.3: Methods used in the observed lessons (n=6)



The results in Figure 4.3 indicate that all teacher educators used group work followed by discussion and question and answer methods. This agrees with the findings from the questionnaire and interviews which indicate that the same methods were used extensively

in the teaching of mathematics at the college. At the same time, the results show that two teacher educators used lecture method in their lessons. This is also consistent with the findings from the questionnaire and interviews which show that lecture method was being used in the teaching of mathematics.

Basing on results from the three sources, it can be noted that group work was extensively used in the teaching of mathematics followed by discussion method. In most cases, these two methods are used concurrently whereby students discuss various activities in their groups. Generally, the choice of the teaching methods to use in a particular lesson depends on the nature of the lesson activities in relation to the needs and ability of students. However, the instructions for most activities in the IPTE mathematics handbooks ask students to discuss in their group. Hence, it could be suggested that most teacher educators overused group work and discussion methods in the teaching of mathematics by following the instructions in the handbooks.

Nonetheless, most teacher educators expounded the benefits of using group work in addition to other teaching methods in the teaching and learning of mathematics. Some of them made the following remarks:

> "*G r o u p w o r k e n h a n c e s s t u d e n t s ô i n t e r a c t*
> (T4)

> *ñ G r o u p w o r s l o w l e a r n e r s b y i n v o l v i n g t h e m i n t h e l e s s o n a c t i v i t i e s ò* (T3)

The extensive use of group work agrees with the findings by Mizrachi et al. (2010) which indicates that most teachers use group work in their teaching. This method involves a number of students working together on the given activity such as solving mathematics problems. This allows horizontal learning since learners are given the opportunity to share ideas amongst themselves (Rudhumbu, 2014). Through group work, students are able to hear the ideas and opinions of others, have the opportunity to react to them and make their own contributions. Depending on the task, group work incorporates other collaborative methods such as discussion, project work and games.

Generally, the effective use of various learner-centred methods in a lesson helps to encourage the interest and active participation of students with wide range of needs and abilities (Mizrachi et al., 2010; InWent, 2009). Usually, students who are well motivated in the lesson can be able to carry out various activities with minimal support from their teacher educators. Rudhumbu (2014) postulates that motivating students in mathematics teaching is critical to successful learning of its content which most of them find to be abstract, mechanical and difficult. Hence, the use of learner centred methods is ideal for students to construct meaningful knowledge which they can be able to apply in daily life after finishing their initial training.

The results from all the three sources of data show that lecture method, which is mostly teacher-centred, was used in the teaching of some mathematics lessons in addition to learner-centred methods. This is opposed to the requirement of outcomes based education which encourages the use of learner-centred teaching methods in the teaching process in

order to achieve high quality education. Most teacher educators cited some factors that force them to use lecture method in mathematics teaching such as syllabus coverage, inadequate resources and failure by students to come up with the expected information in the given tasks. The continued use of lecture method agrees with the findings of studies in several other countries which indicate that the traditional teaching approaches are still being used in the education institutions despite the adoption of learner-centred approaches (Schweisfurth, 2011, Chiu & Whitebread, 2011).

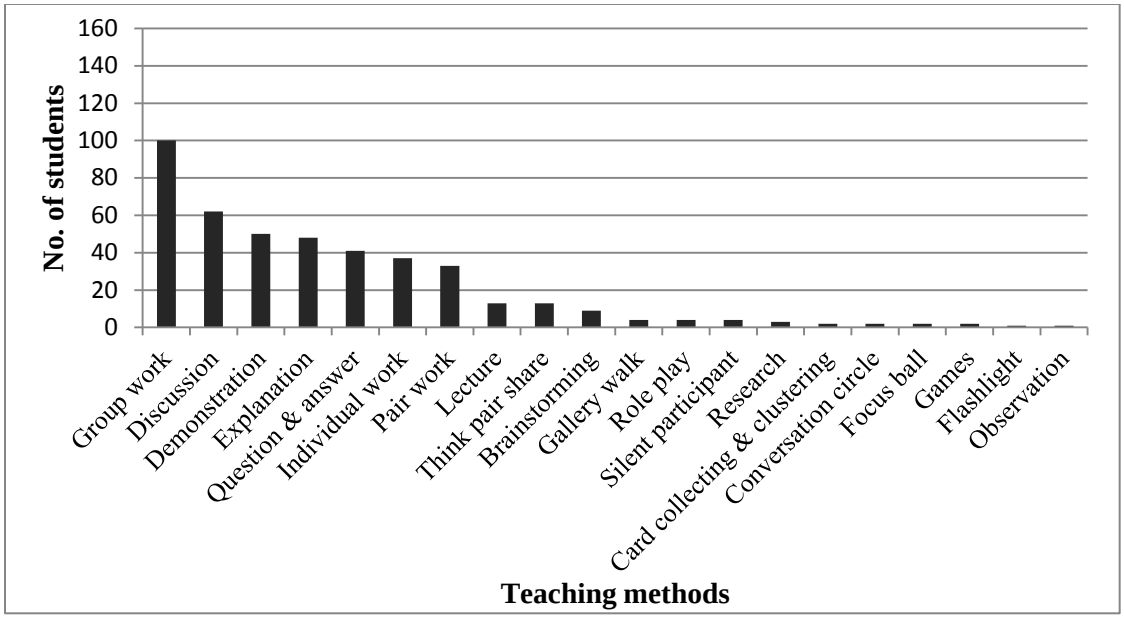
4.3 Views of students and teacher educators regarding teaching methods

The IPTE curriculum promotes the use of learner-centred methods as a way of helping students to acquire the necessary knowledge and skills for teaching learners in primary schools. The findings of this study reveal some views of students and teacher educators regarding the use of these methods in mathematics teaching.

4.3.1 Methods that made students enjoy learning mathematics

With the adoption of outcomes based education, teacher educators are required to use various learner-centred teaching methods in the lessons as a way of encouraging active participation of all students in class. In most cases, students participate actively when the teaching methods meet their needs and interests in the lesson. For this reason, students were asked to identify some teaching methods that made them enjoy learning mathematics. Most of them identified various methods as indicated Figure 4.4.

Figure 4.4: Methods that made students enjoy learning mathematics (n=160)



Basing on the results in Figure 4.4, it can be noted that the majority of students enjoyed learning mathematics through group work followed by discussion methods. Coincidently, these are the methods that were commonly used in the teaching of mathematics. In this case, one could suggest that the frequent use of the methods by most teacher educators was also based on the joy that the methods brought to students during the teaching and learning of mathematics.

Several educationists contend that the use of learner-centred methods make students enjoy learning by being actively involved in the teaching and learning process (Kalpana, 2014; Brackenbury, 2012; Vavrus et al., 2011). The students' interest in the teaching methods could eventually help them to get motivated to learn mathematics which is regarded by most students as difficult. This was evidenced in the study findings by Stefaniak and Tracey (2015) in USA which indicate that students who were learning

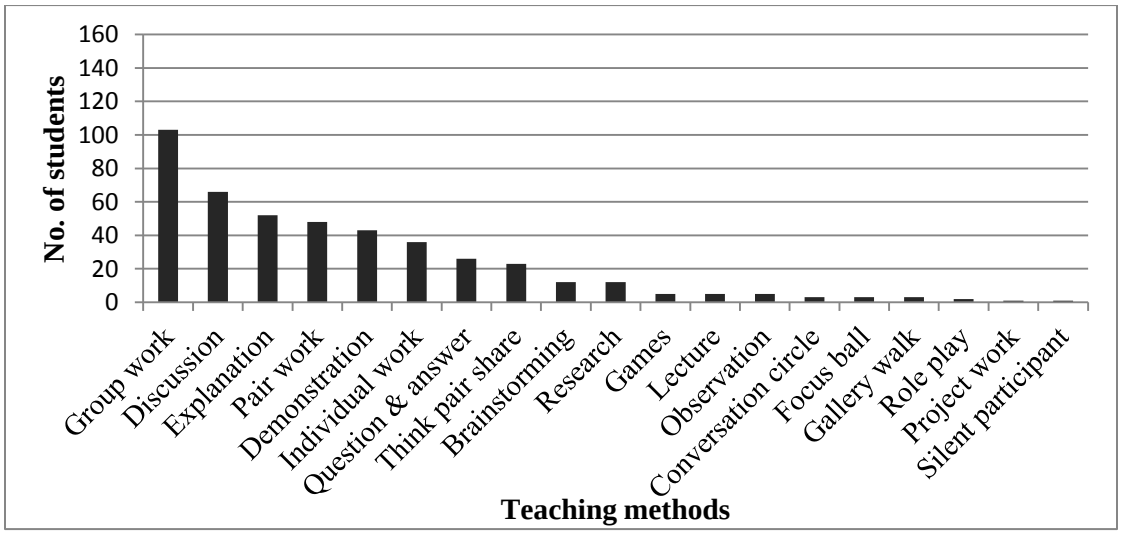
through learner-centred approaches in the course were actively engaged in the learning process and demonstrated higher levels of motivation towards the course.

However, it can be noted from Figure 4.4 that some teaching methods such as flashlight, conversation circle and focus ball were identified by very few students. Basing on the results in Figures 4.1, 4.2 and 4.3, it can be noted that most of these methods were rarely used in mathematics teaching. Basically, student teachers need to be exposed to various teaching methods as a way of preparing them to teach effectively in primary schools.

4.3.2 Methods that helped students learn mathematics better

In some cases, enjoying the teaching process may not translate into learning of mathematics. The use of a particular teaching method in a lesson must help students to understand what is being taught. For this reason, students were asked to identify the teaching methods that helped them to learn mathematics better. Figure 4.5 shows the methods that were identified by students.

Figure 4.5: Methods that helped students to learn mathematics better (n=160)



The results in Figure 4.5 indicate that most students learned mathematics better through collaborative methods such as group work and discussion methods. Coincidently, these are the methods that made most students enjoy learning mathematics. Some of them gave the following reasons for identifying group work as the method that helped them to learn mathematics better:

> "*In group work, we are able to understand each other well and listen to the views of others as we discuss*" (S73)

> "*With group work, there is sharing of knowledge and by the end of the day I have a lot of information on the concept being taught*" (S8)

Subsequently, most teacher educators agreed with students' views that group work helped students to learn mathematics better. Most of them reported that they used group work in most lessons for students to share their experiences on how to perform various activities such as solving mathematics problems, modelling and carrying out micro teaching. Some teacher educators made the following comments regarding the use of group work:

> *ñ S t u d e n t s g e t e n g a g e d i n a l l l e s s o n c understand and perform well in mathematics ò*(T5)

> "*Group work allows students to carry out hands-on and minds-on activities which involve e v e r y o n e* (T1) *i n C l a s s ò*

Definitely, not all students can understand mathematics by just listening to their teacher educators. Kalpana (2014) contends that positive learning outcomes are achieved through the use of teaching methods which promote collaborative learning. Generally, the appropriate use of group work creates collaborative learning environment which

promotes active participation and interactions among students. According to Mwangi et al. (2015), collaborative learning promotes mutual search for knowledge, understanding, meaning and solutions to problems.

Group work splits the class into smaller groups to ensure that every student gets involved in the given task. In mathematics teaching, the use of group work provides opportunity for students to share their personal experiences, feelings, opinions and ideas on the given task basing on what they already know. Accordingly, this helps to stimulate students' joint exploration of ideas in the lesson activities. This is in agreement with the social constructivism which emphasizes the social contexts of learning and that knowledge is mutually built and constructed (Kalpana, 2014).

Despite the positive views of participants on the use of group work, an earlier study to evaluate IPTE instructional materials reveals that group work is overused as a method of teaching by most teacher educators; hence, learning becomes boring (MIE, 2008). Being in groups does not guarantee meaningful learning by all students. Usually, it is difficult to achieve positive learning outcomes in disorganised groups which are mostly characterised by disagreement and noisy participation.

In some cases, the frequent use of one teaching method may not be in the interest of some students who dislike the method. The study findings reveal some negative views of some students regarding the use of group work in mathematics teaching as follows:

> ñ*Fast learners dominate in group discussions and this affects learning by other students in mathematics* ò(S4).

ñIn some groups, fast learners solve all mathematics problems on their own and report to class ò(S133).

In most cases, the views of some students in mixed-ability groups are inhibited by those of the outspoken or fast learners. Consequently, this makes it difficult for teacher educators to assess the achievement of all students in such groups.

Usually, group work is more productive when it is well organised with group members working cooperatively to accomplish the given task. The effective use of group work requires very clear instructions for students to achieve the intended learning outcomes as a group (MIE, 2014). Furthermore, teacher educators need to always change group formation and students' roles. This helps to ensure that all students have opportunity to take up different roles in their groups as one way of developing their leadership skills. This agrees with learner-centred teaching aspect by Weimer (2002) that the lesson content should aim at producing students who are more mature and self-regulating with sophisticated learning skills.

4.3.3 Ineffective teaching methods

The study findings reveal that lecture method, which is mostly teacher-centred, was also used in the teaching of mathematics. However, the method was enjoyed by only 8% of the students (see Figure 4.4). At the same time, only 3% of students identified it as the method that helped them to learn mathematics better (see Figure 4.5). This shows that lecture method was not helpful to most students in the learning of mathematics. The

method involves coverage of a lot of information to passive students leaving little room for their independent thoughts or interactions.

Most students had negative views regarding the use of lecture method in mathematics teaching such as the following:

> *Lecture method is boring because the teacher educator talks and talks without giving us chance to talk (S1).*

> *When lecturing, the teacher educator just dictates and asks us to write down, but we write down unknown things (S151).*

In most cases, lecture method is used to teach information which is important part of the school curriculum, but students can't find it on their own (Kaur, 2011). Teacher educators start by asking students to generate their own information in the given task through group discussions. When all the groups fail, some teacher educators tend to use lecture method to provide students with information from the Tutor's book or other sources.

Despite the continued use of lecture method, most teacher educators concurred with students that the method was not effective in the teaching of mathematics. One teacher educator pointed out as follows:

> "*Creativity is not promoted through lecture method because students get all the information from the teacher* (T2).

The views of students and teacher educators on the use of lecture method agree with the views of most educationists that teacher-centred approaches are no longer effective in modern teaching (Chiphiko & Shawa, 2014; Vavrus et al., 2011). According to Chiphiko

and Shawa (2014), lecturing does not prepare students on how to solve complex problems in real life. Similarly, Vavrus et al. (2011) contends that teacher-centred approaches do not build students' ability to analyze, evaluate and think critically about the subject matter content. Generally, the use of teacher-centred methods hinders students' participation in the lesson activities. Consequently, this may lead to poor performance by students, especially slow learners who struggle to follow the teaching and learning process when lecture method is used.

It is contended that the knowledge which is encoded by students themselves is easily understood and retained unlike the knowledge which is transmitted to them by their teacher (Chisholm & Leyendecker, 2008). Arguably, teacher-centred methods do not encourage students to think critically and construct their own knowledge because teacher educators provide them with all the information. Generally, inactive learning as opposed to learner-centred learning encourages students to memorize and regurgitate facts just to pass the examinations (Emenyeonu, 2012).

In Kenya, teacher educators at Kericho TTC adopted teacher-centred teaching in order to cover all the work in the syllabus before the national examinations (Willitter et al., 2013). The study findings indicate that most students performed poorly in Primary Teachers' Examinations (PTE) as compared their counterparts in other public TTCs. In most cases, students forget easily what they get directly from the teacher educators unlike what they discover on their own.

Nowadays, most education programmes promote the use of learner-centred teaching which allows students to control their learning by being actively involved in the teaching and learning process. In this way, students are able to develop critical thinking and ability to apply complex ideas in real-life situations (Vavrus et al., 2011).

4.4 Views of students regarding the use of learner-centred approaches

Effective teaching of mathematics in teacher education requires the use of appropriate teaching approaches which offer more opportunities for students to learn with understanding. Eventually, this helps the student teachers to acquire meaningful knowledge and skills which would help them to teach effectively in their own classrooms after finishing their initial training.

Generally, the teaching approaches that teacher educators use in a lesson may have positive or negative impact on the performance of students. For this reason, students were asked to indicate whether learner-centred approaches offered more opportunities for them to learn mathematics than the traditional teaching approaches. The responses from students were as shown in Table 4.2.

Table 4.2: Learner-centred approaches offer more opportunities to learn mathematics (n=160)

Response	Strongly agree	Agree	Not sure	Disagree	Strongly disagree	Total
Frequency	88	43	15	7	7	160
Percentage (%)	55.0	26.9	9.4	4.4	4.4	100

The results in Table 4.2 show that most students had the view that learner-centred approaches offered more opportunities for them to learn mathematics than the traditional approaches. Some of the students who agreed gave the following reasons for their choices:

> "*In a learner-centred classroom we are able to answer and ask questions when the teacher educator is teaching, so there is communication between teacher and students*" (S4)

> "*Through learner-centred approaches we have more opportunities to practice various activities rather than*

> *ñSlow learners are helped by fast lea*
> *teacher educator cannot reach all stude* (S80)

Furthermore, students were asked to rate their performance when learning mathematics in learner-centred teaching environment. Most of them indicated high performance as indicated in Table 4.3

Table 4.3: Performances of students in learner-centred mathematics teaching (n=160)

Response	Very good	Good	Average	Poor	Very poor	Not sure	Total
Frequency	80	52	20	3	1	4	160
Percentage (%)	50.0	32.5	12.5	1.9	0.6	2.5	100%

From Table 4.3, it can be noted that most students had the opinion that learner-centred approaches helped them to perform well in mathematics. One student explained as follows:

ñ *Le a-centred approaches are good because most of the work is done by students which help us to practice in the process of teaching and learning*" (S7).

The views of students agrees with the views of Weimer (2002) that learner-centred approaches promote active learning and encourage all students to play more active roles during the teaching and learning experiences. Aliusta and Bekir (2013) contend that the effective use of learner-centred approaches help to meet the needs, abilities, interests and preferences of all students in class. Through collaborative or cooperative teaching methods, all students get involved in the lesson through interactions among students themselves and between students and teacher educators (Mwangi, et al., 2015). In so doing, more capable students scaffold slow learners in their groups for all of them to achieve the intended learning outcomes.

Nevertheless, few students in the study had some reservations on the use of learner-centred approaches as indicated in Tables 4.2 and 4.3. Their views were mainly based on their personal experiences in the learning of mathematics. For instance, one of them stated as follows:

"*Sometimes it is difficult to understand some concepts on our own, so in the absence of the teacher educator no* (S56).

Nevertheless, some teacher educators pointed out that most students who do not perform well in learner-centred mathematics teaching have poor mathematical background. In a typical learner-centred classroom, students with difficulties are assisted accordingly. For instance, through collaborative teaching methods such as group discussions, students are

able to share their understanding of the given tasks. In addition, teachers use various strategies to help students to develop necessary knowledge and skills for handling the given tasks independently (Metto & Makewa, 2014). For example, scaffolding helps most students to work within their zone of proximal development. This is in line with social constructivism which encourages the use of scaffolding and other strategies to help students to carry out tasks that are beyond their unassisted effort (Mensah & Somuah, 2014).

4.5 Views of teacher educators regarding the use of learner-centred approaches

Most teacher educators concurred with students that learner-centred approaches offer more opportunities to learn mathematics than the traditional approaches. One teacher educator commented as follows:

> *ñ S t u d e n t s f i n d t h e i r o w n w a y s o f s o l v i n*
> *o p p o r t u n i t i e s t* (T6). *l e a r n m a t h e m a t i c s ò*

This concurs with the views of Moody and DuCloux (2015) that learner-centred approaches offer more opportunities for learning mathematics through students' active participation in meaningful discourse. These approaches opt for instructional strategies that promote deep and lasting learning by putting students at the centre of the teaching and learning process (Fahraeus, 2013; Mizrachi et al., 2010).

In learner-centred classroom, all students have opportunity to learn mathematics by doing and not by just listening to their teacher educators. This is in line with constructivism which holds that students learn better by actively constructing and assimilating

knowledge rather than through passive addition of discrete facts to their prior knowledge (Mtika & Gates, 2010).

4.6 Findings from the observed lessons

The researcher observed some mathematics lessons using the observation form which had five features to depict learner-centred teaching. According to Weimer (2002), the dominant aspect of learner-centred teaching is reflected by changes in the following features of the lesson: the function of content, the responsibility for learning, balance of power, the role of the teacher and the purpose and process of evaluation.

The findings from the observed lessons are summarized according to the five features as shown in Tables 4.4 to 4.9.

Table 4.4: Lesson 1

Feature	**Remarks**
Topic	Commission and discount
Teaching methods used	Group work, discussion, explanation, gallery walk and observation
Function of lesson content	For students to: ¶ solve questions on commission and discount ¶ develop the procedure for teaching commission and discount ¶ link commission and discount to everyday life
Responsibility for learning	Most students were actively involved in their group discussions throughout the lesson.

Balance of power	Students were given enough time to perform various activities in their groups.
Role of teacher educator	¶ Corrected wrong answers ¶ Gave additional information after the gallery walk
Processes and purpose of evaluation	Students together with the teacher educator assessed the displayed students' work through gallery walk

Table 4.5: Lesson 2

Feature	**Remarks**
Topic	Taxes and premiums
Teaching methods used	Question and answer, group work and think-pair-share
Function of lesson content	For students to: ¶ solve questions on taxes ¶ give examples of taxes from everyday life
Responsibility for learning	Most students worked in pairs and solved problems in their groups
Balance of power	Students were given enough time to interact in pairs and groups
Role of teacher educator	¶ Assisted students who had some problems ¶ Gave additional information after marking group work
Processes and purpose of evaluation	Teacher educator assessed student' work by marking the work done in groups

Table 4.6: Lesson 3

Feature	**Remarks**
Topic	Teaching of money
Teaching methods used	Brainstorming, think-pair-share, group work, discussion, gallery walk and observation

Function of lesson content	For students to: ¶ develop classroom shop for the shopping scene ¶ practice shopping scene involving basic operation of money using their classroom shop
Responsibility for learning	Students worked in groups to gather resources, develop the classroom shop and practice the shopping scene.
Balance of power	Students were actively involved in various group activities throughout the lesson.
Role of teacher educator	¶ Assisted students who had some problems ¶ Consolidated the activities after the gallery walk
Processes and purpose of evaluation	¶ Each group of students developed the classroom shop ¶ Students together with the teacher educator assessed group presentations and displays through gallery walk

Table 4.7: Lesson 4

Feature	**Remarks**
Topic	Teaching of money
Teaching methods used	Group work, explanation, question and answer, whole discussion, individual work and lecture
Function of lesson content	For students to develop skills on teaching the concept of money
Responsibility for learning	¶ Students discussed the procedure for teaching of money in their groups ¶ Students studied standard 1 teacher's guides individually
Balance of power	Students had enough time to discuss the tasks in their groups
Role of teacher educator	¶ Organized resources and lesson activities ¶ Presented additional information on the topic of money
Processes and purpose of evaluation	The activities done by students were not assessed.

Table 4.8: Lesson 5

Feature	**Remarks**
Topic	Rate, ratio and proportion
Teaching methods used	Question and answer, lecture, demonstration, group work, pair work, explanation
Function of lesson content	For students to ¶ calculate rate, ratio and proportion ¶ explain the application of rate, ratio and proportion in everyday life
Responsibility for learning	Students mostly worked in groups to solve some questions and identify examples of rate, ratio and proportion in daily life
Balance of power	¶ Students carried out some activities in their groups ¶ The teacher educator controlled most lesson activities
Role of teacher educator	¶ Organized activities for students, but they were inadequate for the lesson period of one hour. ¶ Assisted students who had some problems on the work
Processes and purpose of evaluation	Assessment was not done

Table 4.9: Lesson 6

Feature	**Remarks**
Topic	Taxes and premiums
Teaching methods used	Think-pair-share, brainstorming, card collecting and clustering, discussion, demonstration, group work and jigsaw
Function of lesson content	For students to: ¶ solve questions on taxes ¶ identify examples of taxes in everyday life.
Responsibility for learning	Most students were actively involved in group discussions following the examples given by the teacher educator

Balance of power	¶ Students were given enough time to interact in pairs and groups with the guidance of the teacher educator
Role of teacher educator	¶ Corrected wrong answers ¶ Consolidated lesson activities
Processes and purpose of evaluation	Used group assessment whereby each group assessed the work done another group of students

Basing on the findings from the observed lessons, it can be noted that at least three or more teaching methods were used in each lesson as indicated in Tables 4.4 to 4.9. The teaching process in most lessons was aimed at promoting students' construction of mathematics knowledge rather than delivering the information to them. Generally, most students were actively involved in the teaching and learning process. The major roles of teacher educators were to assist students who had some problems and to provide additional information which students could not find on their own. This is in line with the constructivist teaching which promotes active participation of students with the teacher acting as facilitator of the teaching and learning process (Brackenbury, 2012; InWent, 2009).

In lessons 1, 2, 3 and 6 students were well motivated to carry out various activities in their groups with minimal support from their teacher educators. This was mainly achieved through the use of various participatory methods which encouraged students to take active roles in the teaching and learning process. This is in line with constructivist teaching which places students at the centre of instruction by considering their needs, characteristics, abilities, interests and preferences (Aliusta & Bekir, 2013). The use of

some teaching and learning resources added variety in the lessons and motivated students to participate actively in most lesson activities.

On the other hand, in lessons 4 and 5 both learner-centred and teacher-centred methods were used in teaching. For example, the teacher educator for lesson 4 started by asking each group of students to discuss and develop the procedure for teaching the concept of money in standard 1. When all groups failed to come up with the correct procedure, the teacher educator provided the procedure by lecturing while students took down the main points in their notebooks. Similarly, students in lesson 5 worked in groups to solve some questions and identify examples of rate, ratio and proportion in daily life. Likewise, most groups failed and the teacher educator assisted them by solving the questions and providing examples of rate, ratio and proportion in daily life using lecture method.

The main problem in lessons 4 and 5 was lack of resources to assist students to carry out the group activities successfully. For instance, developing the procedure for teaching the concept of money requires the use of adequate resources such as teacher's guides and real money. With adequate resources, students can be able to carry out complex activities in mathematics lesson with minimal support from their teacher. Chisholm and Leyendecker (2008) argues that the knowledge and skills which are developed by students themselves can be more useful than those that are transmitted to them by their teacher educator. Basically, pre-service teachers need application skills more than the content (Major & Tiro, 2012). Therefore, student teachers need to develop meaningful knowledge and skills of mathematics teaching for them to teach successfully in their own classrooms after finishing their initial training.

4.7 The success of using learner-centred approaches at the TTC

The findings from this study reveal that learner-centred approaches were used to a large extent in the teaching of mathematics at the TTC as compared to similar studies which were mostly conducted in primary schools in Malawi. This success can be attributed to a number of factors. The first one is the college-based training on the use of learner-centred approaches which was conducted from 2011 to 2013. The training involved some practical aspects on the use of various learner-centred methods in the teaching process. This helped teacher educators to understand how to use the methods in the teaching of particular subjects. It was noted during lesson observation that most teacher educators who had participated in the training were able to use learner-centred approaches successfully in their lessons.

The second factor is the decreased number of students at the TTC. At the time of the study, each class had not more than 27 students. This is less than the number of students in each class during the previous years. The reduced number of students helped teacher educators to organize and manage learner-centred activities easily. This may not be the case in most primary school where the classrooms are always overcrowded with learners (Chiphiko & Shawa, 2014). According to Kaambankadzanja (2012), learner centred approaches work much better in atmosphere where the teacher is able to interact with each individual learner in class on daily basis.

The third factor is the use of teaching and learning resources in some mathematics lessons such as chart papers, classroom shop and Teacher's guides. The availability of resources for the classroom shop was achieved mainly through the involvement of

students in collecting locally available resources such as food items which were sold at a local market, used grocery items and bottle tops prior to the mathematics lessons. In most cases, teacher educators are encouraged to use locally available resources in the teaching of mathematics. This helps to instill in students the skill of Teaching and Learning Using Locally Available Resources (TALULAR) which is promoted in primary school teaching (InWent, 2008).

Generally, the effective use of learner-centred approaches entails the use of appropriate teaching methods and adequate resources (InWent, 2008). This helps to make learning more fun and encourage students to be more active and participatory in the lesson activities. This was evidenced in most observed lessons where the use of resources promoted active participation of students in the lesson activities. It is argued that learner-centred approaches cannot be successful without the use of appropriate and adequate resources (Chiphiko & Shawa, 2014; Mizrachi et al., 2010). The appropriate use of resources helps to add variety of experiences in the lesson. In mathematics teaching, resources help students to understand some abstract concepts and to practice some teaching skills easily.

Nowadays, resources such as computers and internet are very good source of additional information for students as well as teacher educators. However, it was noted that students at the TTC had no access to computers which were inadequate for even one class of students. The few available computers were mainly used by teacher educators during lesson preparation.

4.8 Difficulties that were experienced in the use of learner-centred approaches

Despite the numerous benefits of learner-centred approaches, the findings of this study show that there were some difficulties that teacher educators and students experienced in the process of using learner-centred approaches in the teaching and learning of mathematics. Tables 4.10 and 4.11 show some difficulties that were identified by students and teacher educators.

Table 4.10: Difficulties experienced by students (n=160)

Difficulties	**Frequency**	**Percentage of respondents %**
Inadequate guidance from teacher educators	38	23.8
Group disturbances	24	15.0
Shortage of time to complete given tasks	21	13.1
Inadequate resources	12	7.5
No difficulties	2	1.3
Negative attitude by some students	1	0.6

Table 4.11: Difficulties experienced by teacher educators (N=7)

Difficulties	**Frequency**	**Percentage of respondents %**
Negative attitude by some students	5	71.4
Shortage of time	3	42.9
Inadequate resources	3	42.9
Disturbances in the lesson	1	14.3

The results in the Tables 4.10 and 4.11 show that students and teacher educators experienced some similar difficulties in the use of learner-centred approaches in mathematics teaching namely inadequate resources, negative attitude, group disturbances and shortage of time.

4.8.1 Inadequate resources

Both students and teacher educators reported that teaching and learning resources were inadequate at the college for the effective use of learner-centred approaches in some lessons. One teacher educator remarked as follows:

> *"Learner-centred approaches require a lot of resources; hence I face some difficulties when resources are not* (T5).

In most cases, teachers are encouraged to use locally available resources to facilitate learning in all lessons (Kaambankadzanja, 2012). However, some teaching resources such as thermometers are not locally available and difficult to improvise. According to Chiphiko and Shawa (2014), when resources are not available and cannot be improvised, most teachers revert to using teacher-centred approaches. In this case, it requires teacher educators to be resourceful, creative and tactful in order to use learner-centred approaches effectively.

4.8.2 Negative attitude by some students

Most teacher educators reported that some students performed poorly in mathematics because of the negative attitude which they had towards mathematics or the teaching methods. Some of them explained as follows:

"Some students expect teacher educators
as a result, they do not participate actively in learner-centred activities" (T6).

"Most students want to be spoon-fed all the time like it was the case in the previous curriculum" (T2).

In some cases, students may develop negative attitude as a result of the teaching methods that are used. For instance, the study findings indicate that most students enjoyed learning mathematics through the use of group work and discussion methods. This means that their interest in mathematics learning might get affected when different methods were used in the teaching and learning process. In the end, they may lose motivation to learn mathematics.

In most cases, student develop negative attitude when their needs and expectations are not met in the lesson. Consequently, students with negative attitude do not perform well in most lesson activities. This agrees with the view of Nayak (2007) that students' negative experiences in mathematics affect their achievement as well as attitude towards mathematics even during adulthood.

For this reason, it requires proper planning for learner-centred approaches to bring about success in the learning of mathematics by all students. Teacher educators need to consider the needs, abilities, backgrounds and interests of students when preparing to teach each lesson (Vavrus et al., 2011; InWent, 2008).

4.8.3 Disturbances by some students

As students interact in collaborative activities such as pair work and group work, disagreements are inevitable. These disagreements might disturb learning in groups and sometimes the whole classroom. In this study, most students cited lack of cooperation as the main cause of disagreements during some group activities. In most cases, these disagreements result into noise which can hinder students' participation in the given task. One student pointed out that *ñlearning is boring (S126) when there* Nonetheless, noise is inevitable in most learner-centred activities where students interact in order to come up with common understanding of the given tasks.

In some cases, disagreements are part of the discussion process for students to come up with solution to a given problem. Usually, teacher educators resolve disagreements through logical reasoning, explanations and justifications of views raised by students. Therefore, it requires the teacher educator to judge on the nature and level of noise to be tolerated in the teaching and learning process.

4.8.4 Shortage of time

Most students and teacher educators indicated that time management was a challenge when using learner-centred approaches in the teaching and learning of mathematics. One student remarked as follows:

> *ñLearner-centred approaches are time consuming because we need more time to finish (S180) the group activitiesò*

Most teacher educators agreed with students on the issue of time management when using learner-centred approaches. One of them made the following comment:

> ñ U s i learner-centred approaches is time consuming; hence, I sometimes use teacher-centre d a p p r o a c h e s t o c o v e r m o r e (T3).

The issue of time was evidenced in some observed lessons where some planned activities were not completed due to inadequate time. For this reason, most teacher educators indicated that they conducted evening lessons in order to teach the work which they could not complete during the normal teaching hours. The problem of shortage of time is in line with the study findings by Mizrachi et al., (2010) which reveal that most teachers' perception on learner-centred approaches is that they are time consuming during lesson delivery.

4.8.5 Inadequate guidance by some teacher educators

This difficulty was mainly experienced by students who pointed out that mathematics was generally difficult and most of them could not carry out some tasks without adequate guidance from teacher educators. One student had this to say:

> "*Sometimes guidance from the teacher educator is minimal which makes the work very difficult*" (S114).

This difficulty was evidenced in one of the observed lessons where students were asked to solve some questions on the topic of Taxes in their groups. Due to inadequate guidance from the teacher educator, all groups of students failed to get the correct answers. They missed some important steps which led to wrong solution. At the end, the teacher

educator solved the questions on the chalkboard which students copied in their exercise books.

Khalid and Azeem (2012) reveal a common misunderstanding regarding constructivism that teachers are not supposed to tell students anything directly when teaching. However, it can be argued that without proper support and guidance, mathematics can be viewed as difficult subject to learn by some students, especially those who have poor mathematical background. Major and Mangope (2012) stress that teachers need to provide structures or set of plans that supports the development of informed exploration and reflective inquiry without taking initiative and control away from students. In other words, teacher educators should translate the lesson content into the format which is appropriate to the students' current state of understanding (Khalid & Azeem, 2012). This helps to provide students with clues to guide them in carrying out difficult tasks in mathematics independently.

In learner-centred classroom, the role of teacher educators is to act as a catalyst in the learning process by providing guidance and direction through close supervision of students as they perform the given tasks. This agrees with the learner-centred teaching aspects by Weimer (2002) that the teacher acts as a facilitator and contributor rather than director and source of knowledge in learner-centred teaching.

4.9 Chapter summary

The chapter has presented findings which show that learner-centred approaches were used to a large extent in the teaching of mathematics at the TTC. However, teacher-centred approaches were also used in teaching some mathematics lessons. The chapter has also presented the views of students and teacher educators regarding the use of learner-centred approaches in the teaching of mathematics. Finally, the chapter has highlighted some difficulties that students as well as teacher educators experienced when learner-centred approaches were used in mathematics teaching.

Chapter 5 gives the concluding remarks on the use of learner-centred approaches, makes recommendations, suggests areas for further research and highlights some limitation of the study.

CHAPTER 5

CONCLUSIONS, IMPLICATIONS AND RECOMMENDATIONS

5.0 Chapter overview

The purpose of this study was to investigate the use of learner-centred approaches in the teaching of mathematics. The study involved one of the public teachers training colleges in Malawi. The sample included seven mathematics teacher educators and students from six classes at the college. The quantitative findings were collected from students using the questionnaire while qualitative findings were collected from mathematics teacher educators using semi-structured interviews and lesson observation.

The study was mainly responding to the following research questions:

- To what extent are learner-centred methods being used in the teaching of mathematics?
- What are the views of students regarding learning mathematics in a learner-centred environment?
- What are the views of teacher educators regarding the use of learner-centred approaches in teaching of mathematics?

All the three questions have been answered in Chapter 4. This chapter presents a summary of the study findings, draws conclusion, makes recommendations, suggests some areas for further studies basing on the findings and highlights some limitations of the study.

5.1 Key findings

5.1.1 Extent of the use of learner-centred methods in mathematics teaching

In response to the research question one, both quantitative and qualitative findings of the study illustrated that learner-centred approaches were used to a large extent in the teaching of mathematics at the TTC. This was also evidenced in four of the six observed mathematics lessons which were mostly learner-centred. The lessons depicted most of the five features of learner-centred teaching according to Weimer (2002). The teaching methods such as group work, discussion, explanation and question and answer were used extensively in the teaching of mathematics. Generally, these methods are easy to organize and use in teaching as compared to other methods such as project work and research which were rarely used in mathematics teaching.

Nevertheless, teacher-centred methods such as lecture were also used in the teaching of some lessons in mathematics. Teacher educators cited some factors that force them to use lecture method such as syllabus coverage, inadequate resources and failure by students to come up with correct information in the given tasks. This is consistent with the findings of the studies in several other countries which indicate that traditional teaching approaches are still used in most schools (Schweisfurth, 2011; Chiu & Whitebread,

2011). Consequently, the use of teacher-centred methods encourages students to cram the information which gets forgotten easily. In most cases, students are forced to memorize the provided information mainly for the sake of examinations.

However, despite many disadvantages of teacher-centred approaches as argued by several researchers, there is room and need for lecture method and other teacher-centred approaches in teaching certain important mathematics content which students cannot work out on their own.

5.1.2 Views of students and teacher educators regarding the use of learner-centred approaches

There was absolute unanimity among students and teacher educators that learner-centred approaches offer more opportunities to learn mathematics than the teacher-centred approaches. Most of them indicated that the performance of students in mathematics improved significantly when learner-centred methods were used in the teaching and learning process.

Through collaboration with others, students are able to construct their own knowledge instead of listening to continuous lecture by their teacher educators. In most cases, students feel more comfortable to get clarification from their peers on the given task than from their teacher educators. This is in line with the social constructivism which emphasizes that meaningful knowledge is constructed by the collaborative nature of learning (Kalpana, 2014; Mensah & Somuah, 2014).

5.1.3 Difficulties experienced in the use of learner-centred approaches

Despite the opportunities that learner-centred approaches create, both students and teacher educators highlighted some difficulties that they experienced when using these approaches in mathematics teaching such as inadequate teaching and learning resources, shortage of time to complete the work, negative attitude by some students, disturbances by some students and inadequate guidance by some teacher educators. Generally, these difficulties relate to classroom practices. Therefore, it requires thorough preparation, creativity, tactfulness and commitment on the part of teacher educators in order to achieve the effective use of learner-centred approaches in the teaching of mathematics.

5.1.4 Overall conclusion

Basing on the findings from the study, it can be concluded that there is evidence of the use of learner-centred approaches in the teaching of mathematics at the TTC despite some difficulties that were experienced in the teaching process. These approaches create collaborative learning environment which helps to promote active participation of all students as opposed to teacher-centred approaches. The effective use of learner centred methods together with relevant and adequate resources help to achieve high quality teacher education as required in outcomes based education. This conforms to the theory of constructivism which assumes that meaningful learning is achieved when learners actively construct their own knowledge and meaning from their experiences (Kaplana, 2014; Vavrus et al., 2011).

It is argued that trainee teachers' instructional practices are, to a good extent, influenced by the practices of their trainers in teacher education (Bunyi et al., 2013). Hence, the effective use of learner-centred approaches at the TTC can help student teachers to acquire necessary skills for effective teaching in primary schools. This might result in meaningful learning by all learners.

5.2 Recommendations

The study has drawn some recommendations from the findings which if considered can help to achieve effective use of learner-centred approaches in teaching of mathematics by all teacher educators.

The findings reveal that group work and discussion methods were used more extensively in mathematics teaching as compared to other teaching methods. One of the reasons could be the design of handbooks for teaching mathematics. The instructions for most activities in the handbooks ask students to discuss in their groups. In this case, it becomes difficult for other teaching methods to be used easily in the teaching of mathematics. For this reason, there is need for a review of the handbooks to make teacher educators flexible to use various learner-centred methods in mathematics teaching.

5.3 Consideration for future research

This study explored the use of learner-centred approaches in the teaching of mathematics at one public TTC. This provides a spring board for comparative studies in other subjects

or learning areas in teacher education in order to have a wider view of the use of learner-centred approaches at the college.

Furthermore, there is need for a broader research in the use of learner-centred approaches in teacher education at national level in order to have a clear picture of the use of these approaches as required in outcomes based education.

5.4 Limitation of the study

The study was conducted in one subject at one TTC. Hence, it would be inappropriate to generalize the results to all TTCs countrywide. However, the findings can simply be generalized within the context of the participating TTC.

In addition, the teacher educators knew in advance that their lessons would be observed by the researcher. For this reason, most of them were well prepared for the lessons in terms of the teaching methods and resources. Consequently, this might not depict their actual teaching when they are not being observed. However, the researcher used various methods of data collection in order to minimize the effects of this limitation.

5.5 Chapter summary

The chapter has given a summary of the study findings on the use of learner-centred approaches basing on the three research questions. The chapter has also suggested some recommendations which if implemented would result in the effective use of learner-centred approaches in the teaching of mathematics at the college. Furthermore, the

chapter has suggested some areas for further research. Finally, the chapter has highlighted some limitations of the study.

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APPENDICES

Appendix 1: Letter of Introduction

CHANCELLOR COLLEGE

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OFFICE OF THE DEAN OF EDUCATION

16th December, 2015

TO WHOM IT MAY CONCERN

Dear Sir/Madam

LETTER OF INTRODUCTION (MASTER OF EDUCATION)

The Faculty of Education would like to introduce to you Mr Paschal W. B. Kayange, Registration no. MED/PR/SC/07/14, Chancellor College M.Ed Student who is supposed to do research in area of his interest.

This letter serves to request you to assist him with data collection in your institution.

The Faculty of Education will appreciate your support in this very important aspect of our students' training.

Yours faithfully,

UNIVERSITY OF MA... CHANCELLOR COLLEGE
2015 -12- 16
DEAN
FACULTY OF EDUCATION

F. Kholowa, (PhD)
DEAN OF EDUCATION

cc: Supervisor

Appendix 2: Letter of Introduction and Informed Consent

Chancellor College

Faculty of education

Introduction and Informed Consent

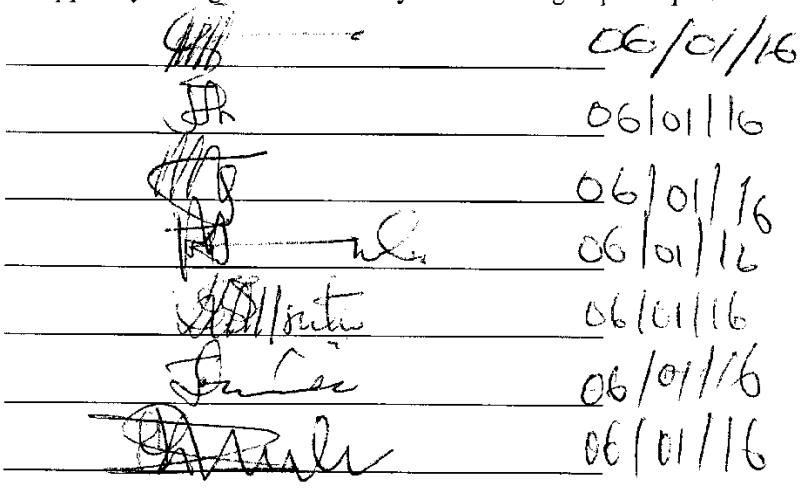
Dear respondents,

My name is Paschal Watson Benjamin Kayange. I am a student for Master of Education degree from the University of Malawi, Chancellor College specializing in mathematics and science. I am collecting data for my academic research whose general objective is to investigate the use of learner-centred approaches in the teaching of mathematics in teacher education. I would be grateful if you could spend some time with me to answer some questions and thereafter allow me to observe one of your mathematics lessons.

All the information that I will collect in this study will be strictly confidential and your name will not be written anywhere. The gathered information is for academic purpose only.

You may wish to withdraw from the study any time.

Please append your signature below if you are willing to participate.



Appendix 3: Students' questionnaire

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Teachers' Training College (TTC) students' questionnaire

Dear respondent,

The purpose of this questionnaire is to collect information on the use of learner-centred approaches in the teaching of mathematics in teacher education programme. Your participation in completing the questionnaire is extremely useful and sincerely appreciated. The information gathered will be for academic purpose only. Therefore, you will be treated with anonymity and confidentiality. In this case, you do not need to write your name on the questionnaire.

You are requested to respond to questions truthfully by ticking in the brackets [√] provided against the answer or write your answer in the spaces provided.
Please read each question thoroughly before answering.

Gender : M [ ] F [ ]

Age range : 15 – 20 [ ] 21 – 25 [ ] 26 – 30 [ ] 30 – 35 [ ]
36 – 40 [ ] 41 – 45 [ ]

1. Which of the following methods does your teacher educator use when teaching mathematics? *(You may add methods that are used but not on the list)*

Artistic problem solving [ ]	Games [ ]	Question and answer [ ]
Brainstorming [ ]	Group work [ ]	Research [ ]
Bus stop / Work stations [ ]	Individual work [ ]	Role play [ ]
Card collecting and clustering [ ]	Investigation [ ]	Silent participant [ ]
Concept mapping [ ]	Jigsaw [ ]	Singing [ ]
Conversation circle [ ]	Lecture [ ]	Speaking chain [ ]
Demonstration [ ]	Making a stand [ ]	Think-pair-share [ ]
Discussion [ ]	Mind mapping [ ]	_____ [ ]
Explanation [ ]	Observation [ ]	_____ [ ]
Flashlight [ ]	Pair work [ ]	_____ [ ]
Focus ball [ ]	Poster making [ ]	_____ [ ]
Gallery walk [ ]	Project work [ ]	_____ [ ]

2. Which methods in **question 1** above do you enjoy **most** when learning mathematics?

_____

_____

_____

b) Which methods in **question 1** above do you enjoy **least** when learning mathematics?

_____

_____

_____

3. Which methods that you have selected in **question 1** can be classified as learner-centred? *(You may add learner-centred methods that are not on the list below)*

Artistic problem solving	[ ]	Games	[ ]	Question and answer	[ ]
Brainstorming	[ ]	Group work	[ ]	Research	[ ]
Bus stop / Work stations	[ ]	Individual work	[ ]	Role play	[ ]
Card collecting and clustering	[ ]	Investigation	[ ]	Silent participant	[ ]
Concept mapping	[ ]	Jigsaw	[ ]	Singing	[ ]
Conversation circle	[ ]	Lecture	[ ]	Speaking chain	[ ]
Demonstration	[ ]	Making a stand	[ ]	Think-pair-share	[ ]
Discussion	[ ]	Mind mapping	[ ]	_____	[ ]
Explanation	[ ]	Observation	[ ]	_____	[ ]
Flashlight	[ ]	Pair work	[ ]	_____	[ ]
Focus ball	[ ]	Poster making	[ ]	_____	[ ]
Gallery walk	[ ]	Project work	[ ]	_____	[ ]

4. Do you think your performance in mathematics gets affected by the teaching methods that the teacher educator uses?

   Strongly agree [ ] agree [ ] not sure [ ] disagree [ ]

   Strongly disagree [ ]

5. How would you describe your overall performance in mathematics when your teacher educator uses learner-centred approaches?

   Very good [ ] good [ ] average [ ] poor [ ] very poor [ ]

6. Write down some methods that help you to learn mathematics better.

_____

_____

_____

_____

7. a) In your opinion, do you think learner-centred approaches offer more opportunities to learn mathematics than the traditional teaching approaches?

   Strongly agree [ ] agree [ ] not sure [ ] disagree [ ] strongly disagree [ ]

   b) Explain your choice.

_____

_____

_____

_____

8. State any difficulties that you experience in learning mathematics through leaner-centred approaches.

_____

_____

_____

End of questions. Thank you for your participation

Appendix 4: Interview guide

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Interview guide for TTC mathematics teacher educators

Opening

The purpose of this interview is to collect information on the use of learner-centred approaches in teaching of mathematics. Your participation in answering the questions is extremely useful in making this study a success. Be assured of confidentiality about the information that you provide.

A. Experience

1) For how long have you been in the teaching service?
2) How many years have you been a teacher educator?
3) How many years have you been a mathematics teacher educator?
4) Did you attend any training in the use of learner-centred approaches?
5) For how long have you learned about learner-centred approaches?

B. Learner-centred approaches in mathematics teaching

1. Which teaching approach do you frequently use when teaching mathematics?

2. Which methods do you use when teaching mathematics?

Examples

Artistic problem solving	Games	Question and answer
Brainstorming	Group work	Research
Bus stop / Work stations	Individual work	Role play
Card collecting and clustering	Investigation	Silent participant
Concept mapping	Jigsaw	Singing
Conversation circle	Lecture	Speaking chain
Demonstration	Making a stand	Think-pair-share
Discussion	Mind mapping	
Explanation	Observation	
Flashlight	Pair work	
Focus ball	Poster making	
Gallery walk	Project work	

3. How often do you use learner-centred methods when teaching mathematics?

4. Of all the methods that you have mentioned, which ones do you feel are more effective in the teaching of mathematics? Why?

5. Do students experience some difficulties when learner-centred approaches are used in the teaching of mathematics? Please explain.

6. Do you experience some difficulties in using learner-centred approaches when teaching mathematics? Please explain.

C. Evaluation

1. Do you think the performance of students in mathematics gets affected by the teaching methods that teacher educators use? Please explain.

2. In your opinion, do you think learner-centred approaches offer more opportunities for students to learn mathematics than the traditional approaches? Why?

3. What is your general comment on the use of learner-centred approaches in the teaching of mathematics in teacher education programme?

Closing remarks

Thank you very much for the information that you have provided

End of interview

Appendix 5: Lesson observation form

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Lesson observation form

Feature	Indicator	Yes	Partly	No	Remarks
1. Function of lesson content	¶ Students practice various learning skills				
	¶ Students relate lesson content to what they already know				
	¶ Students connect lesson content to daily life situation				
2. Responsibility for learning:	¶ Students are actively involved in the learning process				
	¶ Students suggest their own ideas in lesson activities				
3. Balance of power	¶ Gives students more time to interact				
	¶ Allows students to control their learning				
	¶ Students are involved in various classroom activities				

4. Role of the teacher educator	¶ Organizes various students' activities				
	¶ Promotes collaborative and cooperative learning				
	¶ Supports students in their construction of knowledge				
5. Processes and purposes of evaluation	¶ Students practice both theoretical and practical skills				
	¶ Students assess their own work				

	Methods used in the lesson	**Remarks**
1		
2		
3		
4		
5		

Overall remarks

_____

_____

_____

_____