BED FOUNDATION PHASE FOURTH YEAR STUDENT TEACHERS' SELF-EFFICACY BELIEFS TOWARDS TEACHING MATHEMATICS AND THE SELF-REPORTED FACTORS THAT INFLUENCE THESE SELF-EFFICACY BELIEFS

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ABSTRACT

The underperformance of mathematics teaching and learning is a pressing concern in South Africa. Many foundation phase in-service teachers show inadequate mathematics content knowledge which creates barriers to their learners acquiring adequate mathematics skills. Teacher training programmes offer a key opportunity to improve the instructional practices of teachers at foundation phase level. In order to improve the teaching skills of in-service teachers, one focus must be on teacher training programmes. Unfortunately, there are many foundation phase student teachers who are leaving the profession within the first few years of teaching reportedly due to low levels of motivation. This research investigates the self-efficacy beliefs of pre-service student teachers. It also focuses on foundation phase student teachers as they experience significant challenges to their self-efficacy beliefs in mathematics and mathematics teaching.

Self-efficacy is the key theory of the study. It stems from Bandura's social cognitive theory and is an individual's judgments about their capabilities, skills and perceived performance. This qualitative research adopts an interpretivist approach which seeks to identify BEd foundation phase fourth year student teachers' self-efficacy beliefs towards teaching mathematics and the self-reported factors influencing such beliefs. This research found that BEd foundation phase fourth year student teachers have low self-efficacy beliefs towards teaching mathematics. The purpose of this research is to raise awareness of the BEd student teachers' low self-efficacy beliefs towards teaching mathematics. The results from this research will provide a platform for future intervention research, as well as potentially influencing student teacher training programmes.

Key terms: *Mathematics teaching, self-efficacy theory, foundation phase teacher training, BEd foundation phase student teachers*

DECLARATION

I, Chloe Harrison, have read and understood the university's policy on plagiarism. I hereby declare that this is my own work and where I have drawn on the work of others, they are acknowledged in full, using referencing according to the Rhodes University Education Guide to References. This work has not been submitted to fulfil the requirements of a degree at any other university.

4 December 2019

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(Signature) (Date)

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I can do all things through Christ who strengthens me (Philippians 4.13)

For I know the plans I have for you … plans to prosper you and not to harm you, plans to give you hope and a future (Jeremiah 29:11)

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GLOSSARY OF ABBREVIATIONS

BEd	-	Bachelor of Education degree
PhD	-	Postgraduate doctoral degree
MEd	-	Master in Education
FP	-	Foundation phase
MRTEQ	-	Minimum requirements for teacher education qualifications
TP	-	Teaching practice
Maths	-	Mathematics

CLARIFICATION OF TERMINOLOGY

In this research I make reference to *pre-service teachers* as *student teachers* because this is a term used at Rhodes University Education Department. The participants in this research are all BEd Foundation Phase fourth year student teachers, and for the sake of brevity I will interchangeably refer to them as *the student teachers* and/or *the participants*. The term *learners* is used throughout this research when discussing the *children* in the classroom. *Colleagues* are the BEd student teachers' peers who participated in the same teacher training programme at Rhodes University. *Teaching practice* is the supervised and assessed classroom based teaching practical, which forms a crucial part of the BEd teacher training program. *Mentor teachers* are *in-service teachers* who have been selected to provide assistance, guidance and serve as a model for observation to the student teachers during their teaching practice.

CHAPTER ONE: INTRODUCTION

1.1 Introduction

Foremost, it is important that I explain my motives for undertaking this research on BEd foundation phase student teachers' self-efficacy beliefs towards teaching mathematics. While obtaining my PGCE at Rhodes University, I noticed that many of my colleagues disliked mathematics and the teaching thereof. Since becoming a teaching practical examiner for BEd foundation phase student teachers, I discovered that they were not confident in their ability to teach mathematics. This ongoing pattern sparked an interest that drew me to doing my MEd and to research student teachers' feelings, thoughts and opinions towards their capabilities in teaching mathematics to foundation phase learners. My general interest in the self-efficacy theory stemmed from my previous studies in psychology honours.

As a result, the research question is as follows: *What are the BEd foundation phase fourth year student teachers' self-efficacy beliefs towards teaching mathematics and what are the self-reporting factors that give rise to these beliefs?*

In order to understand the concept of self-efficacy, the broader South African context is inevitably implicated. The broad context of this research is comprised of teacher motivation in South Africa. Motivation is a key concept which is used often by researchers when investigating individuals' self-efficacy beliefs towards a specific phenomenon. It is important to note that motivation is not self-efficacy, but they do influence each other in various ways (Bandura, 1997). For example, individuals who are highly motivated are more likely to achieve their goal which may result in an increase in their self-efficacy beliefs (Gibbs, 2002). Therefore, investigating their motivation towards teaching mathematics in South Africa may provide useful insights into their self-efficacy beliefs. More detail on the related concept of motivation will be given in Section 2.2.2.

In general, studies have revealed that teacher motivation in South Africa is a concern, as many of them are leaving the teaching profession within the first three years (Jackson, 2008). It has been found that large numbers of teachers are allegedly either dropping out, not showing up at work, or are teaching unenthusiastically in ways that do not stimulate learning in the classroom

(Armstrong, 2014). They are reportedly dissatisfied with various aspects of the education system in South Africa. Recent research has shown that South Africa is underperforming in education, particularly mathematics teaching and learning (Jojo, 2019). In other words, the education system is an influential factor on teacher motivation. Much of this underperformance is visible in the public schools which form about 80% of the schooling in South Africa (Jojo, 2019). In addition, according to Sayed and McDonald (2017), 10% of the country's teachers are absent from school every day. It is therefore important to identify the reasons why many teachers in South Africa experience feelings of demotivation, especially with regard to mathematics teaching, which is addressed in Section 1.2 below.

1.2 Context

Teacher motivation in South Africa will be discussed as follows:

This section will begin by generally explaining teacher motivation in South Africa. The broad peripheral effects provided by the education system that contribute towards teacher motivation in South Africa will be addressed. I will then narrow down the discussion to more specific intrinsic and extrinsic factors that affect teacher motivation in South Africa.

Foundation phase student teacher's motivation in South Africa is then explored. More specifically, student teachers' motivation towards teaching mathematics is then discussed, as well as its influence on their self-efficacy beliefs.

1.2.1 General teacher motivation in South Africa

This research uses Bandura's theory of self-efficacy, but as previously mentioned in Section 1.1, teacher motivation and self-efficacy influence each other (Bandura, 1997). They affect a teacher's experiences, their beliefs about their capabilities, and confidence in their teaching ability (Bandura, 1994). Thus, considering factors that are broadly described as "motivation" provides a useful starting point.

Before discussing the factors that influence teachers' motivation in South Africa, it is important to understand the meaning of motivation. Researchers from many theoretical perspectives address two common questions with regard to motivation: "how are people motivated, and when are people motivated?" (Han, Yin, & Boylan, 2016, p. 3). Motivation among teachers is

influenced by four factors, three of which apply to this research, namely; "motivation to teach and career expectations, confidence and optimism or anxiety and concerns about teaching and perceptions of the roles and responsibilities of teachers" (Brookhart & Freeman (1992) as quoted in Han et al., 2016, p. 38). Feelings such as anxiety, optimism and confidence also impact teachers' self-efficacy beliefs (Bandura, 1994).

1.2.2 Teacher extrinsic and intrinsic motivation in South Africa

Teacher motivation in South Africa is a broad topic because there are many factors that affect a teacher's motivation. Intrinsic and extrinsic motivational factors are major contributors towards their self-efficacy beliefs in South Africa (Han et al., 2016). Extrinsic factors consist of the social environment, which influences an individual's personal thoughts and feelings (Wolhuter, Van der Walt, Potgieter, Meyer, & Mamiala, 2012). Intrinsic factors refer to the motivation that is driven from within the individual; it relies on their thoughts and feelings (Heystek & Terhoven, 2014). Even though extrinsic and intrinsic factors influence each other, it is important to understand the contexts in which teachers feel demotivated. This research focuses on student teachers only and therefore the following extrinsic and intrinsic motivational factors contributing to in-service teachers feeling demotivated in South Africa, will be briefly discussed.

Extrinsic factors are vitally important as they are major contributing factors to the overall motivation among teachers in South Africa (Iwu, Gwija, Benedict, & Tengh, 2013). The rapid pace of change in the education system has had a significant effect on the motivation of teachers, especially in curricula development, as this has forced teachers to change their methodologies. As a result, they can feel inadequate and overwhelmed (Iwu et al., 2013). Other challenges to their motivation caused by the changes in the education system cover a broad range: job security, perceived promotion opportunities, work overload, lack of resources, lack of recognition, pay incentives, accountability for poor pass rates, lack of support and lack of job satisfaction (Shalem & Hoadly, 2009; Bantwini, 2010; Iwu et al., 2013; Heystek & Terhoven, 2014). The physical working environment also plays an important contributing factor to their low levels of motivation in South Africa. Many teachers in South Africa are expected to teach in buildings which are often in poor condition. These unsatisfactory teaching environments impact negatively on their morale (Cobbold (2007), as cited in Iwu et al., 2013).

Improving the education system may take a considerable amount of time and effort, but improving teachers' intrinsic motivation and self-efficacy beliefs is feasible. Intrinsic factors such as limited content knowledge and skills of the subject's content have been found to have a major impact on their motivation (Heystek & Terhoven, 2014). Sayed and McDonald (2017) for example, show that 79% of South African mathematics teachers do not display sufficient content knowledge required at a primary school level. These alarming results further highlight the importance of investigating why many of them experience low levels of motivation. According to Heystek and Terhoven (2014), one way to improve motivation is through professional development, which allows them to acquire and enhance their skills, knowledge and attitudes. Previous studies have indicated that many of the teachers who do not take part in self-development activities often do not have self-confidence, interest or collegial support (Heystek & Terhoven, 2014).

The above extrinsic and intrinsic factors such as the education system, working environment and limited content knowledge, have been shown to be among the main reasons why teachers feel demotivated in the work place. Because this research focuses on foundation phase student teachers, the following section addresses their motivation towards teaching mathematics in South Africa and the influence it has on their self-efficacy beliefs.

1.2.3 Foundation phase student teachers' motivation in South Africa

Foundation phase teachers are vitally important in any education system as they teach young learners the fundamental tools for learning (Armstrong, 2014). However, many of them have been found to leave the teaching profession in South Africa within the first five years of teaching, due to low levels of motivation (Sayed & McDonald, 2017). For this reason, it is vitally important to investigate the factors contributing to this decline. According to Sayed and McDonald (2017), there is a need to increase the supply of foundation phase student teachers in South Africa. Linked to this, Jackson (2008) argues, that many of these student teachers feel the greatest challenge to their concept of self-efficacy is when they come to prepare and teach mathematics.

As discussed earlier, it has been identified that many in-service teachers in South Africa experience feelings of demotivation due to various extrinsic and intrinsic factors (Han et al., 2016). Student teachers' motivation to remain in the teaching profession is slightly different to

that of in-service teachers. The reason for this is that they are at different stages of their teaching career (Sayed & McDonald, 2017). The reported factors influencing their motivation in South Africa will be discussed in more detail below.

1.2.4 Student teachers' motivation to pursue teaching

The following are extrinsic and intrinsic motivational factors that influence student teachers' motivation to pursue the teaching profession in South Africa.

Financial reasons are partially responsible for student teachers' demotivation in pursuing the teaching profession in South Africa. The cost of tuition and limited availability of bursaries offered to them in South Africa have been found to influence their decision negatively to become teachers in the first place (Sayed & McDonald, 2017). This research acknowledges that the cost of tuition may be a contributing factor in many student teachers' decisions to continue with their teacher training programme.

In addition, opportunity factors also contribute to student teachers' low levels of motivation to pursue a teaching career. Opportunity costs include working hours, flexibility of schedules and job stability (Armstrong, 2014). It is argued that even though they are concerned with their future salaries, they are often more worried about the stability of the teaching profession. Job security has been found to be a widespread concern in South Africa and many of these student teachers require confirmation that their career will be a stable one (Sayed & McDonald, 2017).

Student teachers are often driven by the thought that, by becoming a teacher, they can make a difference to society. Sayed and McDonald (2017) state that the inherent joy and satisfaction of becoming a teacher is an intrinsic motivator that most seem to experience. It has been identified that many of them view teaching as a socially worthwhile and important job and believe that being a teacher may give them a chance to make a difference in the lives of young learners. However, the perceived low status of being a teacher in South Africa has affected their high expectations of making a difference (Sayed & McDonald, 2017). In addition, research shows that they are concerned with the possibility of underperforming in their role as a teacher. This in turn has caused significant anxiety among student teachers, which can negatively impact their self-efficacy beliefs and motivation (Moodley, Adendorff, & Pather,

2015). These factors broadly affect student teachers' perception of being a teacher in South Africa and, consequently, their motivation and self-efficacy.

Another intrinsic factor that influences student teachers' motivation in South Africa is their perception of or belief in their ability to teach and to become good teachers (Wolhuter et al., 2012). Petersen (2017) argues that their main concern is based on the emerging economy of South Africa and the pressures it creates on them to improve the educational outcomes for all learners. This huge burden has been known to cause many of these student teachers to doubt their skills and content knowledge (Korthagen (2011), as cited in Petersen, 2017). Doubtful thoughts about one's own skills and ability to teach, negatively influences one's self-efficacy beliefs.

Student teachers' background schooling experience in learning mathematics has been shown to influence their aspirations and perceptions of becoming a foundation phase teacher (Moodley et al., 2015; Sayed & McDonald, 2017). Many of them have had negative mathematics schooling experiences which have been found to negatively influence their feelings towards mathematics. Studies have also revealed that their perception of mathematics, their beliefs, attitudes and understanding of the subject, impacts their self-efficacy beliefs (Moodley et al., 2015). This research aims to identify student teachers' feelings towards mathematics, as these provide insight into their self-efficacy beliefs. Sayed and McDonald (2017) also stress that these negative feelings towards mathematics may have severe negative repercussions on their self-efficacy beliefs towards learning mathematics, as well as towards teaching it. According to Moodley et al. (2015), one way to prevent these negative feelings towards mathematics, is by investigating their prior perceptions towards mathematics learning and make them aware of these perceptions. This research hopes to provide awareness to these student teachers of their perceptions towards mathematics and the teaching of mathematics. This highlights the importance and contribution of this research. The purpose of this research is further discussed in more detail in Section 1.3.

1.2.4.1 The teaching environment and motivation

Highly trained student teachers are one of the main contributors to improving education in South Africa (Moodley et al., 2015). However, according to Moodley et al. (2015), many of them are experiencing anxiety in the South African teaching environment. The following

section discusses the extrinsic teaching environmental factors in South Africa which contribute to their feelings of demotivation.

The foundation phase classrooms in South Africa are frequently overcrowded and the transition from university to the realities of the school working environment can be challenging for student teachers (Sayed & McDonald, 2017). According to Petersen (2017), many of them may find it challenging to teach large groups of learners with no prior knowledge of what to expect. The responsibilities weighing on these student teachers may result in anxiety. This anxiety has been shown to negatively influence their motivation and self-efficacy beliefs to teach mathematics effectively (Moodley et al., 2015). This research is done with the understanding that the BEd foundation phase fourth year student teachers have already been exposed to the transition period, as they are required to teach over a period of four years in various schools. Their future teaching environment may be different to that of their teaching experience, however, identifying their feelings towards their teaching practice helps this research to gain insight into their overall self-efficacy beliefs.

In South Africa, most classrooms present a diversity of cultures and languages. However, many student teachers may find it difficult to teach in a classroom where they are unfamiliar with the home language of the learners. Studies have revealed that language has emerged as another environmental factor impacting on their motivation (Petersen, 2017). With regards to foundation phase teaching, many teachers in South Africa are obliged to code switch to communicate effectively in the classroom. When a student teacher is unfamiliar with the learner's home language, their anxiety may increase. This is said to influence their motivation to teach and as a result affects their self-efficacy beliefs (Petersen, 2017).

Teacher training programmes have been identified as another environmental factor which contribute to student teachers' low levels of motivation. Many of the student teachers in South Africa have reportedly blamed their teacher training programmes and their university lecturers for their unsuccessful transition to the school working environment (Sayed & McDonald, 2017). They may feel pressured as they are expected to implement what they have learned during their four years in the teacher training programme. According to Sayed and McDonald (2017), these student teachers find it challenging to know which methods and frameworks are best suited for particular mathematical concepts. With regards to mathematics teaching, student teachers may experience a 'reality shock' when stepping out into the teaching profession.

Furthermore, it is stressed that this 'reality shock' may stem from their mathematics anxiety when instructed to teach mathematics (Petersen, 2017; Sayed & McDonald, 2017). It is important that teacher training programmes, aid in shifting any negative attitudes by ensuring that student teachers enter the teaching profession confident and competent (Moodley et al., 2015).

Another contributing environmental factor impacting student teachers' motivation in South Africa, is the perceived lack of support from schools. According to Petersen (2017), many student teachers find it difficult to adjust to another teacher's classroom and teaching style. Their position in the classroom affects their motivation, as they consider themselves as "no longer a student but not yet a teacher either" (Petersen, 2017, p. 3). It has been pointed out that there is a shortage of in-service teachers in some schools in South Africa, and when student teachers are available, in-service teachers may take leave without permission. This situation can impact their motivation during their teaching practice, as they are expected to manage classrooms on their own without supervision. They are also expected to plan, prepare and teach by themselves during the teaching practice and, at the same time, complete various assignments from their teacher training programme (Petersen, 2017). In addition, if they do not have the necessary support during their teaching practice, student teachers do not acquire the important skills received from positive feedback (Petersen, 2017). According to Bandura (1994), unsuccessful teaching practice may influence their self-efficacy beliefs. This research seeks to identify the type of experiences the BEd foundation phase fourth year student teachers had during their teaching practice in order to understand this phenomenon.

1.2.4.2 Content knowledge and motivation

It is argued that "the performance of mathematics must be detached from politics and be controlled by conceptual knowledge of the subject" (Jojo, 2019, p. 3). In other words, teachers' mathematics content knowledge must be the primary focus. The BEd foundation phase programme results in qualified teachers who are able to teach from Grade R to Grade 3. The policy on the Minimum Requirements for Teaching Education Qualification (MRTEQ) states that in South Africa, all foundation phase teachers "must be capable of teaching all four subjects, one of these being mathematics" (South Africa. Department of Higher Education and Training, 2015, p. 26). Therefore, it is a requirement that they are trained to be mathematics teachers. For this reason, this research focuses on the important area of BEd foundation phase

fourth year student teachers' self-efficacy beliefs towards their mathematics content knowledge.

In South Africa, there has been increasing investigation on foundation phase student teachers' poor content knowledge as it is considered to be a factor contributing to educational underperformance. In particular, their lack of mathematics knowledge restricts learners' opportunities to acquire proper mathematics skills (Jojo, 2019). Generally, therefore, mathematics teaching is of concern in South Africa (Jojo, 2019). The student teachers' self-efficacy beliefs towards their mathematics content knowledge forms a crucial dimension in identifying their overall self-efficacy beliefs towards teaching mathematics. This indicates the importance of investigating mathematics teaching in South Africa.

The content knowledge that this research refers to is known as "common content knowledge" which is defined by Ball, Thames and Phelps (2008), as "simply calculating an answer or, more generally, correctly solving mathematic problems" (p. 399). Common content knowledge is discussed in more detail in Section 4.2.2.

As mentioned in Section 1.1, South Africa's mathematics education is facing challenges wherein learners are not performing at the expected levels and the teachers' mathematics content knowledge is significantly low (Jojo, 2019). Jojo (2019) explicitly states that South Africa needs to ensure high quality training of mathematics teachers by equipping learners with the mathematics content knowledge they need at a young age, highlighting the importance of research on foundation phase mathematics teaching in South Africa. The following paragraph discusses the intrinsic factors influencing student teachers' content knowledge and motivation.

Poor content knowledge is a factor influencing student teachers' motivation to teach in South Africa. As discussed above, many of them do not have the necessary content knowledge needed to teach young learners, and that in turn has raised their mathematics anxiety (Jojo, 2019). According to Moodley et al. (2015), many student teachers with high mathematics anxiety are afraid of making mistakes while teaching, or not being able to solve particular mathematical problems. This emerged as a concern among the participants in this research. According to Wolhuter et al. (2012), developing skills and knowledge may increase their confidence, which ultimately affects their self-efficacy beliefs. Investigating their feelings towards their

mathematical skills and their need to take part in self-developmental activities, provides insight into their motivation and self-efficacy beliefs and contributes to findings in this research.

1.3 Problem Statement

As mentioned in the section describing the context of this research, studies have identified that teachers in South Africa are not motivated and leave the teaching profession within the first few years of teaching (Armstrong, 2014). Demotivation and inadequate mathematics content knowledge does not only affect the student teachers' confidence and emotional state, but also affects the learners that they teach (Jaggernauth & Jameson-Charles, 2010). Because teachers are responsible for guiding young learners, this crisis of underperforming teachers in South Africa needs to be addressed. In Section 1.1, it was explained that motivation and self-efficacy are concepts that influence each other. Thus, according to Heystek and Terhoven (2014), one way to address this educational crisis is by identifying student teachers' thoughts, feelings and opinions towards teaching mathematics by using the psychological theory known as self-efficacy. This research recognises that there is a lack of research among foundation phase student teacher's self-efficacy beliefs in South Africa. For this reason, this research aims to identify student teachers' self-efficacy beliefs towards teaching mathematics.

1.4 Research Goals and Purpose

1.4.1 Research goals

This research seeks to identify BEd foundation phase fourth year student teachers' self-efficacy beliefs towards mathematics. It aims to investigate the self-reporting factors that influence these self-efficacy beliefs by applying the theory and concepts addressed in Chapter Two. This research also aims to provide further insights into student teachers' self-efficacy beliefs towards teaching mathematics.

1.4.2 The purpose of this research

This is an interpretive study that seeks to bring about awareness to teacher training programmes and to the student teachers themselves of their self-efficacy beliefs towards teaching mathematics, that will provide a platform for future intervention research. As discussed above, not much research, if any, has been done on mathematics foundation phase teacher's self-

efficacy beliefs in South Africa, which presents a gap which this research hopes to fill (Jackson, 2008). This research hopes to contribute to the developing field of educational psychology and mathematics teacher training programmes.

1.5 Research Question

Given the setting and issues briefly outlined above, this research tries to answer the following broad question: *What are the BEd foundation phase fourth year student teachers' self-efficacy beliefs towards teaching mathematics and what are the self-reporting factors that give rise to their self-efficacy beliefs?*

This research consists of three sub-questions:

1. What are the BEd foundation phase fourth year student teachers' self-efficacy beliefs towards their mathematics content knowledge?
2. What are the BEd foundation phase fourth year student teachers' self-efficacy beliefs towards their mathematics teaching ability?
3. What are the self-reporting factors that influence the BEd foundation phase fourth year student teachers' self-efficacy beliefs?

1.6 Outline of the Thesis

The following discusses how the content of this research is organised into five chapters:

Chapter One: Context

Chapter One described the context of this research in South Africa by presenting the underperformance of mathematics teaching and learning. This section suggested the importance of improving mathematics education, providing evidence of mathematics teaching in South Africa. The chapter emphasised the necessity of identifying motivation and self-efficacy among student teachers.

Chapter Two: Concepts and Theory

Chapter Two presents the theoretical framework of this research. Self-efficacy theory is introduced by discussing the complexity of its definition. It is described with reference to the

broader social cognitive theory. The self-efficacy theory is also the main theoretical concept of this research and is distinguished from relating concepts. The self-efficacy beliefs and their influences are explained in relation to student teachers. Bandura's four sources of self-efficacy beliefs form a crucial part of the self-efficacy theory and are discussed in detail. Mathematics anxiety is a related concept which is addressed with reference to student teachers' self-efficacy beliefs. As self-efficacy theory is a psychological theory introduced in the 1980s, recent studies relating to teacher self-efficacy are discussed.

Chapter Three: Methodology

Chapter Three reviews the methodological design of this research and justifies the choice of qualitative research with an interpretivist approach. This chapter then discusses sampling, and the sample size for each data collection tool. The selected research site and its importance to the data collection process is acknowledged. The different research tools used to conduct this research and their purpose is discussed, as well as the type of data analysis for each data collection tool. Ethical considerations are addressed. The validity and reliability of each data collection tool is examined. This chapter ends by discussing Guba's four criteria in ensuring validity and reliability in relation to this research.

Chapter Four: Data Presentation and Analysis

Chapter Four presents the data, together with its analysis. This chapter is divided into three parts, each part answering a different research sub-question by analysing and discussing relevant responses.

Chapter Five: Conclusion

This chapter presents the significance of this research and the usefulness of the self-efficacy theory. The key findings of this research are discussed by merging the three parts of data analysis from Chapter Four, as well as addressing the research question. The insights that emerged from the key findings are then discussed, as well as the limitations of the research. Recommendations for future research are included. A final word has been added in order to sum up my experience during this research process.

1.7 Summary

This research was introduced by discussing the context. The problem statement, research goals and purpose, as well as the research question were presented, along with an outline in order to guide the reader through the research. Chapter Two now discusses the main theory of this research, self-efficacy theory, both generally and in relation to this research on BEd foundation phase fourth year student teachers' self-efficacy beliefs towards teaching mathematics.

CHAPTER TWO: CONCEPTS AND THEORY

2.1 Introduction

The self-efficacy theory is both the main theory and forms part of the conceptual framework of this research. Bandura's theory of self-efficacy was first established in the 1980s and I will be drawing on his work throughout this chapter, particularly in large amounts in the first section which introduces the broad theory of self-efficacy and its related concepts. This chapter then further discusses what constitutes as high and low self-efficacy beliefs by explaining the differences between them, as well as the influences it has, specifically in relation to student teachers. Bandura has been used in penetrating studies as an original source in looking at factors that give rise to self-efficacy beliefs which this chapter then discusses in detail. Later in the chapter, Bandura's theory of self-efficacy is then used to explain teacher's self-efficacy, specifically focusing on mathematic teacher's self-efficacy. Because this research seeks to identify BEd foundation phase fourth year student teachers' self-efficacy beliefs towards teaching mathematics, the last section focuses on foundation phase student teacher mathematics anxiety and mathematics teaching anxiety.

2.2 Self-Efficacy Theory

An influential social cognitive psychologist, Albert Bandura is best known for his self-efficacy theory and defines self-efficacy as "how people feel, think, motivate themselves and behave" (Bandura, 1994, p. 1). Bandura (1977; 1997) explains that efficacy is not about knowing what to do in certain situations, but being able to cope with one's environment. Inman (1999) similarly defines efficacy as what an individual is capable of doing and stresses that it is not the same as knowing what to do (as cited in Tschannen-Moran & McMaster, 2009). According to Tschannen-Moran and McMaster (2009), self-efficacy is the belief that an individual has the ability to accomplish desired outcomes, which strongly affects their behaviour, motivation and even their success or failure (as cited in Bandura, 1997). From these definitions, one can conclude that effective human functioning is not simply about knowing what to do and then being motivated to do it. Rather it is important to note that human competencies are established and manifested in diverse forms, hence people differ in how they cultivate their efficacy and in the levels to which they develop it (Bandura, 1997). For this reason, it was important that

this research gathered data from as many student teachers as possible, using a variety of data gathering tools, in order to identify their self-efficacy beliefs towards teaching mathematics as a collective. This ensured the validity and reliability of their responses. In Chapter Three, I discuss the data collection tools, as well as the process of participant selection in more detail.

Self-efficacy is important, as without it, individuals do not put effort into certain endeavours because they may perceive their efforts as inadequate (Tschannen-Moran & McMaster, 2009). With regards to mathematics teacher self-efficacy, without self-efficacy, many teachers would not put as much effort into teaching mathematics and would possibly perceive their mathematics teaching ability as insufficient (Giles, Byrd, & Bendolph, 2016). Section 2.6 below, provides more insight on teachers with low mathematics teaching self-efficacy. Zulkosky (2009) takes a different approach in defining self-efficacy by providing an alternative definition, stating that *self* is the identity of the person and *efficacy* is the power to produce an effect. To summarise these viewpoints, self-efficacy is an individual's conscious awareness of their ability to perform a task, in this case foundation phase student teachers' conscious awareness of their ability to teach mathematics (Zulkosky, 2009).

Maddux (2000) takes on a different approach in defining self-efficacy compared to other researchers, as he builds on Bandura's definition by looking at opposing views of the theory, focusing on not only what it is but also what it is not. These views add insights and understandings which are useful for this research. He states that self-efficacy does not provide an explanation for events but rather suggests the beliefs about what an individual is capable of doing (Maddux, 2000). In other words, student teachers' mathematics self-efficacy beliefs are their thoughts and opinions towards their capability of teaching mathematics effectively (Wah, 2007). Self-efficacy beliefs are not outcome expectancies, or the notion that a specific behaviour leads to a specific result. It is the individual's belief that they have the ability to produce the desired outcome regardless of their own behaviour. Lastly, it is important to emphasise that self-efficacy is not a personality trait, as self-efficacy is measured as a belief about the ability to perform a task and not as a trait which defines who you are (Maddux, 2000). With the above definitions in mind, this research was done with the understanding that student teachers who have low self-efficacy beliefs about their ability to teach mathematics will not be defined as incapable teachers, but as persons who doubt their teaching ability and have the ability to change their self-efficacy beliefs.

2.2.1 Self-efficacy and its existence in the social cognitive theory

Self-efficacy is both the main theory and the concept of this research that exists in the broader theoretical framework of social cognitive theory. Many psychological theories have been advanced over the years in order to explain why people act in the way that they do (Bandura, 1977). Bandura's social cognitive theory is derived directly from his earlier theory, known as social learning theory, which suggests that people acquire new behaviours from observing others (Bandura, 1994). The social learning theory, consisting of five concepts, only developed into the social cognitive theory when the concept of self-efficacy was added as a sixth concept. Social cognitive theory emphasises the unique way in which people acquire or maintain behaviour, while taking into account the social environment in which they perform the behaviour. It also takes into account individuals' experiences. The social cognitive theory acknowledges that past experiences influence individuals' expectations and that these both shape the way in which they engage in a task, as well as the reasons they have for engaging (Bandura, 1994). In other words, student teachers' self-efficacy beliefs are influenced by their past experiences, such as teaching mathematics during their teaching practical, which may shape the way in which they approach teaching mathematics in the future (Redmon, 2007). As discussed in Section 1.2.3, foundation phase student teachers' self-efficacy beliefs may also be influenced by their background schooling experiences as it affects their motivation to pursue teaching, as well as their perception toward learning mathematics and teaching it. Section 2.4 below, provides more insight into how student teachers' past experiences in teaching mathematics influences their self-efficacy beliefs towards teaching it.

There are many psychologists who have contributed to the social learning theory and I acknowledge that Bandura is not the only psychologist who believes that learning takes place in social settings. Vygotsky and Lave's theories of learning relate strongly to Bandura's work, as they also emphasise the role of social learning. Vygostky's social learning theory also states that individuals' performance is affected by their interactions in their social environment. Lave's work on situated learning emphasises that learning occurs within an activity, context and culture, that is, in a social context (Daniels, 2005). Although Bandura's work is broadly located in the same understanding of how learning happens, Vygotsky's social learning theory and Lave's situated learning theory are not explicitly used in this research, as its main focus is

on self-efficacy only. For this reason, it is important to outline the broad theoretical context of Bandura's work, and I do so in the following definition of the social cognitive theory.

Social cognitive theory explains human functioning in terms of a "model of triadic reciprocity in which behaviour, cognitive and other personal factors, and environmental events all operate as interacting determinants of each other" (Bandura, 1989a, p. 1175). According to Richey, Klein and Tracey (2011), those factors all influence a person's perception of situations and their resultant actions. Each factor plays an important part in understanding an individual's behaviour and each provide useful insights for this research. The following discusses these three factors, that is, personal factors, behavioural factors and environmental factors.

Personal factors are internal events such as cognition, self-efficacy, motives and personality (Maddux, 2000). Cognition, motives and personality are factors that are not considered in this research, as self-efficacy beliefs are not defined by an individual's cognitive ability, motives or personality traits, as explained by Maddux (2000) in Section 2.2 and in Section 2.2.2 below.

Behavioural factors are those actions and reactions that an individual observes, for example, student teachers observing colleagues or mentor teacher's teaching mathematics (Bandura, 1986; Tschannen-Moran & McMaster, 2009). Their observed behaviour is a key aspect in this research, as are their accounts of the behaviours of others. The importance of observed behaviour is discussed in more detail in Section 2.4.2 below.

Environmental factors are the context of the social situation. According to Bandura (1994), the social environment is one of the most influential factors and in relation to this research it includes family, friends and colleagues, as well as the physical environments of the classroom and lecture room (Tschannen-Moran & Hoy, 2007; Tschannen-Moran & McMaster, 2009). Bandura (1994) also states that these factors influence the development of a person's self-regulatory system, which is further discussed below and in more detail in Section 2.3. Maddux (2000) argues that we respond cognitively, emotionally and behaviourally to social environments. With this understanding of the phenomena in mind, this research investigates how student teachers are influenced by their social and physical environment.

2.2.2 Self-efficacy and its related concepts

As mentioned above in Section 2.2.1, self-efficacy is a concept in social cognitive theory and many studies have stressed the importance of distinguishing self-efficacy from its related concepts (Gosselin & Maddux, 2003; Kulkosky, 2009). I acknowledge that slippage may occur throughout this chapter between related concepts such as self-esteem, self-regulation, motivation and confidence. The reason is that they intertwine with self-efficacy in many ways and may aid in identifying and understanding the student teachers' self-efficacy beliefs towards teaching mathematics. The participants may also show slippage and refer, for example, to *motivation* when describing their own self-efficacy beliefs. Teasing these terms apart therefore also helps the analysis of the data.

Self-esteem is a concept that is often mistakenly confused with *self-efficacy*. Self-esteem is not self-efficacy because self-esteem is the evaluation of and judgment on one's self-worth or self-value, whereas self-efficacy is concerned with one's judgments about one's capabilities of accomplishing a particular task or goal (Bandura, 1986; Bandura, 1997; Kulkosky, 2009). In essence, beliefs about one's capabilities are different from whether or not an individual likes or dislikes themselves (Bandura, 1997). Individuals may judge themselves as having high self-efficacy beliefs even though they might have a low self-esteem (Bandura, 1997). Bandura (1997) also stresses that one needs more than self-esteem alone to achieve a task: people need confidence in their efficacy in order to maintain the ongoing effort needed for success. The concepts of self-esteem and of perceived self-efficacy are used interchangeably even though they refer to completely different phenomena (Bandura, 1989b). Gosselin and Maddux (2003) agree with Bandura and believe that "self-efficacy beliefs in a given domain will contribute to self-esteem only in direct proportion to the importance of that domain" (p. 220). For example, student teachers' self-efficacy levels might be raised due to a successful teaching experience, which may boost their self-esteem when they teach mathematics (Redmon, 2007).

Many studies have also distinguished between *self-concept* and *self-efficacy*, which, like self-esteem and self-efficacy, represent different phenomena. Schunk (1991) for example, defines self-concept as an individual's perception, which is formed through experiences and interpretations within the environment and is highly influenced by the evaluations of others. This is not the case with self-efficacy which is an estimate of probable performance. Gosselin and Maddux (2003) argue that self-concept includes many beliefs about the self that are not

related to self-efficacy such as, beliefs about personality traits and assessments of physical characteristics. Pajares and Miller (1994) mention that the major difference between these two concepts is that self-efficacy is the judgments of one's capability to execute specific behaviours in specific situations, whereas self-concept is a broad and varied concept.

Self-efficacy can sometimes be confused with the concept of *self-regulation* because they intertwine in many ways but represent different phenomena. Self-regulation is a concept that is used in studies where identifying self-efficacy beliefs and its effects on academic achievement is the main focus, which is not the case for this research. Self-regulation refers to an individual's self-generated thoughts, feelings and actions that affect their learning. On the other hand, this research is done by identifying student teachers' perceived mathematics teaching abilities (self-efficacy beliefs) and not their achievement in mathematics courses at teacher training programmes. This explanation means that self-regulation is more of a strategy to achieve a goal, while self-efficacy is the individual's belief that they can succeed. However, these two concepts can be simultaneously developed (Schunk & Zimmerman, 2007). For example, student teachers with high self-efficacy beliefs towards teaching mathematics may believe that they can manage time effectively, organise work and set goals for themselves (Schunk & Usher, 2012). Self-regulation and its contribution to the development of self-efficacy beliefs will be used in this research and is discussed in more detail below in Section 2.3, as well as in Section 2.6.

Motivation and *self-efficacy* are also two separate concepts, in that self-efficacy is based on an individual's belief in their capacity to succeed, while motivation is based on the individual's desire to achieve. Motivation is a concept that often appears when investigating an individual's self-efficacy beliefs. The reason is that self-efficacy and motivation can intertwine closely in some circumstances, as mentioned briefly in Section 1.1.2. When an individual's self-efficacy beliefs increase through a successful experience, their motivation to continue succeeding may also increase. On the other hand, when an individual is highly motivated, for example to produce a successful mathematics lesson, they are more likely to achieve their goal which may contribute to their overall self-efficacy beliefs (Bandura, 1997). Bandura uses the term 'motivation' often in the context of teachers' self-efficacy, as it is a major influence on teacher self-efficacy beliefs, which is discussed in more detail in Section 2.3 below.

Competency is another related concept which differs from *self-efficacy*, as self-efficacy is an individual's perceptions about their ability to succeed in future tasks but not their immediate evaluations of their actual skill level (Olson (2014), as cited in Hoy & Spero, 2005). Self-efficacy beliefs are the beliefs about an individual's competence and an individual's ability to exercise these competencies in certain situations (Gosselin & Maddux, 2003). In other words, self-efficacy beliefs do not affect one's competency levels or vice versa.

Finally, another related concept that many theorists distinguish from *self-efficacy*, is that of *confidence*. Bandura (1997) defines confidence as "a nondescript term that refers to strength of belief but does not necessarily specify what the certainty is about" (p. 382). This means that self-efficacy is not the same as confidence but they do intertwine in many ways. For example, a positive experience in teaching mathematics may increase a foundation phase student teachers' self-efficacy beliefs towards teaching mathematics and in turn increase their confidence (Giles et al., 2016).

Self-efficacy beliefs is the main concept of self-efficacy and for this reason, it is discussed in detail in the section below. Literature refers to individuals' self-efficacy beliefs as high or low. The following section explains in detail what constitutes high self-efficacy beliefs, low self-efficacy beliefs, and their influences.

2.3 Self-Efficacy Beliefs and Their Influences

Because this research seeks to identify student teachers' self-efficacy beliefs, it is important to understand the difference between high and low self-efficacy beliefs and the influences of each on the individual. Once this understanding has been established, the factors that give rise to these self-efficacy beliefs will be discussed in Section 2.4 below.

Self-efficacy belief is a concept of the self-efficacy theory and is defined as "people's judgments of their capabilities to organize and execute courses of action required to attain designated types of performances" (Pajares, 1997, p. 39). In other words, they are the judgments individuals have in their ability to reach a goal in a particular area, for example, in their ability to teach mathematics effectively. Bandura (1997) states that people have an influence over what they do and that their "beliefs of personal efficacy constitute the key factors of human agency" (p. 3). This explanation means that an individual's self-efficacy beliefs impact on what they choose to pursue, how much effort they will expend on a task, how much time they will put into

overcoming obstacles and the amount of stress that they experience when faced with challenges (Bandura, 1997). In relation to foundation phase student teachers, their self-efficacy beliefs towards teaching mathematics may impact the effort and time they exert on a specific mathematic related task, such as planning mathematics lessons (McGuire, 2016). Bandura (1997) also argues that "self-efficacy beliefs operate as a key factor in a generative system of human competence" (p. 37). In other words, people with the similar skills, or the same person under different circumstances, may perform differently depending on their self-efficacy beliefs (Bandura, 1997). This research is done with the understanding that some student teachers might have acquired similar mathematical teaching skills, but perform differently depending on their self-efficacy beliefs towards teaching mathematics. Bandura (1989a) also highlights the fact that effective functioning requires both skills and high efficacy beliefs. This fact indicates that individual's self-efficacy beliefs are crucial determinants of how they function in their environments, as discussed in the above Section 1.2.1. Identifying these self-efficacy beliefs will provide insight into how student teachers function in a mathematics teaching environment (Pendergast, Garvis, & Keogh, 2011).

Self-efficacy beliefs are not only concerned with 'control over action' but also with self-regulation as mentioned above (Bandura, 1997). A study by Komarraju and Nadler (2013) indicates that individuals do not only observe others but also engage in self-observation that is, analysing and evaluating one's own behaviour, thoughts and emotions. This in turn sets the platform for self-regulation which is linked to performance. Student teachers who possess high levels of teaching mathematics self-efficacy are likely to work harder and use self-regulation processes such as setting goals, self-mentoring and self-evaluating more often (Komarraju & Nadler, 2013). Gosselin and Maddux (2003) further argue that self-efficacy beliefs can influence self-regulation in many ways, as mentioned above in Section 2.2.2., and identifying these ways provides insights into student teachers' self-efficacy beliefs towards teaching mathematics.

Self-efficacy beliefs influence self-regulation as they have been shown to influence the tasks that individuals choose, as well as their efforts toward setting goals. Self-efficacy beliefs may also influence their motivation, because motivation is not static and might change according to their levels of self-efficacy. For this reason, identifying student teachers' work ethic and perceptions toward their subject (in this case mathematics) may provide useful insights in terms

of their motivation and efficacy levels towards teaching mathematics (Gibbs, 2002). Pajares and Bandura, key theorists in the field, provide details on the differences between high and low self-efficacy beliefs and their influences (Pajares, 1997). Commonly, research focusing only on high or only on low self-efficacy beliefs tend to be quantitative, aimed at proving a hypothesis right or wrong. This research by contrast, is done by identifying student teachers' self-efficacy beliefs towards mathematics in a qualitative study, and so supply a more nuanced understanding of both.

With regard to personal agency, there is nothing more central than a person's belief about their capacity to take control over situations that impact their lives (Bandura, 1994). Bandura (1994) stresses that there are four psychological processes through which beliefs of self-efficacy influence or affect human functioning. Thus, these four psychological processes are also key to providing insights for this research. They are: cognitive processes, motivational processes, affective (emotional) processes and selection processes. The following discusses these four psychological processes, specifically in relation to student teachers.

Firstly, cognitive processes are self-efficacy beliefs that affect thought patterns and which may aid or hinder cognitive functioning (Bandura, 1989a). These cognitive effects "take on various forms and much human behaviour is regulated by forethought embodying cognized goals and personal goals setting is influenced by self-appraisal of capabilities" (Bandura, 1989a, p. 1175). In other words, the stronger the perceived self-efficacy belief, the bigger the goals individuals will set and the more committed they will be towards them. In relation to foundation phase student teachers, the higher their self-efficacy beliefs are towards teaching mathematics, the more goals they will set and the more dedicated they will be towards achieving those goals (Gibbs, 2002). Personal and cognitive goals are goals they set with regards to improving their mathematics and mathematics teaching skills and ability (Kinnunen, 2012). Thus, investigating the student teachers' commitment to improving their mathematics skills and mathematics teaching skills/ability, will aid in identifying their self-efficacy beliefs towards teaching it.

Pajares (1997) similarly states that self-efficacy beliefs of personal competence can determine how much effort an individual will exert on a cognitive task and also how long he/she will engage in it. Bandura (1994) further stresses that most courses of action are organised through thought and people's beliefs about their efficacy shape the 'anticipated scenarios they form'. This means that those who have high self-efficacy beliefs envision successful scenarios,

whereas those with low self-efficacy beliefs envision failure scenarios and think of many doubtful situations that could go wrong (Bandura, 1994). With regards to foundation phase student teachers, those who have high self-efficacy beliefs may be more likely to envision successful mathematics teaching lessons during their teaching practical.

On the other hand, those who have low self-efficacy beliefs may envision scenarios where they fail or achieve poorly during a mathematics lesson (Hendricks, 2016). Thus, this research is done with the understanding that student teachers who envision successful lessons will most likely have high self-efficacy beliefs and vice versa. Each individual has a different view on what constitutes a successful lesson. Thus, the success of a lesson varies greatly from person to person. The results of what determines a successful lesson for the participants are addressed in Chapter Four. It can be said that thought allows people to predict events and exercise control over the effects in their lives. Therefore, it takes a strong sense of self-efficacy beliefs to face and overcome challenging situations, failures and setbacks that have serious consequences (Bandura, 1994). Those who have high self-efficacy beliefs tend to be more persistent, work harder and manage their anxiety better (Komarraju & Nadler, 2013). In other words, the amount of effort foundation phase student teachers exert on mathematics teaching tasks may provide an understanding of their motivation and self-efficacy levels.

Individuals perform at a higher level because they can cope with cognitive demands, such as student teachers' mathematics ability and mathematics teaching ability (Komarraju & Nadler, 2013). On the other hand, individuals with high self-efficacy beliefs will often increase their efforts when confronting cognitive tasks that might result in failure (Pajares, 1997). With the above understanding in mind, this research acknowledges that student teachers with high self-efficacy beliefs will choose to teach mathematics in the classroom and may also choose to be critiqued on a mathematics lesson (Pajares, 1997). Bandura (1994) further adds that when individuals face difficult and challenging environments under harsh circumstances, those who are plagued by self-doubt end up lowering their aspirations and in turn their performance deteriorates. On the contrary, those with high self-efficacy beliefs, set challenging goals and make use of critical thinking which contribute to high performance. Additionally, Komarraju and Nadler (2013) suggest that student teachers who doubt their mathematics teaching ability may lower their determination to succeed and end up performing poorly under pressure. In conclusion, Bandura (1989b) states that high self-efficacy beliefs contribute to positive

wellbeing. The reason is that people are constantly faced with challenges and failures, therefore they must have a robust sense of self-efficacy in order to sustain the effort to succeed. Bandura stresses that self-doubt arises quickly after failures and the most important thing is to recover perceived efficacy after any challenges (Bandura, 1989a). This explanation presents another reason why it is important to identify student teachers' past experiences and whether these will affect their ability to teach mathematics in the future.

Secondly, a great part of motivation is cognitive: people motivate themselves and their actions through anticipatory thinking, which is the process of recognising and preparing for difficult challenges (Bandura, 1994). Motivational processes are the "self-efficacy beliefs of efficacy that play a key role in the self-regulation of motivation" (Bandura, 1994, p. 75). In other words, individuals form beliefs about what they are capable of doing and anticipate possible outcomes (Bandura, 1994). Student teachers may motivate themselves by understanding scenarios which may be difficult, such as misbehaving learners or challenging mathematical questions asked by their learners, and being prepared for it (Brady & Bowd, 2005). According to Bandura (1994), there are three different forms of cognitive motivators: how people explain the causes of events, their outcome expectancies and the achievement of their goals, in all three of which self-efficacy beliefs operate. The way individuals explain causes of events is influenced by self-efficacy beliefs, in that individuals with high self-efficacy beliefs blame their failures on the amount of effort they exerted in a task, whereas those who have low self-efficacy beliefs blame their failures on their inability to perform (Bandura, 1994). For example, student teachers with low self-efficacy beliefs may blame a poor mathematics lesson on their ability to teach the subject, rather than on the amount of effort they put into planning the lesson (McGuire, 2016). Thus, understanding how they explain their mathematics lesson, will provide insight into whether they have high or low self-efficacy beliefs towards teaching mathematics.

With regards to outcome expectancy theory, motivation is regulated by the idea that certain behaviours will provide certain outcomes. In other words, people act both on their beliefs about what they are capable of doing and on their beliefs about the possible outcome of their performance (Bandura, 1994). According to Pajares (1997), self-efficacy beliefs have an impact on motivation which influences the choices individuals make. Those who have low self-efficacy beliefs will most likely engage in tasks in which they feel confident and avoid those in which they do not. With regards to student teachers, those who have low self-efficacy beliefs

towards teaching mathematics, may choose to teach another subject instead or choose to be critiqued on another subject in which they feel more confident (Giles et al., 2016). In this case, they are also avoiding an opportunity for constructive feedback which could increase their sense of self-efficacy. For these reasons, this research identifies whether student teachers choose to teach mathematics instead of another subject.

Thirdly, affective processes are "people's beliefs in their coping capabilities which affect how much stress and depression they experience in threatening or taxing situations as well as their level of motivation" (Bandura, 1989a, p. 1177). Those who have low self-efficacy beliefs are usually unable to manage threats that they experience and are more prone to anxiety. They focus on their difficulties and see their environment as dangerous and unmanageable. They also magnify the potential threats of the situation and this impairs their ability to perform (Bandura, 1997). Because self-efficacy beliefs influence the amount of stress and anxiety an individual will experience when engaging in a task, it is important that this research is done by identifying stress and anxiety levels among student teachers when they teach, or think of teaching mathematics. The section below (2.5) goes into more detail about student teachers' mathematics anxiety and the influences it has on their self-efficacy beliefs towards teaching mathematics.

Lastly, selection processes are when "people exert some influence over their life course by their selection of environments and construction of environments" (Bandura, 1989a, p. 1178). In other words, self-efficacy beliefs can shape individuals' lives by influencing the activities or the environments they choose. People avoid activities or environments in which they believe they will not succeed. In other words, people with low self-efficacy beliefs seldom choose activities that will be challenging, whereas those who are highly efficacious will select activities in which they are challenged (Bandura, 1989a). This has serious implications in an environment in which so few student teachers choose to become mathematics teachers, and many foundation phase teachers choose to spend less time on mathematics than on other aspects of the curriculum (Gibbs, 2002). Any aspect that influences choices can affect one's personal development. The reason is that social influences in chosen environments continue to influence individuals' competencies and interests even after their efficacy beliefs have been established (Bandura, 1989a). An example is career choice and development, in which the higher the individual's self-efficacy beliefs, the wider their career options or choices will be.

In relation to this research, the student teachers' environment, such as the classroom or lecture room, may influence their self-efficacy beliefs towards teaching mathematics (Bekkdemir, 2010). I discuss Bekkdemir's (2010) factor of 'selection processes' in relation to student teachers in Section 2.6.

2.4 Sources of Self-Efficacy Beliefs

With the understanding of the difference between high and low self-efficacy beliefs and their influences outlined above, the following section discusses the factors that give rise to these self-efficacy beliefs which form a crucial part of this research. As mentioned in Section 2.3, self-efficacy beliefs are influenced by many factors. I do acknowledge that *culture* is an aspect that influences self-efficacy beliefs and does not only affect the information provided by the various sources of self-efficacy beliefs, but also "which information is selected and how it is weighted and integrated in people's self-efficacy judgments" (Bandura, 1997, p. 151). This research is not using the lens of culture, as it seeks to identify student teachers' self-efficacy beliefs towards teaching mathematics and not their individual cultural values on teaching or on mathematics, or the effect of culture on their beliefs.

Bandura (1994) argues that there are four main sources of self-efficacy that provide significant insights into the reasons for high and low self-efficacy beliefs (Bandura, 1994). This is the largest section of this chapter as these four sources of self-efficacy beliefs will be used to guide the current investigation through questions asked to participants in interviews and questionnaires, as well as in units of analysis to assess the data for similarities or contrasts. These four main sources are as follows:

- Mastery of experience;
- Vicarious experience;
- Social persuasion;
- Physiological indicators.

Research conducted by Oh (2010) added *personality characteristics* to the list, but this research will not incorporate this additional source because it is only relevant when comparing class management and learner's achievement in the classroom, as explained in Section 2.2.2.

Figure 2.1 presents Bandura's four sources of self-efficacy beliefs in a diagram.

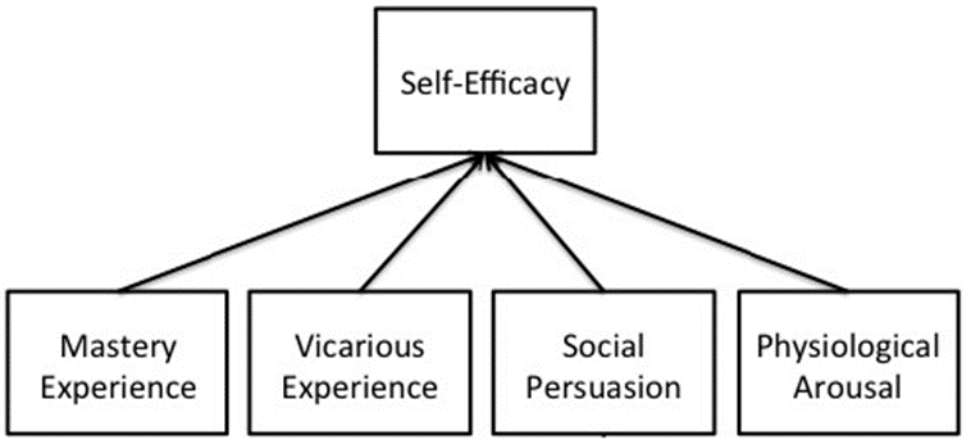

Figure 2.1: Bandura's model of the sources of self-efficacy (adapted from Olson, 2014, p. 5)

2.4.1 Mastery of experience

Mastery of experience is the most influential source of self-efficacy and one of the most effective ways to create a strong sense of self-efficacy (Bandura, 1994). The reason is that the most reliable source of efficacy is through accomplishments that we have experienced ourselves and of which there is often tangible evidence of success (Schunk & Usher, 2012). As mentioned above in Section 2.3, successful experiences will raise a person's self-efficacy beliefs, while failure will lower it, especially if the failures occur before a sense of self-efficacy is established (Usher & Pajares, 2009). I acknowledge that the student teachers may already have a sense of self-efficacy beliefs towards teaching mathematics as they are in their final year, however it could be subject to change depending on their experiences during their teaching practical. Hendricks (2016) adds, that a high sense of self-efficacy is built on past successes which can create the determination which is vital when facing setbacks.

In addition, individuals who usually experience only success, may easily be discouraged by failure which is unfamiliar to them. In other words, a strong sense of self-efficacy is built by experience in overcoming challenges (Bandura, 1994). Bandura (1994) also stresses that challenges, failure and setbacks teach individuals that success requires constant effort. Some

student teachers remain positive even after bad teaching experiences, and this cultivates high levels of self-efficacy (Usher & Pajares, 2009). It is therefore important to investigate if they were able to overcome setbacks and challenges when teaching mathematics during their teaching practical, as this provides insight into their self-efficacy beliefs.

Self-efficacy beliefs are also affected by the way in which an individual chooses to remember past experiences (Hendricks, 2016). In this case, student teachers who choose to only remember negative aspects of their mathematics teaching experiences, will most likely underestimate their performance capabilities. Bandura (1997) argues that building a resilient sense of self-efficacy through mastery of experiences is "not a matter of programming ready-made behaviour, it involves acquiring the cognitive, behavioural, and self-regularity tools for creating and executing effective courses of action to manage ever-changing life circumstances" (p. 80). In other words, through experiences one develops skills such as setting goals, as mentioned above with regards to self-regulation, and acquiring the behavioural skills that enable one to withstand setbacks and overcome any challenges that one might face. Gosselin and Maddux (2003) further believe that experiences are likely to be successful when both goals and strategies are specific. Hendricks (2016) focuses on the actual task that is being experienced and argues that accomplishment of a successful task that is less challenging, will not increase a person's sense of self-efficacy beliefs to the same extent as the accomplishment of a challenging task. An example would be student teachers who identify mathematics as a challenging subject to teach and who still opt to teach it during their practical, will most likely build a more resilient self-efficacy beliefs towards teaching mathematics (Hendricks, 2016).

One way to improve self-efficacy beliefs among student teachers that is realistic and achievable is through mastery of experience in terms of tutoring, observation and field experience/practical. The reason is that a teaching practical provides a real world experience (Fives et al. (2007), as cited in Oh, 2010; Knoblauch & Hoy, 2008). According to Charalambous, Philippou and Kyriakides (2008), "previous research confirms that mastery of experience of science and mathematics teaching is an important source of self-efficacy for the beginning teachers" (p. 27; Mulholland & Wallace, 2001). Redmon (2007) further adds that meaningful teaching experience is essential, and Hoy and Spero (2005) conclude that through exposure, teachers become more confident of their ability to manage classrooms: the more mastery experiences they have, the better they judge their capabilities to be. It is important to

note that student teachers' self-efficacy beliefs increase as they progress through the teaching programme at university because of the successful opportunities to teach real learners in the classroom (Oh, 2010). In other words, meaningful field experience is vital in building the foundation phase student teachers' self-efficacy beliefs.

Teaching experiences in field environments may build their self-efficacy beliefs along with skills and knowledge. The earlier student teachers experience success in teaching, the more resilient their sense of self-efficacy will be (Redmon, 2007). This highlights the importance of identifying student teachers' self-efficacy beliefs, especially towards teaching mathematics, as their teaching practice experiences will significantly influence their future teacher self-efficacy. For this reason, this research investigates their experiences when teaching mathematics during their teaching practical and how that has affected their self-efficacy beliefs.

2.4.2 Vicarious experience of others

The second main source of creating a strong sense of self-efficacy is through the vicarious experiences of others. Individuals do not rely only on their own experiences as the sole source of self-efficacy, but they also experience success or failure vicariously through others. Bandura (1994) emphasises that when people with similar experiences, such as teaching mathematics, succeed in a task or overcome a challenge, it gives others the belief that they too can achieve or overcome similar challenges. Seeing others perform successfully in threatening activities "can generate expectations in observers that they too will improve if they intensify and persist in their efforts" (Bandura, 1978, p. 145). In other words, individuals can persuade themselves that if others can do it, then they can also. Tschannen-Moran and McMaster (2009) relate the vicarious experiences of others to student teachers and argue that when a student teacher observes a successful mathematics lesson, they are more likely to see the teaching practical as something they too can manage.

On the other hand, when a student teacher observes an individual, for example a colleague or a mentor teacher, fail despite their efforts, they may judge the task as being unmanageable for them also. Thus, identifying their interpretation of their colleagues' experiences and how it influenced their perception of teaching mathematics, will provide insight into their self-efficacy beliefs (Bandura, 1978).

It has been identified that individuals always seek to observe someone who demonstrates competence no matter what the challenge is (Tschannen-Moran & McMaster, 2009). The reason is that competent models transmit knowledge, skills and strategies for managing tasks through the way that they behave and in turn reveal their thinking about the task (Tschannen-Moran & McMaster, 2009). Pajares (2003) adds that a person's experience involves making social comparisons with others and these comparisons, along with peer modelling, may influence their perceptions about their competence. Tschannen-Moran and Hoy (2007) argue that the "impact of the modelled performance on the observer's efficacy beliefs depends on the degree to which the observer identifies with the model" (p. 84). In other words, the individual must be able to identify themselves with the person that they are observing or modelling, through aspects such as similarities in experience or training (Tschannen-Moran & Hoy, 2007). In relation to this research, student teachers will most likely model themselves on colleagues who have gone through similar experiences, for example teaching Grade 2 learners mathematics during teaching practice at the same school. Tschannen-Moran and Hoy (2007) further state that when student teachers closely identify themselves with the person that they are observing, their self-efficacy beliefs towards teaching mathematics will increase.

On the other hand, if student teachers do not identify themselves with the person that they are observing (their model), then their self-efficacy beliefs may not be enhanced (Pajares, 2003). This research identifies whether they can identify themselves with the person who they choose to observe and model, as this will influence their self-efficacy beliefs towards teaching mathematics. Bandura (1997) stresses that modelling someone with clear outcomes is more likely to increase one's self-efficacy beliefs than of those who model behaviour that is ambiguous. Thus, modelling oneself on individuals who are successful does increase one's self-efficacy beliefs (Pajares, 2003). It is also important to investigate the reasons why student teachers choose a particular person as a model.

The attitude of the person who an individual chooses to model can affect their persistence, for example, a foundation phase student teacher who is observing or modelling someone who is optimistic, is more likely to persist in the completion of the task than those who observe a pessimistic model (Hendricks, 2016). Bandura (1977) stresses that there are many situations that influence self-efficacy beliefs with regards to the vicarious experiences of others. The most prominent factor is the uncertainty in one's capability. An individual's self-efficacy beliefs can

easily be changed when they have little prior experience on which they can judge their personal competence. In other words, individuals who lack knowledge of their own capabilities will rely more on modelling their colleagues (Hendricks, 2016). With regards to this research, BEd foundation phase fourth year student teachers have all acquired the same amount of teaching experience during their teaching practical. Therefore, the above explanation will not be taken into account in this research. Their teaching practice requirements are discussed in more detail in Section 3.3.1. Bandura (1978) believes that if modelling ensures coping strategies, individuals' self-efficacy beliefs will increase even though they have undergone experiences that contributed to low self-efficacy beliefs. It is argued that without effort and persistence in one's own activities, there will be no improvement. In other words, viewing others' experiences are not enough. One must put effort into the activity or task in order to succeed (Hendricks, 2016). This research understands that both the vicarious experience of others and student teachers' persistence to achieve the task is important. For this reason, this research investigates whether the experiences and interactions of the student teachers, lecturers or colleagues influenced their self-efficacy beliefs and if so, how.

2.4.3 Social persuasion

Social persuasion is the third way of strengthening one's self-efficacy beliefs. Through the suggestions of others, individuals are led to believe that they too can be successful at tasks or activities that were challenging in the past. The self-efficacy beliefs that arise from social persuasion are not regarded as weaker than those that arise from one's own accomplishments and persistence (Bandura, 1978). Bandura (1997) stresses that verbal encouragement is not enough: one must have the necessary skills to pursue the challenging task. Thus, "efficacy beliefs are best instilled by presenting the pursuit as relying on acquirable skills, structuring activities in masterable steps that ensure a high level of initial success, and providing explicit feedback to continued progress" (Bandura, 1997, p. 105). In other words, verbal persuasion serves best as a tool for self-development. Bandura (1997) states that self-efficacy beliefs shape a person's life and therefore verbal persuasion is more than just a 'pep talk' as mentioned above. It plays an important role in instilling self-efficacy beliefs that in turn influence the direction that one's life takes. According to Tschannen-Moran and McMaster (2009), effective verbal encouragement of student teachers is important in getting them to exert themselves towards realistic goals, which in turn are aimed at strengthening their teaching skills. An

example of effective verbal encouragement is positive feedback from a mentor teacher surrounding a mathematics lesson, where the student teacher is encouraged to build on their mathematics teaching skills. Bandura (1978) highlights the importance of social persuasion further when he stresses that "in the face of distressing threats and a long history of failure in coping with them, whatever mastery expectations are induced by suggestion can be readily extinguished by disconfirming experiences" (p. 145). In addition, Tschannen-Moran and Hoy (2007) identify the sources of verbal encouragement as administrators, colleagues, parents and their community, in this case the BEd foundation phase community in the Education Department at Rhodes University. These sources of encouragement may all motivate them in achieving more goals and make them feel more confident (Bandura, 1994).

Tschannen-Moran and Hoy (2007) argue an opposing view and stress that student teachers as well as in-service teachers do not rely heavily on administrative support. With this understanding of sources of verbal encouragement, this research is done with the awareness that student teachers receive vicarious experiences from colleagues, families, mentor teachers and lecturers. Kinnunen (2012) adds that the effectiveness of the verbal encouragement depends strongly on the relationship that the persuader has with the receiver, as well as on the situation. For example, student teachers who receive verbal persuasion from colleagues who taught a similar mathematics lesson, will have greater impact on their self-efficacy beliefs than those who taught an unrelated lesson.

The degree of verbal persuasion also depends on the credibility, trustworthiness and expertise of the persuader (Poulou, 2007). It is important to note that those who receive the kind of verbal encouragement that instils unrealistic beliefs about their own competence, will only summon failure that will impact the persuader's performance and in turn bring down their perceived self-efficacy beliefs (Bandura, 1989b). Hendricks (2016) adds that verbal persuasion consisting of superficial praises may be detrimental to student teachers' intrinsic motivation and performance progress. He concludes that verbal encouragement can be meaningful if it is balanced, specific and genuine and if the performances themselves are praiseworthy (Hendricks, 2016). In order to gain insight into this aspect, the credibility of the verbal persuasion that student teachers receive will be investigated.

The support that foundation phase student teachers receive from their community and colleagues provides information of the differences between their self-efficacy beliefs

(Hendricks, 2016). Oh (2010) argues that those who have lower levels of self-efficacy beliefs may rely more heavily on their colleagues. In relation to this research, student teachers who receive only verbal support may have low levels of self-efficacy beliefs towards teaching mathematics. Investigating the extent to which they receive verbal support provides more insight into whether they have low or high self-efficacy beliefs. According to Bandura (1997), those who are persuaded that they can succeed are likely to partake in more challenging tasks because successful performances raise a person's beliefs about their competence. Student teachers who are persuaded that they can teach mathematics effectively, are more likely to teach challenging mathematical concepts.

Additionally, verbal persuasion is also effective as it contributes to self-change (Poulou, 2007). According to Redmon (2007), without social support, new teachers enter the profession believing that they do not have the ability to teach some learners and that the efforts they make are ineffective. This indicates the importance of identifying student teachers' social persuasion before they become in-service teachers. According to Bandura (1978), those who receive additional verbal support and who are socially persuaded that they can achieve and master their experiences, are more likely to exert greater effort than those who only receive performance aids. In other words, student teachers who are socially persuaded that they can succeed in mastering an experience, such as teaching mathematics, will most possibly put more effort into their mathematics lesson plans, than someone who did not receive adequate feedback regarding their mathematics lesson (Bandura, 1978).

Individuals who put greater effort into tasks due to verbal persuasion may have better success rates (Kinnunen, 2012). This ultimately raises their self-efficacy beliefs. Thus, it is important that this research investigates the degree to which student teachers utilise the social persuasion that they receive for more accurate results. Those who receive verbal support are also more likely to sustain effort during challenging tasks than those who possess high levels of self-doubt and who focus on personal deficiencies during difficult tasks (Bandura, 1989a). In other words, verbal encouragement boosts self-efficacy beliefs and has a greater impact on those who believe that they can succeed and complete a task. In addition, people interpret stress and anxiety, as well as mood, as a sign that they may perform poorly (Bandura, 1994). This research is done by identifying student teachers' stress levels and moods towards mathematics and the

teaching of it, and how this affects their self-efficacy beliefs, which is discussed below in the last factor that influences self-efficacy beliefs.

2.4.4 Physiological indicators

The fourth way of ensuring a strong self-efficacy is by controlling physiological indicators such as the health and well-being of an individual (Bandura, 1994). "When judging their own capabilities, people rely partly on information conveyed by physiological and emotional states" (Tschannen-Moran & McMaster, 2009, p. 23). The participants did not really refer to physiological indicators as much when discussing their self-efficacy beliefs towards teaching mathematics. For this reason, the following section discusses physiological indicators briefly. Poulou (2007) stresses that physiological states are not predictors of personal efficacy but rather that they affect efficacy beliefs. In other words, an individual's level of arousal, whether it is positive as in anticipation or negative as in anxiety, can influence their self-efficacy beliefs. Arousal such as trembling hands or increased heart rate are perceived as a response to a challenge or threat (Tschannen-Moran & McMaster, 2009). According to Kinnunen (2012), physiologically strong arousal to anxiety or fear may contribute to an individual predicating failure, whereas a calm and relaxed state of mind may contribute to them expecting a positive outcome. For example, a student teacher preparing to teach a mathematics lesson for a practical examination may feel a certain level of anxiety but if the state of the arousal is strong, it could build up to a feeling of insecurity and low self-efficacy beliefs (Kinnunen, 2012). Thus, it is important that student teachers' level of physiological arousal is investigated in order to identify their level of self-efficacy beliefs towards teaching mathematics.

Stressful situations may also stimulate emotional arousal which may provide information with regards to one's performance. Individuals judge their physiological arousal in stressful situations as a sign of vulnerability (Bandura, 1997). Bandura (1997) argues that people differ in terms of their judgments of their emotional states and this research is done with an understanding of this, but focuses on all BEd foundation phase fourth year students teachers' self-efficacy beliefs towards teaching mathematics, as mentioned in Section 1.4. Stressful situations might also have a negative effect on the individuals' personal competency and they may judge their confidence by the emotional state that they are experiencing. Typical physical indicators of fear, such as sweating palms or breathlessness, may affect self-efficacy beliefs and fear-provoking thoughts can lead to elevated levels of distress (Bandura, 1978; Pajares,

1997). In other words, high emotional arousal negatively affects performance and those that overcome their fear provoking thoughts, will most likely succeed (Pajares, 1997). Bandura (1978) also mentions that "avoidance of stressful activities impedes development of coping skills, and the resulting lack of competency provides a realistic basis of fear" (p. 146). With regards to teachers, feelings such as anxiety, stress and depression may have a negative effect on their self-efficacy beliefs and in turn create a feeling that they are incapable of making a difference in a threatening or challenging situation (Hoy & Spero, 2005). This indicates the importance in investigating student teachers' feelings towards teaching mathematics, as it will provide insight into their levels of self-efficacy beliefs towards teaching it.

Bandura (1997) stresses that "environmental factors exert strong influence on how an internal state is interpreted" (p. 107). In other words, the impact that the psychological arousal has on one's self-efficacy beliefs depends on situational factors, for example, a certain environment might make the individual feel uncomfortable and create feelings of nervousness and anxiety which may impact their self-efficacy beliefs towards completing that particular task. In relation to teachers, the environment of a particular classroom may create feelings of distress and uneasiness (Gosselin & Maddux, 2003). It is said that mastery of experiences and modelling approaches diminish anxiety arousal and teaches individuals necessary coping skills by demonstrating effective ways of handling such threatening situations (Bandura, 1997).

When an individual enters a new situation, prior knowledge on their self-efficacy beliefs towards their capabilities, whether it is high or low efficacy beliefs, may impact their physiological state (Bandura, 1978). It is important to note that all student teachers at this point would have already taught mathematics, which is discussed in more detail in Section 3.3.1, and therefore no one would be entering an unfamiliar situation. A bad experience in the past that results in low levels of self-efficacy beliefs may cause an individual to experience high levels of anxiety and distress when entering a new or similar situation (Gosselin & Maddux, 2003). Tschannen-Moran and McMaster (2009) argue that teaching practical experiences may cause nervous anticipation for student teachers, especially when they are being critiqued or examined. Bandura (1978) also stresses that mood plays an important role in one's psychological arousal. The reason is that mood can affect how past events are interpreted, for example, negative moods may activate thoughts of past failures (Bandura, 1978).

It is important to note that the participants may experience mathematics anxiety towards mathematics and teaching mathematics. As discussed in Section 1.3, this research focuses solely on BEd student teachers' self-efficacy beliefs towards teaching mathematics. For this reason, the following section discusses mathematics anxiety, especially in relation to foundation phase student teachers.

2.5 Mathematics Anxiety

According to Jackson (2008), some student teachers choose to teach foundation phase learners, assuming that subjects are easier at that level. However, they fail to realise that in order to teach mathematics at any level, a deep understanding of it is needed (Jackson, 2008). According to Hadley and Dorward (2011), foundation phase teachers may feel the greatest challenge to their concept of self-efficacy when they come to prepare and teach mathematics. Many studies have revealed that foundation phase student teachers have one of the highest levels of mathematics teaching anxiety, as mentioned in the Abstract, and have concluded that student teachers who have mathematics anxiety also have lower levels of mathematics teaching self-efficacy beliefs (Hadley & Dorward, 2011). For these reasons, mathematics anxiety, specifically mathematics teaching anxiety, is discussed below as it provides insight into student teachers' self-efficacy beliefs towards teaching mathematics. Studies focusing on mathematics teaching anxiety tend to investigate ways to improve mathematics anxiety among student teachers, as well as the negative effects mathematics teaching anxiety has on the learners they teach (Jaggernauth & Jameson-Charles, 2010). Because this research seeks to identify student teachers' self-efficacy beliefs towards teaching mathematics, the following section discusses mathematics anxiety, mathematics teaching anxiety and their impact on student teacher's self-efficacy beliefs towards teaching mathematics.

2.5.1 Mathematics anxiety

In order to understand mathematics anxiety, the general definition of anxiety must be explained, as it is a complex emotional response which has been defined in many ways. Kellerman and Burry (1997) define anxiety as "behavioral, psychological, affective, physiological and cognitive aspects that impede an individual's ability to constructively manage challenges, problems and opportunities" (as quoted in Jaggernauth & Jameson-Charles, 2010, p. 5). Anxiety is frequently confused with fear which is an immediate response

to a stimulus or a threat, whereas anxiety is a response to an anticipated stimulus or threat. When an individual faces a scenario in which they feel threatened, feelings such as agitation, sweating and tension will arise (Jaggernauth & Jameson-Charles, 2010).

There are many forms of anxiety but this research focuses on mathematics anxiety only. Anxiety can be classified into two components namely, trait anxiety which is relative to an individual's differences in anxiety-proneness and state anxiety which is an emotional reaction to a threatening situation (Jaggernauth & Jameson-Charles, 2010). Mathematics anxiety is classified as state anxiety because it manifests in threatening situations and prior experiences are one of the largest onsets of mathematics anxiety (Brady & Bowd, 2005). According to Brady and Bowd (2005), mathematics anxiety and its impact on student teachers' confidence in their mathematics teaching ability, is related to their past experiences in teaching mathematics to foundation school learners. This relates to Bandura's (1997) argument, as mentioned in the above section (2.4), that past experiences play an influential role on teachers' self-efficacy beliefs. Bekkdemir (2010) explains further that prior experiences such as troublesome mathematics classrooms or mathematics teaching experiences that occurred during their youth, have a direct influence on mathematics anxiety among teachers.

Feelings towards mathematics may be influenced by people's attitudes rather than their cognitive skill (Jackson, 2008). Thus, mathematics anxiety affects an individual's self-efficacy beliefs as attitudes play a major role in the way people feel about their capabilities towards a specific task. Mathematics anxiety is associated with emotional factors such as anger, panic, bewilderment, frustration and dislike (Jackson, 2008). As seen in Figure 2.2, mathematics anxiety is identified as a source of negative physiological arousal that influences teachers' self-efficacy beliefs, in this case their self-efficacy beliefs towards teaching mathematics (Bandura, 1989a; Olson, 2014). Swars, Daane and Giesen (2006) argue that mathematics anxiety is more than just a dislike of mathematics, it is a feeling of discomfort individuals have when required to perform mathematically. Individuals who suffer from mathematics anxiety often have the mentality of being 'no good' at mathematics and possess beliefs that a 'mathematical mind' is needed (Jackson, 2008). In relation to this research, it is important to note and be aware of student teachers' feelings towards mathematics because any negative feelings towards their capabilities affect their self-efficacy beliefs.

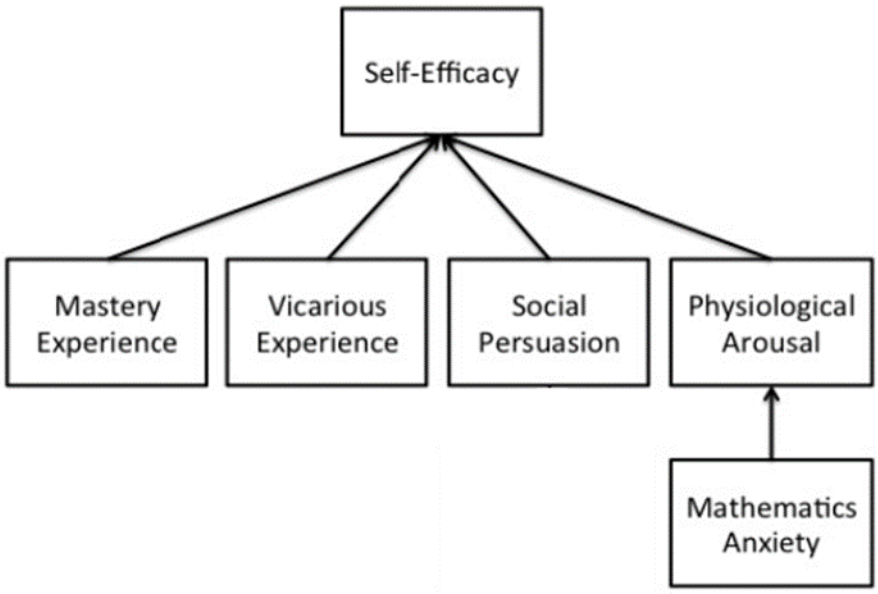

Figure 2.2: Mathematics anxiety as a contributor to physiological arousal pathway in the development of self-efficacy (Adapted from Olson, 2014, p. 6)

According to Bekkdemir (2010), mathematics anxiety is categorised into three factors which provide vital insight into student teachers' self-efficacy beliefs towards mathematics. The first factor is the environment, which includes negative classroom experience, insensitive teachers and non-supportive classroom environment (Bekkdemir, 2010). With regards to this research, environmental factors include the classroom in which student teachers teach mathematics during their teaching practical and the lecture room where they are taught mathematical teaching methods. Secondly, intellectual factors, which consist of poor results in the past, negative attitudes towards mathematics, low persistence in improving mathematics knowledge and teaching methods and self-doubt and lack of confidence in their mathematics ability and in their mathematics teaching ability (Bekkdemir, 2010). This research is done with the understanding that intellectual factors influence student teachers' self-efficacy beliefs towards teaching mathematics. Lastly, there are personality factors which include shyness and gender bias, however, these personality factors will not be used in this research to identify student teachers' self-efficacy beliefs (Bekkdemir, 2010).

2.5.2 Mathematics teaching anxiety

Mathematics teaching anxiety is the anxiety that teachers' experience when preparing lessons and teaching mathematical concepts and theories (Jaggernauth & Jameson-Charles, 2010). Gresham (2008) argues for the relationship between mathematics anxiety and mathematics teaching self-efficacy beliefs, stating that teachers who have high self-efficacy beliefs have lower mathematics anxiety levels and on the other hand, those who have low self-efficacy beliefs have high mathematics anxiety levels. Teacher mathematics anxiety includes tension, nervousness, difficulty in concentrating, extreme agitation at learners and negative self-talk which affects their self-confidence (Jaggernauth & Jameson-Charles, 2010). A recent study done by Ramirez, Hooper, Kersting, Ferguson and Yeager (2018) similarly adds that teachers who have high levels of mathematics anxiety doubt their skills and ability to teach mathematics effectively. Student teachers who have high mathematics anxiety may have less confidence in their abilities to teach mathematics than those who identify themselves with having low mathematics anxiety (Ramirez et al., 2018). This indicates another reason why mathematics anxiety contributes to this research, as it affects teachers' self-confidence which not only influences their self-efficacy beliefs but also their motivation (Ramirez et al., 2018). Thus, this research acknowledges the importance of identifying whether student teachers have mathematics anxiety as it is a contributing source of low-self-efficacy beliefs.

Mathematics anxiety has many effects on student teachers and it is stressed that in foundation phase classrooms, mathematics anxious teachers believe that there is more leeway in avoiding certain subjects (Sloan, 2010). This means that mathematics anxious student teachers spend more time teaching other subjects and avoid teaching mathematics (Sloan, 2010). According to Ramirez et al. (2018), mathematics anxious student teachers engage in classroom tasks and behaviours that emphasise memorisation which aligns with a fixed-mindset, where they believe that they either have the ability to do mathematics or they do not. It is important that this research investigates whether the student teachers teach mathematics often during their teaching practical and whether they feel comfortable using creative teaching methods. This will provide a clear understanding of their overall confidence in teaching mathematics.

The section below focuses on teacher self-efficacy in more detail, concentrating on mathematics teaching efficacy.

2.6 Teacher Self-Efficacy

Research in education has adopted Bandura's self-efficacy theory, outlined in detail above, in order to improve teacher education (Olson, 2014). Since the self-efficacy theory was introduced in 1980s, researchers have been investigating teachers' self-efficacy beliefs and their effects on learner outcome, teacher classroom management, teacher's willingness to create and use a variety of materials and their enthusiasm for teaching (Woolfolk & Hoy, 1990; Wah, 2007). This chapter so far has drawn on Bandura's work on self-efficacy theory in order to understand teachers' self-efficacy beliefs. The following section is based on recent research and their findings which provides more insights into this research.

It has been identified that most research on teacher efficacy tends to link teacher efficacy to learner's achievement. However, this research is taking a different approach and is looking at identifying student teachers' self-efficacy beliefs towards teaching mathematics and not the effects it has on the learner's achievement (Olson, 2014). According to Woodcock, Hemmings and Kay (2012), teachers form beliefs about teaching prior to training to become a teacher. The reason is that people form beliefs throughout their schooling and from these experiences they have made decisions as to what classifies as a 'good' or a 'bad' teacher (Pajares, 1992; Wah, 2007; Woodcock et al., 2012). Student teachers' self-efficacy beliefs towards teaching are most likely to change during the teaching training courses and field experiences as mentioned above, which indicates that these training years have the greatest impact on their self-efficacy beliefs (Wah, 2007; Woodcock et al., 2012). This supports Bandura's argument that self-efficacy is more likely to change in early learning, thus the first years of training could be critical to the long-term development of teacher efficacy (Hoy & Spero, 2005). For this reason, the design of this research identified fourth year student teachers' self-efficacy beliefs and by the end of this year, they may have developed teacher self-efficacy beliefs towards mathematics, or not.

Teacher self-efficacy, as opposed to general self-efficacy, is context-specific and it is defined as teacher's thoughts, feelings and opinions towards their teaching capabilities (Ederm & Demirel, 2007; Aðalsteinsson, Frímannsdóttir, & Konráðsson, 2014). Thus, teachers make efficacy judgments by assessing their teaching tasks and personal teaching competence in a specific teaching context (Wah, 2007). In relation to this research, identifying how student teachers' judge their mathematics teaching ability will provide insight into their self-efficacy beliefs towards teaching it. Research done by Pendergast et al. (2011) focuses on the

importance and influences that the context and the content of mathematics has on teacher's self-efficacy beliefs. Pendergast et al. (2011) "emphasise the importance of cognitive processing in the formation of efficacy expectations" (p. 20). In other words, their evaluation of the task depends on the context of the teaching situation/environment and the content of the lesson they are teaching. In relation to this research, it is the mathematics classroom and the mathematics content that is being examined for its effect on the student teachers' self-efficacy beliefs.

Teacher self-efficacy is the teacher's beliefs in how well they can manage their teaching practical as well as understanding their knowledge on the subject content (Kinnunen, 2012). This means that teachers with high self-efficacy beliefs towards teaching mathematics are ultimately more confident as teachers; they perceive themselves as good teachers and are more effective in the classroom. Kinnunen (2012) also mentions that high teacher self-efficacy beliefs result in a positive expectation of one's career, as mentioned in Section 2.3. Such student teachers are more likely to pursue teaching as a career once they finish training and are also more likely to be satisfied with their choice.

On the other hand, student teachers with low self-efficacy beliefs are likely to be less confident, feel less successful in their career and have negative expectations about their career options (McGuire, 2016). In other words, student teachers who have high mathematics teaching self-efficacy beliefs are confident in their ability to teach mathematics effectively and are more likely to be satisfied in being a mathematics teacher. McGuire (2016) adds that teacher self-efficacy is the best indicator as to whether or not a teacher will stay in the profession. With the above understanding of how self-efficacy beliefs influence student teachers' career choices, identifying whether they are satisfied with their career choices to be foundation phase teachers will provide insight into their self-efficacy beliefs towards teaching overall. Wah (2007) argues that "the beliefs that teachers create and develop and hold to be true about themselves will influence their perceptions and judgments, which are vital forces in affecting their behaviour in the classroom" (p. 17). Wah's (2007) argument indicates the importance of identifying a teachers' self-efficacy beliefs early on, as it is a powerful construct that ultimately affects their teaching behaviour as well as their learner's success. Thus, the purpose of this research is to make BEd foundation phase fourth year student teachers aware of their self-efficacy beliefs

towards teaching mathematics before they become professional teachers, as mentioned in Section 1.3.

The combination of motivation and performance are significant reinforcers for teaching behaviours. Teachers with a strong sense of self-efficacy also believe that they have control, as well as influence, over learner's achievement and motivation (Aðalsteinsson et al., 2014). Teacher self-efficacy is also a situation-specific expectation that teachers can help learners learn (Cantrell (2003), as cited in Olson, 2014). Bandura (1997) stresses that learners perform better in classrooms where the teacher has high self-efficacy beliefs, because these teachers are effective at solving problems in the classroom and are confident in their teaching methods. On the other hand, teachers with low self-efficacy beliefs may have little motivation to understand the concepts they teach, in this case mathematics (Pendergast et al., 2011). This means that student teachers who have low self-efficacy beliefs towards teaching mathematics will most likely avoid putting in effort to improve their knowledge on mathematical concepts as well as in improving their content knowledge on mathematics. As discussed in Section 1.1.3.3, the content knowledge that this research refers to is common content knowledge, which is the student teachers' ability to calculate simple equations as well as solve mathematical problems (Ball et al., 2008). Identifying the amount of effort student teachers exert in improving their mathematics knowledge will provide insight into their self-efficacy beliefs towards teaching mathematics. Teachers with low self-efficacy also tend to avoid problems, only focus on their personal problems and dismiss learners with difficulties (Aðalsteinsson et al., 2014). Thus, this research investigates student teachers' confidence in their ability to answer mathematics questions in the classroom, as well as their confidence in teaching pupils with mathematical difficulties.

The key attributes of effective teachers such as survival, reliance, persistence, and innovativeness are governed by teachers' beliefs about their capability (Gibbs, 2002). Thus, effective teachers have the ability to exercise self-efficacy as well as exercise thought control over their actions (Gibbs, 2002). It is important for student teachers to exercise control over threatening situations, as it is important for regulating anxiety and stress. Knowing how to do something and being able to do it, does not mean that someone will do it. Self-efficacy mediates between knowing and being able to demonstrate mathematics teaching skills. Teachers who believe in their capability are effective teachers, and hold strong self-efficacy beliefs such as

persistence in failed situations and use new teaching methods and styles. On the other hand, student teachers with low self-efficacy beliefs are more likely to spend less time on instruction (Gibbs, 2002). Gibbs (2002) also adds that goal setting increases when a teacher is confident and motivated. This research explores student teachers' use of creative teaching methods and their persistence through challenging mathematics teaching experiences which will provide insight into their self-efficacy beliefs towards teaching mathematics.

With regards to mathematics teaching, the focus of this research, efficacy is the "belief or perception of an individual in their abilities to teach mathematics successfully" (Zuya, Kwalat & Attah, 2016). According to McGuire (2016), self-efficacy for teaching is not likely to be the same across multiple subjects. In other words, a teacher who has high self-efficacy beliefs towards teaching mathematics might not have the same efficacy beliefs for languages. In relation to student teachers, those who show dissatisfaction towards mathematics are more likely to avoid planning or even teaching the subject (Trice & Ogden, 1986; Giles et al., 2016). On the other hand, teachers with high teaching mathematics efficacy are more likely to engage in answering learner's inquiries and adopt a student-centered teaching approach (Giles et al., 2016). Identifying student teachers' satisfaction with teaching mathematics instead of other subjects is necessary when identifying their self-efficacy beliefs towards teaching mathematics. Giles et al. (2016) adds to this and stresses that those who have high self-efficacy engage in constructive learning activities during their mathematics courses.

The use of effective instructional practices is linked to teacher efficacy and it is argued that teachers with high self-efficacy beliefs towards teaching mathematics are more effective mathematics teachers than those with low self-efficacy beliefs (Giles et al., 2016). Therefore, student teachers who have confidence in their ability to teach mathematics provide a greater academic focus in the classroom, they assist learners who struggle and engage with staff development programmes (Giles et al., 2016). According to McGuire (2016), enjoyment in mathematics may lead to higher perceived ability to teach it and this higher perceived ability to do mathematics can also lead to higher self-efficacy beliefs towards teaching it. Identifying student teachers' enjoyment towards teaching mathematics, will provide insight into their self-efficacy beliefs towards mathematics. This all indicates the importance of this research in identifying student teachers' self-efficacy beliefs towards teaching mathematics.

2.7 Conclusion

Self-efficacy beliefs have long been associated with the work of psychologist, Albert Bandura. In reality, self-efficacy beliefs are far more "influential than knowledge in determining how individuals organise and define tasks and problems, and are stronger predictors of behaviors" (Giles et al. (2016), as cited in Pajares, 2003, p. 12). Recently, this psychological theory has been used in educational research to identify teacher self-efficacy beliefs and its impact on learner achievement. The self-efficacy theory has contributed to improving teacher training programmes and learner outcomes. During teaching training programmes, student teachers develop their teacher self-efficacy, which indicates that this is a crucial time for the development of self-efficacy beliefs (Oh, 2010). This indicates the importance of this research in identifying student teachers' self-efficacy beliefs towards teaching mathematics before they enter the profession. Bandura's four sources of self-efficacy is used in this research to identify the factors that give rise to student teachers' self-efficacy beliefs towards teaching mathematics. Figure 2.3 provides a summary of the sources of self-efficacy and the mode of induction.

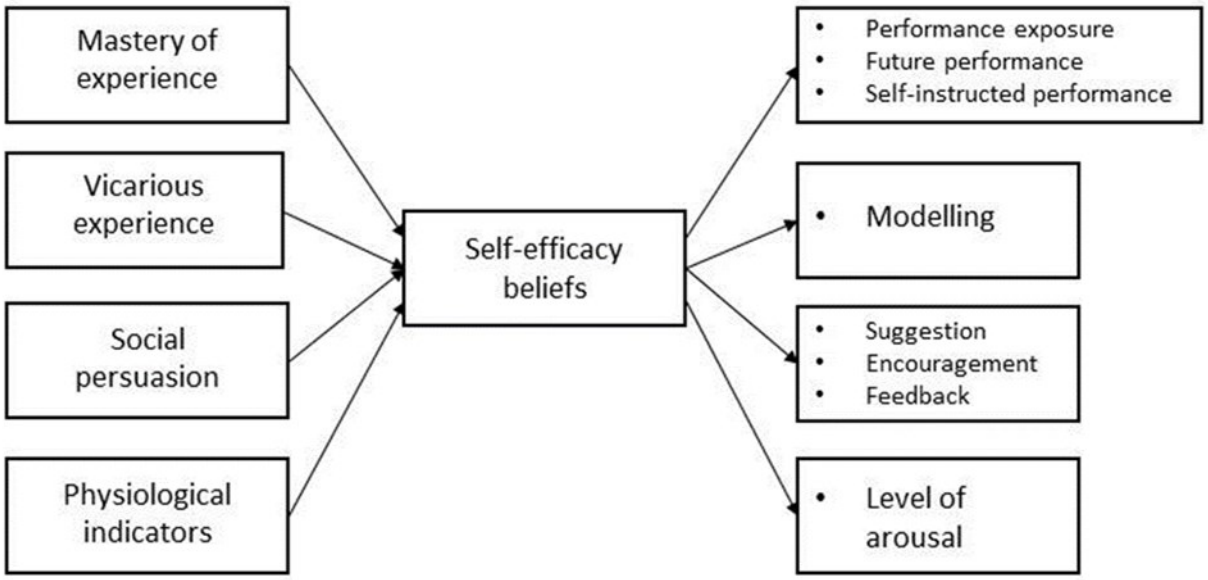

Figure 2.3: Bandura's sources of self-efficacy and mode of induction (adapted from Bandura, 1994)

Mathematics anxiety and mathematics teaching anxiety has a crucial impact on student teachers' self-efficacy and is a negative form of physiological indicators (Bandura, 1994; Olson, 2014). Therefore, this research is done with the understanding that mathematics anxiety is a factor influencing student teachers' efficacy beliefs which cannot be ignored. This research acknowledges the importance of identifying their self-efficacy beliefs in the hope that future research develops programmes to improve and develop strong self-efficacy beliefs among student teachers, as mentioned in Section 1.3.

In the next chapter, Chapter Three, I will present the research methodological design which I believe will enable me to answer the research questions listed in Section 1.4.

CHAPTER THREE: METHODOLOGY

3.1 Introduction

This chapter will discuss the methodological design of this research which sought to identify BEd foundation phase fourth year student teachers' self-efficacy beliefs towards teaching mathematics and the self-reporting factors that gave rise to these beliefs. Austin and Sutton (2014) define methodology as the "explanation of the approach, methods, procedure with some justification for their selection" (p. 436). In other words, methodological design is the plan for conducting the study (Austin & Sutton, 2014).

In this chapter, the research method and approach is first discussed by outlining the ontology and epistemology of this research. This is followed by a description of the selected participants and the research site. The data collection process is then explained in detail, as well as the pilot study and how it was used to strengthen the data collection tools. This is followed by the description of how the data was analysed. Finally, the ethical considerations, as well as the validity and the reliability of the research are addressed.

3.2 Research Method, Approach and Paradigm

3.2.1 Research method, approach and design

This research adopted a qualitative research method as it explored participant's behaviours, perspectives and feelings (Merriam, 2009). In other words, a qualitative method of research investigates what people think and why they think so, which is key to identifying self-efficacy beliefs. This research also adopted a qualitative research method as it was not only concerned with gathering data but also with exploring how people make meaning of their lives (Taylor, Bogdan, & DeVault, 2015). Qualitative research method was also appropriate as it is defined as a form of social inquiry of people's ideas and thoughts and how they make sense of their experiences (Taylor et al., 2015).

In order for this research to answer the research question satisfactorily, a detailed analysis of the data was needed. Therefore, this research did not adopt a quantitative research design method, as this would focus on gathering numerical data and generalising across groups of

people in order to understand a specific phenomenon. Studies mainly use qualitative research when investigating self-efficacy beliefs, as statistical data is simply not enough (Bryman, 2006).

This research adopted the inductive approach generally associated with qualitative research (Flick, von Kardoff, & Steinke, 2004). Some of the data collected in this research underwent thematic analysis, discussed in more detail below in Section 3.8; an inductive approach is best used when the findings are analysed by identifying themes which emerge from the data (Flick et al., 2004). As discussed in Section 3.1, the theory used in this research is self-efficacy theory. This theory is used in this research to explain the themes that emerged from the data and therefore does not incorporate a hypothesis. This is another reason why this research adopted an inductive approach, as a deductive approach to research is aimed at testing a theory and usually begins with a hypothesis (Flick et al., 2004). The self-efficacy theory is not being tested in this research; it is simply used to explain the themes identified in the research.

Within a qualitative research framework, this research chose the exploratory research design, which seeks to explore the research questions and does not aim to provide conclusive solutions to existing problems. This research adopted an exploratory research design as it aids in providing an understanding of an issue, in this case student teachers' self-efficacy beliefs towards teaching mathematics (Carvalho, Scott, & Jeffery, 2005). This research did not aim to provide solutions, but rather aimed at providing awareness among researchers, teacher training programmes and student teachers, of BEd foundation phase fourth year student teachers' self-efficacy beliefs towards teaching mathematics, as discussed in Section 1.3. This research explored student teachers' self-efficacy beliefs and in this way produced descriptive data (Carvalho et al., 2005).

3.2.2 Research paradigm

According to Maxwell (2008), the term paradigm refers to a "set of very general philosophical assumptions about the nature of the world (ontology) and how we understand it (epistemology)" (p. 224). The following discusses the research paradigm and the ontology of this research.

This research was driven by the research question and for this reason it adopted a qualitative research paradigm known as an interpretive paradigm (Elliott & Timulak, 2005). This is because the data results depend on the participants input regarding their self-efficacy beliefs and therefore, they lead the interviewer to highlight the important aspects of their experiences (Elliott & Timulak, 2005). Further information regarding the interviews is discussed in Section 3.7 below. Another aspect of this research which aligns with an interpretive design is the way in which data was collected from a number of different sources. Triangulation is a strategy which is often used in interpretative qualitative research, as the data is gathered by using various methods (Elliott & Timulak, 2005).

The ontology of the interpretive paradigm is that reality is socially constructed, that it exists in individuals' minds and is conditional upon their experiences (Lotz-Sisitka, Fine, & Ketlhilwe, 2013). An interpretivist approach seeks to identify and analyse individuals' interpretations of their reality and attempts to recognise any patterns that may arise (Neuman, 1997). The BEd foundation phase fourth year student teachers' self-efficacy beliefs towards teaching mathematics is socially constructed through their own thoughts and experiences. Because the data is based on the participants' responses only and therefore aims to understand and explain their reality through their eyes, this research aligns with an interpretivist approach (Mack, 2010). This research sought to identify these student teachers' self-efficacy beliefs toward teaching mathematics by understanding their experiences of teaching it.

The epistemology of the interactive paradigm is that knowledge is subjective and that it is constructed through the interaction of people, researchers and the objects of inquiry (Lotz-Sisitka et al., 2013). In other words, the self-efficacy beliefs among student teachers are also constructed though the interaction between colleagues, lecturers and mentor teachers as well as with the subject, mathematics. As knowledge arises from individuals' situations and through personal experiences (Mack, 2010), this research aimed to penetrate participants' perceptions of the support provided by relevant groups.

3.3 Sample

This research used purposeful sampling, a common sampling strategy for qualitative research (Merriam, 2009). Sampling, that is the process of selecting participants for inclusion into a study, is one of the most important aspects of a research design (Merriam, 2009). Participants

who could best answer the research question were selected for further interviewing. The following discusses this research's sample selection and the sample size.

3.3.1 Sample selection

Only BEd foundation phase fourth year student teachers were selected to participate in this research, rather than PGCE students. The reason for this participant selection is that the BEd course is four years long, so they have had more time to gain teaching experience and develop a sense of self-efficacy beliefs.

Foundation phase student teachers were also selected as they often experience the most challenges to their self-efficacy beliefs, as discussed in Section 1.2.3 (Jackson, 2008). The purpose of this research is to bring awareness of student teachers low self-efficacy beliefs, so that intervention strategies can be formed for future research.

It was important that this research selected participants who had the most teaching experience, as the more experience a student teacher has, the more aware they may be of their self-efficacy beliefs, as discussed in Section 2.3. The MRTEQ document specifies that BEd foundation phase student teachers must have a minimum of 20 weeks in formally supervised teaching practice. Each year they are required to spend up to 12 weeks in schools and at least three weeks of those must be consecutive (South Africa, 2015). This research selected the BEd fourth year student teachers as they have had the most teaching experience, especially with regards to teaching mathematics, one of the four compulsory teaching subject. It was therefore likely that they would have more awareness of their self-efficacy beliefs towards teaching mathematics than (for example) the BEd third years (Bandura, 1997). This supports Creswell's (2003) argument that purposeful sampling involves selecting participants who are especially knowledgeable about the phenomenon.

In addition, student teachers are more likely to have established a sense of self-efficacy towards the end of their teacher training programme (Bandura, 1997). For this reason, the BEd fourth year student teachers were also selected as they were more likely to have established self-efficacy beliefs towards teaching mathematics, as mentioned in Section 2.2.

It is also important to select participants who have the ability to communicate their experiences and opinions in a reflective manner (Merriam, 2009). The BEd fourth year student teachers

often have to reflect on their teaching experiences through 'reflective heart' assignments. This meant that they were familiar with reflecting and could provide substantial, well expressed data with regards to their experiences in teaching mathematics.

3.3.2 Sample size

In purposeful sampling, the size is determined by the amount of information needed to answer the research question (Merriam, 2009). According to Merriam (2009), sample size should be "based on expected reasonable coverage of the phenomenon given the purpose of the study" (p. 5). The sample size for the questionnaires and the interviews used in this research differed and this is discussed below:

Questionnaires: Two types of questionnaires were used in this research, namely: open-ended questionnaires and Likert questionnaires. These questionnaires are discussed in more detail in the section below (3.7.1). In order to be true to the research goals and purpose, the whole fourth year class was selected to participate in the Likert questionnaire and in the open-ended questionnaire. The more participants who took part in the research, the more reliable and accurate the results of these two questionnaires would be. I also selected the whole class as I was aware that some student teachers might be absent on the day that the data was being collected.

There were a total number of 53 BEd foundation phase fourth year student teachers and as predicted, not all were present on the day that the data was collected. With regards to the Likert questionnaire, there were a total number of 34 student teachers present that day, all of whom participated in the study. There were a total number of 25 student teachers present on the day of the open-ended questionnaire, all of whom participated.

Interviews: I originally planned on dividing interviewees into two groups: student teachers with high self-efficacy beliefs and student teachers with low self-efficacy beliefs. I was then going to choose five student teachers at random from each group to participate in the interviews. Because this research focused on the whole fourth year class, I decided to interview as many as possible. This decision is supported by Brenner (2006), who suggests that focus group interviews should comprise of a minimum of three groups in order to ensure accurate and reliable data. He maintains also, that a study consisting of a minimum of three groups will

add breadth and depth to the study (Brenner, 2006). For this reason, I divided the BEd foundation phase fourth year student teachers into three focus groups; those with low self-efficacy beliefs, those with high self-efficacy beliefs and those who were uncertain of their self-efficacy beliefs. I grouped them by looking at the Likert questionnaire only, as its purpose was to identify student teachers' self-efficacy levels towards teaching mathematics. In order to group them into their respective groups, I looked at the items on the Likert scale which had to do with their self-efficacy beliefs towards teaching mathematics only. The reason was that some participants were more uncertain about their mathematics ability, which can be seen in the tables provided in Section 4.1.

I selected seven student teachers to participate in each focus group interview. The reason was that each focus group interview should consist of about six to 10 participants (Brenner, 2006). Brenner (2006) also mentions that if a focus group is too small, the discussion generated during these interviews will be insufficient. The focus group interviews were arranged by asking the participants who provided their student numbers or names on the Likert questionnaire to take part in the interviews, as they were easily contactable via email. The ethical considerations regarding participant anonymity in this regard is discussed in Section 3.9 below. In total there were six student teachers who participated in the first focus group, six student teachers who participated in the second focus group and four student teachers who participated in the third focus group, as some of those who were selected to participate in the focus groups were absent. However, other student teachers volunteered to join the focus group interview. This suggested that the participants were enthusiastic about discussing their mathematics teaching experiences which makes the data more authentic and reliable. Those who did participate provided substantial information.

I decided to interview the same student teachers again after their final teaching practice, in order to ensure that the data was reliable, but I was only able to conduct one focus group interview due to time constraints. I selected the focus group of participants who had provided the most information during the interview before their teaching practice. I also decided to choose the focus group who were more open to sharing their teaching practice experiences and interacted and responded to each interview question asked. There were three student teachers who participated in the final focus group interview, as once again some of them were absent.

However, these participants provided ample information as they were specifically selected for their satisfactory participation in the previous interview process.

3.4 Research Site

I conducted this research at the Education Department at Rhodes University. According to Elwood and Martin (2000), the research setting can be the social, physical and cultural site in which the researcher conducts the study. The Education Department at Rhodes University was specifically selected, as not only is it where the BEd student teachers attend their lectures but it is a familiar environment to me, as I obtained my PGCE at this Education Department. As discussed in Section 1.1, I am also currently working in the department as a teaching practical examiner. I saw this as an advantage to this research as the participants were easily accessible, and arranging a space and time to collect the data was convenient to all parties. I do acknowledge that my involvement posed ethical and validity challenges which I address in Section 3.10 below.

The questionnaires and interviews took place at different venues in the Education Department at Rhodes University and are discussed below.

Questionnaires: Due to the fact that this research focused on their self-efficacy beliefs towards teaching mathematics, the data collection for both questionnaires took place in the student teachers mathematics lecture venue. Their mathematics lecture venue was also purposefully selected, as according to Elwood and Martin (2000), it is important that the data is collected at the site where the participants experienced the issue that is being studied as their memories are clearer. Their mathematics lecture venue was also chosen as it is an environment where they are taught mathematical concepts and mathematics teaching methods. It is also an environment where they are most likely to think about their mathematics abilities and their self-efficacy beliefs towards teaching it.

Interviews: It is important that the research site for interviews must be in a convenient and comfortable location for the participants (Elwood & Martin, 2000). The interviews took place in a familiar venue in the Education Department, two minutes walking distance from their mathematics lecture. The reason being, that according to Elwood and Martin (2000) it is important to ensure the availability of the participants and their willingness to participate. The interviews took place during their tea-time/break and in order to ensure that the participants

were not missing out on their refreshments, tea, coffee and biscuits were provided. This also created a comfortable, informal environment which increased their willingness to participate.

3.5 Data Collection Process

The original intention of my research was to collect data in November 2018 during Rhodes University's examination period. There were concerns that the student teachers might be hesitant to participate due to their upcoming examinations, as well as the limited time I would have to collect the data. With my supervisors' guidance, I decided to collect the data in March 2019, as this would provide insight into their self-efficacy beliefs towards teaching mathematics before their teaching practical in April. Another reason why the data was collected in March, was that they underwent a teaching practical orientation during which they may have thought about their feelings, thoughts and opinions towards teaching mathematics, as well as their past experiences in teaching it. This helped to stimulate their reflections about teaching mathematics.

Before the data collection took place, I contacted the BEd foundation phase fourth year student teacher coordinator, as well as their mathematics lecturers in order to organise the logistics of when I could collect the data. Their mathematics lectures took place every Wednesday and the data was collected three weeks before their teaching practical in April, as described above. The Likert questionnaires were completed first, as I wanted to sort the participants into their necessary groups for the interviews. They all completed the Likert questionnaire in 15 minutes. In the second week I handed out the open-ended questionnaires and these took 30 minutes to complete. Their teaching practice orientation took place during the last week in March and I conducted the interviews over two days during that week. The reason is that their TP orientation programme was flexible and so were the times. The first focus group took 29 minutes and 11 seconds, the second focus group took 16 minutes and the last focus group took 28 minutes and 10 seconds.

As discussed in the above Section 3.3.2, an additional data collection process commenced after the student teachers final teaching practice. This addition was decided after analysing and discussing the data results from the questionnaires and interviews. I believed it would be fundamental to this research if a final phase of focus group interviews were conducted, as this would provide insight into whether their self-efficacy beliefs towards teaching mathematics

had remained the same or changed, and if so why. Before this phase of data collection took place, I followed the same procedure as I had before, of contacting their coordinator, as well as their mathematics lecturers. The final phase of data collection took place after their teaching practical in October 2019. It was important that this interview took place in a similar setting to that of the previous interviews. Thus, the interview took place during their mathematics lecture tea-time on a Wednesday. The final focus group interview took place in October because I wanted to interview the participants' after their vacation. This ensured that they had time to think, reflect and process their teaching practice experiences. This final focus group interview took 23 minutes and 37 seconds.

3.6 Pilot Study

I decided to pilot the questionnaires and interview questions, as through piloting, data collection tools can be strengthened and any flaws or limitations within the design can be identified. This in turn allows for any necessary modifications to be made. Piloting is often used in research to test a particular research technique (Majid, Othman, Mohamed, Lim, & Yusof, 2017). According to Majid et al. (2017), piloting interviews and questionnaires are an integral aspect in the process of conducting qualitative research. The questionnaires and the focus group interview questions had been adapted from reliable sources, but they had never been used in the South African context with foundation phase fourth year student teachers (discussed in more detail in Section 3.7). For this reason, I decided to pilot the questionnaires and the interview questions in order to make these data collection tools more reliable and to strengthen their validity.

I did not want to pilot the questionnaires or interviews on any of the potential participants within the Education Department at Rhodes University, because it might jeopardise the findings if they were made aware of the questions that were going to be asked. I piloted the questionnaires and interviews on one person who was a former student teacher and a BEd fourth year lecturer in the Education Department, and another person who was a friend with no background in teaching. These two individuals were chosen because I wanted to ensure that the questions asked could be understood both by a person who has a teaching background and by a person who does not.

The results of the pilot study indicated that no changes needed to be made to the questionnaires or to the focus group interview questions. Both participants understood the questions and could answer them in detail. Because the interview is a focus group design, the pilot interview assisted me in identifying possible probing questions that I could ask during the interview.

3.7 Data Collection Tools

The following section discusses the data collection tools used in this research. There are many different types of research tools used in qualitative research, particularly with an exploratory research design (Merriam, 2009). This research adopted primary data collection tools which aim at gathering information directly from the participants. Each research tool is discussed in detail below.

3.7.1 Questionnaires

Two types of questionnaires were used in this research, namely a Likert scale questionnaire and an open-ended questionnaire, as mentioned in Section 3.3.2. The following section describes the Likert questionnaire and the open-ended questionnaire in more detail and how the method was adapted for this research.

The social scientist Rensis Likert developed the Likert scale questionnaire, a psychometric scale that has multiple categories from which the individual chooses, in order to indicate their opinions, attitudes, feelings or thoughts about a particular phenomenon (Nemoto & Beglar, 2014). This research used Likert questionnaires as they have been used in other contexts to measure self-efficacy beliefs of individuals, as they consist of a range of answer options which offer more feedback about the phenomenon rather than a simple yes/no answer (Maurer & Andrews, 2000 ; Sillivana & Artino, 2013). There are many other reasons and advantages to using Likert questionnaires when measuring self-efficacy beliefs in this research: the data can be gathered relatively quickly from a large number of participants, the scale questionnaires provide reliable data with regards to individual's self-efficacy beliefs and the data that they provide can be compared, contrasted, and combined with other qualitative research tools, such as interviews and open-ended questionnaires (Nemoto & Beglar, 2014).

There are several self-efficacy belief Likert scale instruments, all of which are derived from modifying the original Science Teaching Efficacy Belief Instrument (STEBI-B). In order to

measure student teachers' mathematics teaching self-efficacy beliefs, I needed to identify the Personal Mathematics Teaching Efficacy (PMTE) and the Mathematics Teaching Outcome Expectancy (MTOE) (Enochs, Smith, & Huinker, 2000). This research adopted the Mathematics Teaching Efficacy Belief Instrument (MTEBI) because it measures both the PMTE and the MTOE. The MTEBI scale "consists of 21 items, 13 items on the PMTE subscale and 8 items on the MTOE subscale" (Enochs et al., 2000, p. 196). Likert questionnaires usually comprise categories of responses ranging from 5 (strongly agree) to 1 (strongly disagree) with 3 being a neutral response. There are many debates among researchers with regards to the optimum number of choices in a Likert questionnaire, but it seems that the higher the number of categories of response, the less reliable the data will be. Researchers advise that the optimum number of choices should be below seven (Croasmun & Ostrom, 2011). For this reason, I adapted the MTEBI scale according to foundation phase student teachers and the scale ranges from 1 (strongly disagree) to 5 (strongly agree), allowing for some neutral responses which adds reliability and nuance to the study (see Appendix 6). With this said, the Likert questionnaire addressed the two sub-questions of this research, namely: *What are the BEd foundation phase fourth year student teachers' self-efficacy beliefs towards their mathematics content knowledge?* and *What are the BEd foundation phase fourth year student teachers' self-efficacy beliefs towards their mathematics teaching ability?*

The second type of questionnaire used in this research was an open-ended questionnaire. This would allow participants to write their thoughts and feelings about a topic and give more insight into their individual experiences (Merriam, 2009). This research's open-ended questionnaire consisted of four main questions, each question is derived from one of Bandura's four main sources of self-efficacy beliefs (see Appendix 7). The reason is that Bandura's four sources of self-efficacy is considered a reliable source in identifying reasons for high and low self-efficacy beliefs among individuals, as discussed in Section 2.4. Bandura's four sources of self-efficacy are also used by many other research on self-efficacy studies. In order to justify the validity and reliability of this open-ended questionnaire, Table 3.1 in Section 3.10 provides insight into which of Bandura's four sources each question derives from and how it aimed to answer this research's sub-question: *What are the self-reporting factors that influence the BEd foundation phase fourth year student teachers' self-efficacy beliefs?* Shortening the questionnaire into four broad questions prompted detailed responses from the participants, encouraging them to elaborate on each question.

3.7.2 Focus group interviews

Interviews were used in this research as it serves as a rich source through which to explore individuals' inner feelings, opinions and attitudes towards a specific phenomenon (Dilshad & Latif, 2013). This research adopted focus group interviews as a data collection tool as these allowed informal discussions between the participants about their self-efficacy beliefs towards teaching mathematics. Focus group interviews also allow participants and the researcher to interact freely with one another (Dilshad & Latif, 2013). This method of data collection also allows for group generated data and memories or observations of other group members, especially if they share a common experience, as these student teachers do (Dilshad & Latif, 2013).

Focus groups can either be unstructured or semi-structured and this research conducted semi-structured focus group interviews. The reason is that semi-structured interviews allow for flexible conversations between the researcher and participants, where the researcher has predetermined questions that aim partially to guide the interview. This research also used semi-structured interviews as they are useful for exploring the thoughts and feelings a person has towards a particular phenomenon, in this case self-efficacy beliefs towards teaching mathematics (Merriam, 2009).

This research adapted Zeldin and Pajares's (2000) interview questions according to foundation phase student teachers and consisted of five broad open-ended questions in order to stimulate a discussion (see Appendix 8). Focus group interviews are purposive (Brenner, 2006). Thus, in the focus group interview, the fifth question (*Given the fact that teaching is your chosen career, if you could choose any other career would it still be teaching or would you chose to do something else and why?*) was chosen as the concluding question because it would provide insight into whether or not the student teachers' self-efficacy beliefs are influenced by their dedication to the teaching profession. As discussed in Chapter Two, student teachers who are satisfied with teaching as their chosen career might be more motivated and have high self-efficacy beliefs (Bandura, 1989a).

The same semi-structured interview questions were used for the second phase of focus group interviews which took place after their final teaching practice. The interview questions were worded slightly differently in order to relate the questions to their final teaching practice

experience (See Appendix 9). The fifth interview question was irrelevant to the final focus group interview and was therefore excluded.

Focus group interviews aim at collecting data that help the researcher to understand a specific problem from the viewpoint of the participants (Dilshad & Latif, 2013). These focus group interviews provided a nuanced explanation in answer to the third sub question, namely: *What are the self-reporting factors that influence the BEd foundation phase fourth year student teachers' self-efficacy beliefs?*

3.8 Data Analysis

After the data sets were collected, they were analysed using different techniques, each set undergoing a different analytic process in order to provide evidence (Ryan, 2006). That is, the Likert questionnaire underwent a different analysis to the open-ended questionnaire and to the focus group interviews. The analysis of this research is divided into three phases; Likert questionnaire, open-ended questionnaire and focus group interview, and final focus group interview. The following section discusses how each data set was analysed.

3.8.1 Likert questionnaire

When analysing qualitative data, researchers often make use of terms such as 'more' or 'less' (Onwuegbuzie & Daniel, 2003). However, it is useful for claims also to be supported by numerical data in order to make it reliable. This is known as quantising qualitative data, where the nature of the research is qualitative and the claims are supported by quantitative measurements such as percentages, graphs or diagrams (Onwuegbuzie & Daniel, 2003). For example, a graph will provide a visual representation of the data, highlighting any potential patterns. In this case, the Likert questionnaire results are presented in a graph which were analysed for general indicators, highlighting how many students were, for example, feeling stressed when teaching mathematics. This identified the general self-efficacy beliefs the participants had towards teaching mathematics and provided a useful basis of knowledge about the phenomenon. More information regarding the process of data analysis is found in Section 4.2.

3.8.2 Open-ended questionnaire and focus group interviews

Once the audio recordings of the interviews were transcribed, the open-ended questionnaire and the focus group interviews both underwent thematic analysis separately. Thematic analysis is the method for "identifying, analysing and reporting patterns (themes) within data" (Braun & Clarke, 2006, p. 6). Data analysis for this research was conducted using this Braun and Clarke method, because it is an effective way of analysing data through phases (Braun & Clarke, 2006). Thematic analysis was used in this research as it is useful for summarising key features in a large data set, for example the open-ended questionnaires, where rich, varied answers were given. The researcher is then forced to take on a well-structured approach when handling data and this produces a clear and organised report on the findings (Nowell, Norris, White, & Moules, 2017). The first phase of this method was to identify certain codes within the data and to categorise the material according to these codes (Ryan, 2006). From these codes, themes were identified and the themes were then given names and were supported by sufficient evidence found in the transcribed interviews and open-ended questionnaires (Bryman, 2012). I named the majority of the subthemes by quoting a participant's response. I followed this process and then analysed it by linking the themes identified in the data to the theory and concepts of this research, which were discussed in Chapter Two. The process of data analysis for the open-ended questionnaire and interviews is found in Section 4.3.1.

3.8.3 Final focus group interview

The final focus group interview, which was conducted after the participants final teaching practice, used the same themes identified in the open-ended questionnaire and focus group interview analysis. The reason is, that this final focus group interview sought to identify any similarities or differences in the participants' responses. However, in order to ensure validity and reliability of this analysis, this interview underwent the Braun and Clarke method of thematic analysis. The process of data analysis for this interview can be found in Section 6.5.1.

3.9 Ethical Considerations

Assurances for the ethical standards of this research stemmed from the *Faculty of Education Ethical Guidelines for Educational Research*. Permission from the Ethics Higher Degrees Committee was granted with a class B level. The following section discusses the ethical procedures before the data was collected and how this research ensured participant anonymity.

3.9.1 Ethical procedures

Firstly, I requested permission from the Director of Student Affairs, the Head of the Education Department and from the Registrar at Rhodes University to conduct research on BEd foundation phase fourth year student teachers at Rhodes University (see Appendix 1, 2 and 3). Once I had obtained permission from the above parties, I introduced the research to the participants. I explained to them the aims, objectives and the goals of this research. I also stressed that their contribution to the study and the findings would not have implications on their academic performance or impact their position in the department. The participant consent forms were then handed out to the participants. There were two participant consent forms, one for the questionnaires (see Appendix 4) and the other for the interviews (see Appendix 5). I then thoroughly explained all the information listed in the consent forms to the participants in order to ensure that they understood their rights in the research process.

3.9.2 Procedures for ensuring participant anonymity

It was a major concern that the participants might forget the pseudonyms that they had chosen for themselves on the Likert questionnaire and open-ended questionnaire. For this reason, the participants also had the option to write their student number on the questionnaires at the top of the page. However, as Rhodes students commonly know each other's student numbers, the numbers were cut off after they had been contacted for the interview. The participants were also given the option to write their student number on the questionnaires as it was easier to contact the selected participants for the interviews. However, I informed them that I would be the only person who would see their student numbers on the questionnaires. With regards to the interviews, all interviews were recorded and all recordings remained completely confidential. Further information regarding the ethical considerations of this research is discussed in Section 3.10 which follows.

3.10 Validity and Reliability

Validity and reliability are conceptualised as the "trustworthiness, rigor and quality of the qualitative design" (Golafshani, 2003, p. 604). The following section discusses the validity and reliability of this research by focusing on the data collection tools, data analysis, as well as ways to overcome any potential threats to the validity of this research. This research also

adopted Guba's four criteria in ensuring validity and reliably, which is also discussed in this section.

3.10.1 Validity in data collection tools

It is vitally important to ensure that the research is trustworthy, especially when conducting a qualitative study (Merriam, 2009). The research must be rigorously conducted in order to present insights and conclusions that are true to the participants and other researchers (Merriam, 2009). The following discusses the validity and reliability of each data collection tool used in this research.

The Likert questionnaire has been used in many studies as it produces accurate results and is the most reliable tool for measuring individuals' feelings, opinions, perceptions, behaviours and thoughts (self-efficacy beliefs). As mentioned above in Section 3.7.1, the MEBI has been used in previous research to measure the self-efficacy beliefs of pre-service teachers but it has never been used in the South African context with foundation phase student teachers. The adaption of this established instrument adds validity to this research and ensures results that are as reliable as those in other studies. This Likert questionnaire consisted of a scale from 1 to 5, with 3 being a neutral response. The reason is that according to Croasmun and Ostrom (2011), a neutral response adds validity and reliability to the data collection tools.

The open-ended questionnaire is derived from Bandura's four sources of self-efficacy beliefs which is still used in research today, making it a valid and reliable source. In order to justify the validity and reliability of this questionnaire, Table 3.1 provides insight into which of Bandura's four sources each question was derived from.

Table 3.1: Justifying the validity and reliability of this open-ended questionnaire

Questions	Bandura's four sources of self-efficacy	Justification of the question (aims and purpose)
Question 1: How have your experiences been when teaching mathematics and how did they make you feel about your mathematics teaching ability? Please provide an example of any experience or an explanation for your answer.	Mastery of experience	This question will provide insight into their past experiences and how this influenced their self-efficacy beliefs. By asking them to give an example about an experience, it will provide not only information but an illustration which itself can be interrogated for positive and negative qualities. Asking the participants about how such an experience made them feel about their teaching ability will provide information on how the experience influenced their self-efficacy beliefs towards their teaching ability.
Question 2: Do you think your fellow colleagues' experiences in mathematics courses or teaching mathematics during their TP affect the way you feel about teaching it? Please provide an example or an explanation to justify your answer.	Vicarious experience of others	This question will provide insight into whether or not their fellow students' experiences in mathematics courses or in teaching mathematics influenced their own self-efficacy beliefs about teaching mathematics. Asking participants to give an example to justify their answer will encourage them to give more information about it. Asking them to state how it made them feel towards their teaching ability will provide insight into how it influenced their self-efficacy beliefs.
Question 3 Do comments (positive/negative) from fellow colleagues/mentor teachers/family/lecturers about mathematics or teaching mathematics affect the way you feel about teaching mathematics? Please provide an example of such an experience or an explanation for your answer.	Social persuasion	This question aims to understand how positive or negative verbal encouragement influenced their self-efficacy beliefs. This question asks the participants to state how such verbal encouragements made them feel which will give an understanding of how it influenced their self-efficacy beliefs towards teaching mathematics.

Question 4 Do you think your emotions about mathematics affect the way you feel about teaching it? Please explain why and provide an example if possible to justify your answer.	Physiological indicators	This question aims to identify how the participants' emotional state influenced their self-efficacy beliefs. Asking them to give an example will provide insight into whether or not they experienced positive or negative emotions towards mathematics and this will indicate their overall self-efficacy beliefs towards mathematics. Identifying whether their emotions towards mathematics affected their feelings towards teaching mathematics will also provide insight into how it influenced their self-efficacy beliefs.

Interviews are a reliable and valid tool for identifying student teachers' self-efficacy beliefs as they are a reliable data collection tool for seeking insight into individuals' experiences and are therefore best used in research which aims at identifying their feelings, thoughts, and opinions (Dilshad & Latif, 2013). Zeldin and Pajares' (2000) interview questions have been adopted by many researchers in investigating the sources of self-efficacy beliefs and even though it has not been used in the South African context among foundation phase student teachers, it has been proved to be a reliable and valid source.

3.10.2 Validity assurance in data analysis

Using tables to analyse the Likert questionnaire adds reliability as it illustrates the participant's responses visually. As explained above, quantising qualitative data ensures reliability and validity as their responses are supported by tables, graphs and numbers (Onwuegbuzie & Daniel, 2003). The process of analysing the Likert questionnaire is discussed in Section 4.2.

The open-ended questionnaire and focus group interviews underwent the Braun and Clarke method of thematic analysis, as discussed in the above section. This research adopted Lincoln and Guba's (1981) process for conducting a trustworthy thematic analysis which involves a linear six-phase method that is used during thematic analysis (as cited in Nowell et al., 2017).

The six-phases include:

- Familiarising yourself with the data;
- Generating initial codes;
- Searching for themes;

- Reviewing themes;
- Defining and naming themes; and
- Producing the report.

This six phased process of thematic analysis ensures trustworthiness as it is a reflective process that is developed over time. It allows the researcher to move forwards and backwards between phases. This constant movement between the six phases ensures that the analysis is trustworthy (Nowell et al., 2017). The six phase method of thematic analysis is further described in relation to this research in Section 4.3.1.

3.10.3 Potential validity threats and ways to overcome them

Chief among the potential threats to the validity of this research will be my position as a researcher as I currently work in the Education Department at Rhodes University as a teaching practical (TP) examiner, as mentioned above in Section 1.1. Therefore, I have formed a relationship with power implications with the BEd foundation phase fourth year student teachers. They might feel as though they have to participate and they also might feel the need to please me by answering the Likert questionnaire, open-ended questionnaire and interview questions in a way they think I would want it answered. In order to mitigate the effects of the power dynamic, before I proceeded with the data collection process, I explained my role as a researcher to the participants. I also stressed to them that my research would not affect their teaching practical results or their teaching experience in any way. I informed them that my position as their teaching practical examiner and our relationship formed during this time would not be jeopardised by this research. I assured the participants that they would remain completely anonymous and that they were free to withdraw from the research at any given time. I also explained to them the aims and goals of this research and addressed any questions that they had. In order to avoid bias in this research, I shared the results with the participants, and these are discussed in more detail below.

3.10.4 Guba's four criteria in ensuring validity and reliability

In this research, I applied Guba's four criteria in ensuring validity and reliability, as it is used in qualitative research. The chief quality of research is that it should make valid claims on which others in the field can rely (Guba, 1981). Guba (1981) believes that there are four criteria

that researchers must seek to satisfy in order to ensure that their research is valid. I adopted Guba's (1981) four criteria to ensure the rigour of the current research, which are: credibility, transferability, dependability and confirmability. This research fulfilled each of these criteria in the following way.

Credibility is concerned with internal validity which seeks to ensure that the research actually measures or tests what it originally intended to test or research (Shenton, 2004). Shenton (2004) stresses that there are a number of ways that researchers can guarantee internal validity. Firstly, the appropriate research methods must be adopted (Shenton, 2004), and the methods in this research were carefully chosen to ensure that they would be able to supply valid data. Honesty among participants when gathering data also ensures credibility (Shenton, 2004), and I attempted at all times to uphold this principle. I stressed that the participants were free to withdraw from this research at any given time, as mentioned above in Section 3.9. This ensured that the data collection process involved those who wanted to take part in the research and who were willing to offer insights into the topic freely and honestly. As fourth year student teachers, they have a greater degree of social and professional confidence than other undergraduate groups. I also informed the participants that there were no right or wrong answers to any of the questions asked in the questionnaires and in the interviews to encourage them to answer openly and honestly. The participants remained anonymous, as discussed in Section 3.9, and this also encouraged them to speak freely and honestly without any fear of repercussions.

Another way to ensure credibility is through frequent debriefing sessions between researcher and supervisor and there were frequent meetings between my supervisors and me to discuss developments during the data collection (Shenton, 2004). Member checks, checking the accuracy of the data and whether or not the participants' words match the meaning they actually intended to convey, forms the most important provision in ensuring credibility (Guba, 1981). This research provided feedback to the participants regarding the various themes identified during the data analysis, to ensure that the data analysed was accurate. Participants had the option to write their email addresses on the questionnaire sheets and on the consent forms if they wished to receive the results (see Appendix 4 and 7). Because the majority opted to receive feedback on the findings, I decided to present the findings to all the student teachers.

Transferability is "the extent to which the findings of one study can be applied to other situations" (Merriam, 2009, p. 223). However, this does not suggest the universality of the

findings, and Shenton (2004) stresses that because qualitative research involves a small number of participants and environments, it is difficult to apply the findings and conclusions to other populations or settings. On the other hand, Guba (1981) believes that transferability is achievable in qualitative studies if the research provides detailed contextual information about the research topic, as well as a deep description of the phenomenon being researched. This will allow readers to understand the phenomenon which will in turn enable them to compare the findings to similar situations (Guba, 1981). To ensure transferability in this research, a detailed description of the context and topic was discussed in Section 1.1 as well as in Chapter Two. The data in Chapter Four is presented in detail to comply with this requirement.

Dependability addresses the issue of reliability and suggests that, if the research is repeated in the same context with the same methods and participants, it would produce similar results (Shenton, 2004). This is done by describing what was planned and "the operational detail of data gathering" (Shenton, 2004, p. 23). In order to achieve dependability in this research, a full description of the data analysis and data collection process has been provided, as well as insight into the research plans and strategies. Quantifying the qualitative data by providing graphs also provided more reliability, as discussed in the above Section 3.7.

Confirmability is the "qualitative investigator's comparable concern to objectivity" (Shenton, 2004, p. 72). Triangulation is one of the ways in which one can ensure confirmability (Shenton, 2004). According to Merriam (2009), triangulation is the use of multiple methods to collect data for a study. Bringing together findings from different types of data in this way will enable a greater and deeper understanding of the data collected. Flick (1992) further argues that there are four different forms of triangulation, namely triangulation of data, triangulation of theories, investigator triangulation and methodological triangulation. In order to ensure confirmability, this research adopted the methodological triangulation by making use of a variety of data collection tools as well as quantising the qualitative data of the Likert questionnaire. This adds a nuanced approach to the qualitative data. Shenton (2004) also suggests that a detailed description of the methods is another way in which one can ensure confirmability. This research provided a thorough description of the methods used in the research in the sections above.

3.11 Summary

This chapter presented and justified design decisions. It used a qualitative research method which adopted an inductive approach to research. The exploratory nature of this research places it in an interpretivist ontology and epistemology, and the implications of this position for this research were presented.

In addition, the selection of participants and research site was explained. The data collection process was then described by discussing the necessary changes made to the original proposal, as well as the steps that were implemented to collect the data.

The pilot and development of questionnaires and focus group interview questions were also explained in detail in this chapter. The pilot study aided in providing probing questions that were used during the interviews.

This research made use of the following data collection tools: Likert questionnaire, open-ended questionnaire and focus group interviews. In order to ensure that these tools were reliable and valid, the Likert questionnaire adapted the MTEBI scale according to foundation phase student teachers and the scale ranged from 1 (strongly disagree) to 5 (strongly agree). The Likert questionnaire sought to answer the two sub questions of this research: *What are the BEd foundation phase fourth year student teachers' self-efficacy beliefs towards their mathematics content knowledge?* and *What are the BEd foundation phase fourth year student teachers' self-efficacy beliefs towards their mathematics teaching ability?* The open-ended questionnaire derived from Bandura's four sources of self-efficacy beliefs and a table explaining the relationship was provided. The open-ended questionnaire answered this research's sub-question: *What are the self-reporting factors that influence the BEd foundation phase fourth year student teachers' self-efficacy beliefs?* The focus group interview questions were derived from Zeldin and Pajares (2000). These interview questions have been used by researchers in identifying the sources of self-efficacy beliefs of individuals and were adapted according to foundation phase student teachers. The focus group interviews answered the third sub question: *What are the self-reporting factors that influence the BEd foundation phase fourth year student teachers' self-efficacy beliefs?*

The Likert questionnaire was analysed by quantifying the qualitative data by the use of graphs. The open-ended questionnaire and the interviews were analysed separately by means of thematic analysis.

This chapter ended by addressing the ethical considerations and the validity and reliability with regards to the data collection tools and data analysis, as well as ways of overcoming potential threats through adopting Guba's four criteria in ensuring validity and reliability which was discussed.

Chapter Four below, is divided into the three phases of data analysis: Likert questionnaire, open-ended questionnaire and focus group interviews, and final focus group interview. The process of analysing each phase is explained. A presentation of the findings, as well as the analysis of the results are also discussed in detail.

CHAPTER FOUR: DATA PRESENTATION AND ANALYSIS

4.1 Introduction

This research aims to identify student teachers' self-efficacy beliefs towards teaching mathematics and the self-reporting factors that give rise to these self-efficacy beliefs. As discussed above in Chapter Three, this chapter addresses each research question by analysing four sets of data. The data collected was analysed over a series of three phases. The chapter is therefore divided into three parts.

- Likert questionnaire results and analysis

The first part of this chapter begins by explaining the process of analysing the Likert questionnaire results.

The Likert questionnaire results are then analysed by discussing the findings which answer the two research sub questions: *What are the BEd foundation phase fourth year student teachers' self-efficacy beliefs towards their mathematics teaching ability?* and *What are the BEd foundation phase fourth year student teachers' self-efficacy beliefs towards mathematics?* This detailed discussion of the findings makes reference to the literature presented in Chapter Two.

This section is then concluded by drawing on the findings of the analysis to answer the main research question: *What is the BEd foundation phase fourth year student teachers' self-efficacy beliefs towards their mathematics teaching ability?*

- Open-ended questionnaire and the focus group interviews results and analysis

The second part of this chapter begins by discussing the process of analysing the open-ended questionnaire and focus group interview results. The reasons for analysing the results of these two data sets together, is explained in detail.

The findings of both the open-ended questionnaire and the focus group interviews are discussed. The themes identified and explained in this section answer the third sub question: *What are the self-reporting factors that influence the BEd foundation phase fourth year student*

teachers' self-efficacy beliefs? This section also refers to the literature addressed in Chapter Two.

- Final focus group interview results and analysis

The third part of this chapter discusses the final focus group interview results. This section begins by explaining the process of analysing the final focus group interview which was conducted after the participants' final teaching practice.

The discussion of the findings is provided by comparing the themes identified in the second phase of data analysis: open-ended questionnaire and focus group interview results. This section refers back to the research question: *What are the self-reporting factors that influence the BEd foundation phase fourth year student teachers' self-efficacy beliefs?* and identifies any changes or similarities in the findings.

In Chapter Five, I discuss all the key findings identified in the three phases of data analysis. This is done by answering the main research question.

4.2 LIKERT QUESTIONNAIRE RESULTS AND DATA ANALYSIS

The Likert questionnaire results indicated that the BEd foundation phase fourth year student teachers have low self-efficacy beliefs towards teaching mathematics.

The following supports this claim by presenting the participants' responses to the Likert questionnaire in the form of tables and figures. A detailed discussion of the findings is then provided with reference to Chapter Two.

4.2.1 The process of analysing the Likert questionnaire results

Once all the Likert questionnaires were collected, they were recorded on an excel spreadsheet and presented in the form of a table. This provided a visual representation of all the participants' Likert questionnaire responses.

As mentioned in Section 4.1, the Likert questionnaire answers two sub questions: *What are the BEd foundation phase fourth year student teachers' self-efficacy beliefs towards their mathematics content knowledge?* and *What are the BEd foundation phase fourth year student*

teachers' self-efficacy beliefs towards their mathematics teaching ability? For this reason, the Likert questionnaires were categorised and arranged into mathematics content knowledge and mathematics teaching ability. All questions highlighted in green represent mathematics content knowledge and all questions highlighted in purple represent mathematics teaching ability. In this way the categorisation of the Likert questionnaire provides a clear and comprehensible representation of the results.

The Likert questionnaire consisted of both negative and positive questions on a scale ranging from 1 to 5; 1 = strongly agree and 5 = strongly disagree. This Likert questionnaire included questions where it is considered positive (desirable/indicating higher self-efficacy beliefs) if they agreed, for example *Question 1: I feel confident in my mathematics ability* and includes questions where agreement is considered negative (undesirable/indicating lower self-efficacy beliefs), for example: *Question 19: I will generally teach mathematics ineffectively*.

Responses were coded according to whether they were considered positive (desirable, or indicating high/positive self-efficacy beliefs) or negative (undesirable, or indicating low/negative self-efficacy beliefs). The codes used were:

(a) Most negative response (a response indicating lowest self-efficacy beliefs)
(b) Negative (a response indicating low self-efficacy beliefs)
(c) Neutral
(d) Positive (a response indicating high self-efficacy beliefs)
(e) Most positive (a response indicating highest self-efficacy beliefs)

For example, *Question 1* states: *I feel confident in my mathematics ability*. A response of 1 (strongly agree) on the Likert scale is a positive response, i.e. the student teacher feels confident, which is desirable and would reflect the highest possible self-efficacy belief for this item. Therefore, a response of 1 would be coded (e), as it is the most positive possible response. In contrast, *Question 4* includes the statement: *I get nervous when tested on my mathematics knowledge*. A response of 1 (strongly agree) on the Likert scale indicates the student gets nervous, which is not desirable and would reflect the lowest possible self-efficacy belief for this item. In this case, a response of 1 would be coded (a), as it is the most negative possible response to the item.

Once all of the questions were coded, I calculated the Countif formulae for each question. This provided a more nuanced picture of the BEd fourth year student teachers' self-efficacy beliefs towards their mathematics content knowledge and their mathematics teaching ability. The Countif formula shows how many codes were allocated for each question (Howell, 2012). The results of the Countif formula are presented in Table 4.1. below.

Table 4.1: Table indicating the Countif formulae for each question

		Countif formulae				
	Questions	**a** - -	**b** -	**c**	**d** +	**e** + +
Q 1	I feel confident in my mathematics ability	0	2	19	12	2
Q 3	I feel that my mathematics knowledge does not need to be improved	14	11	8	0	1
Q 4	I get nervous when tested on my mathematics knowledge	2	6	4	15	7
Q 6	I am able to assist learners with mathematical difficulties	1	2	8	20	4
Q 8	My mathematics ability does not affect my teaching ability	3	8	8	10	6
Q 12	To what extent will you be able to help your learners with mathematical concepts	0	1	16	13	5
Q 13	I will not be very effective in monitoring mathematics activities	6	12	9	6	1
Q 18	I know how to teach mathematical concepts effectively	1	0	23	10	1
Q 20	I understand mathematical concepts well enough to be effective in teaching foundation phase mathematics	0	2	14	12	6
Q 24	I will find it difficult to explain to learners why a particular equation is right	2	2	17	12	2
Q 25	I am unsure if I have the necessary skills to teach mathematics	4	6	18	5	2
Q 27	When I teach mathematics, I will usually welcome learners questions	0	1	4	8	22
Q 28	When a learner has difficulty understanding a mathematical concept, I will usually be at a loss as to how to help the learner understand it better	8	16	8	2	1
Q 29	I will typically be able to answer learners' mathematics questions	0	1	7	14	6
Q 2	When I get asked to teach mathematics I start feeling stressed or anxious	3	5	10	16	1
Q 5	I enjoy teaching mathematics	1	0	17	11	6
Q 7	I would prefer to be evaluated on a mathematics lesson by a lecturer	5	5	10	5	10
Q 9	I have had only good experiences when teaching mathematics	4	8	8	9	6
Q 10	I am not motivated to improve my mathematics skills	15	14	4	1	0
Q 11	If I could choose, I would never become a mathematics teacher	12	9	9	3	2
Q 14	When a learner does better than usual in mathematics, it is often because the teacher exerted a little extra effort	2	2	5	14	12
Q 15	I will continually find better ways to teach mathematics	0	0	3	10	22

Q 16	Even if I try very hard, I will not teach mathematics as well as I will most subjects	14	14	3	2	1
Q 17	When the mathematics grades of learners improve, it is often due to their teacher having found a more effective teaching approach	0	1	7	13	14
Q 19	I will generally teach mathematics ineffectively	11	17	4	2	1
Q 21	Increased effort in mathematics teaching produces little change in learners mathematics achievement	5	6	7	7	10
Q 22	The teacher is generally responsible for the achievement of learners in mathematics	0	0	7	13	14
Q 23	When a low-achieving learner progresses in mathematics, it is usually due to extra attention given by the teacher	0	1	6	14	14
Q 26	Given the choice, I will not invite the principal to evaluate my mathematics teaching	5	9	12	6	3
Q 31	The inadequacy of a learner's mathematics background can be overcome by good teaching	8	11	11	4	1
Q 30	I do not know what to do to make learners like mathematics	0	2	7	13	13

In order to make the data more concise and clear, I calculated the mode of each question. The mode identifies the code that occurred the most for each item (Howell, 2012). Calculating the mode of each question is recommended for analysing Likert questionnaire responses in qualitative research (Howell, 2012). I decided to present the mode of each question in a form of a graph which creates a visual picture of the Likert questionnaire results. All questions range from neutral to more negative or from neutral to more positive. As seen in Figure 4.1, the results highlighted in green represent their mathematics content knowledge and the results highlighted in purple represent their mathematics teaching ability.

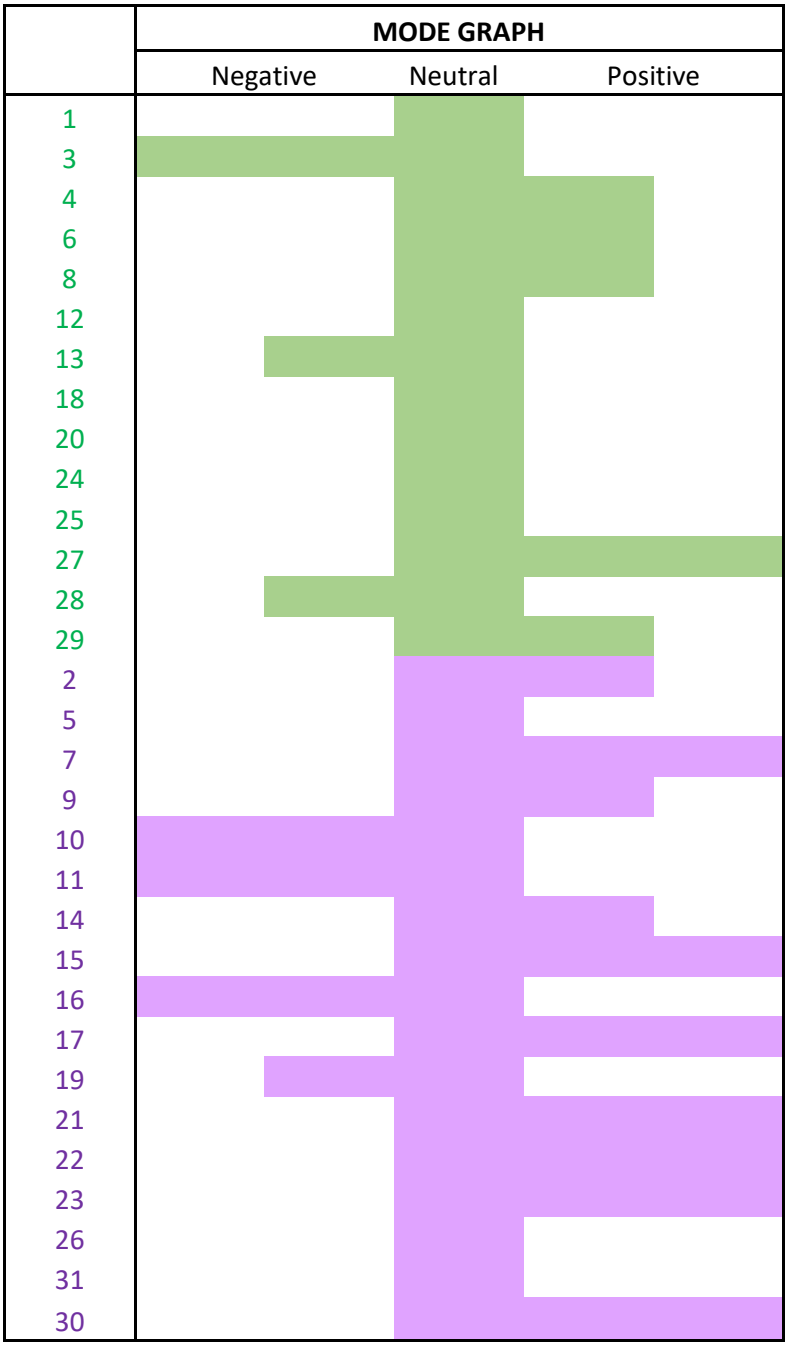

Figure 4.1: Representing the results of the mode of each question

4.2.2 The Likert questionnaire results and data analysis

The picture that emerged from Figure 4.1 indicates a general trend that the participants are unsure of their mathematics content knowledge and are more certain of their mathematics teaching ability. In other words, the participants responded more positively to the questions

regarding their mathematics teaching ability. It is important to note that this does not mean that the student teachers are indicating agreement with the statements in the questions when completing the Likert scale questionnaire, it means that when their responses are coded as being relatively positive (indicating higher self-efficacy beliefs) or relatively negative (indicating lower self-efficacy beliefs) it reveals that participants are selecting responses that hint at a more positive/higher self-efficacy beliefs.

As previously explained in Section 1.2.3.3, when analysing mathematical demands of teaching, it is important to define the mathematics content knowledge needed to perform tasks of teaching mathematics to learners. The content knowledge that this research refers to is known as common content knowledge. Common content knowledge is used in the setting of teaching mathematics to learners and entails the simple calculating of answers or solving mathematical problems correctly (Ball et al., 2008). Ball et al. (2008) stress that teachers must know the material that they are teaching and they must be able to point out when their learners give incorrect answers. In other words, the student teachers must be able to use the terms and notations correctly. This can be seen in the Likert questionnaire, where it investigates the participants' self-efficacy beliefs towards their ability to assist learners with difficult mathematical questions, such as 'welcome learners' questions', 'effectively monitor mathematical activities' and so on. The word 'common' does not simply mean that everyone has this knowledge; it rather suggests that this is knowledge used in a wide variety of settings, not unique to teaching (Ball et al., 2008).

The following analyses and discusses the participants' responses on the Likert questionnaire by answering the two research sub questions: *What are the BEd foundation phase fourth year student teachers' self-efficacy beliefs towards their mathematics content knowledge*? and *What are the BEd foundation phase fourth year student teachers' self-efficacy beliefs towards their mathematics teaching ability*?

4.2.2.1 Research sub question 1: What are the BEd foundation phase fourth year student teachers' self-efficacy beliefs towards their mathematics content knowledge?

Table 4.2: Represents the mode of each question

	Questions	Mode	Category of mode
Q 1	I feel confident in my mathematics ability	c	Neutral
Q 3	I feel that my mathematics knowledge does not need to be improved	a	Strongly negative
Q 4	I get nervous when tested on my mathematics knowledge	d	Positive
Q 6	I am able to assist learners with mathematical difficulties	d	Positive
Q 8	My mathematics ability does not affect my teaching ability	d	Positive
Q 12	To what extent will you be able to help your learners with mathematical concepts	c	Neutral
Q 13	I will not be very effective in monitoring mathematics activities	b	Negative
Q 18	I know how to teach mathematical concepts effectively	c	Neutral
Q 20	I understand mathematical concepts well enough to be effective in teaching foundation phase mathematics	c	Neutral
Q 24	I will find it difficult to explain to learners why a particular equation is right	c	Neutral
Q 25	I am unsure if I have the necessary skills to teach mathematics	c	Neutral
Q 27	When I teach mathematics , I will usually welcome learners questions	e	Strongly positive
Q 28	When a learner has difficulty understanding a mathematical concept, I will usually be at a loss as to how to help the learner understand it better	b	Negative
Q 29	I will typically be able to answer learners' mathematics questions	d	Positive

As seen in Table 4.2, the participants are unsure of their confidence in their mathematics ability (Question 1). Their uncertainty in their confidence towards their mathematics ability reveals that these student teachers have low self-efficacy beliefs towards their mathematics content knowledge (Giles et al., 2016). This in turn affects the way they feel about assisting learners with various mathematical concepts (Giles et al., 2016). This pattern can be seen in the following questions where most of the participants chose a response coded c (neutral):

Question 12: T*o what extent will you be able to help your learners with mathematical concepts*
Question 18: I know how to teach mathematical concepts effectively
Question 20: I understand mathematical concepts well enough to be effective in teaching foundation phase mathematics

Question 24: I will find it difficult to explain to learners why a particular equation is right
Question 25: I am unsure if I have the necessary skills to teach mathematics

To further confirm their uncertainty towards their mathematics content knowledge, most of the participants chose a response coded b (negative):

Question 28: When a learner has difficulty understanding a mathematical concept, I will usually be at a loss as to how to help the learner understand it better
Question 13: I will not be very effective in monitoring mathematics activities

These negative responses would indicate that the student teachers are not confident in their mathematics content knowledge, in their ability to assist learners with mathematical concepts or in their ability to monitor mathematics activities in the classroom. This further shows that they have lower self-efficacy beliefs towards their mathematics content knowledge. This finding supports Giles et al.'s (2016) argument that teachers who are not confident in assisting learners with mathematical activities and are also not confident in their ability to monitor mathematics activities, generally have low self-efficacy beliefs towards their mathematics content knowledge. Aðalsteinsson et al. (2014) similarly mention that teachers with low self-efficacy beliefs are less likely to engage with their learners' enquiries with regards to mathematics in the classroom, as well as with assisting learners with mathematical difficulties.

On the contrary, most of the participants a response coded d (positive) for *Question 6: I am able to assist learners with mathematical difficulties* and for *Question 29: I will typically be able to answer learners' mathematics questions.* The majority of them also chose a response coded e (strongly positive) for *Question 27: When I teach mathematics, I will usually welcome learner questions*. These conflicting results are addressed in the next phase of data analysis in Section 4.3.

It is important to note that the majority of the participants chose a response coded a (strongly negative) for *Question 3: I feel that my mathematics knowledge does not need to be improved*. This reveals that even though they are uncertain about their mathematics ability, they are aware that it needs to be improved. This highlights that these student teachers are willing to improve their mathematics content knowledge which may increase their self-efficacy beliefs.

Teachers' self-efficacy beliefs also influence the amount of stress and anxiety they have when engaging with a task. With regards to *Question 4: I get nervous when tested on my mathematics knowledge*, many participants chose a response coded d (positive). This indicates that their lack of confidence and uncertainty in their mathematics content knowledge does not affect their physiological states. According to Pajares (1997), those with low self-efficacy beliefs are generally unable to manage threats that they experience and are more prone to anxiety and stress. However, the student teachers' low emotional response to being tested on their mathematics content knowledge could be because they are referring to teaching concepts that they are confident in or situations where they had good mathematics teaching experiences. This is further discussed in Section 4.3 where the participants were given the opportunity to elaborate further on their confidence towards their mathematics ability and mathematics teaching experience.

4.2.2.2 Research sub question 2: What are the BEd foundation phase fourth year student teachers' self-efficacy beliefs towards their mathematics teaching ability?

Table 4.3: Represents the mode of each question

	Questions	Mode	Category of mode
Q 2	When I get asked to teach mathematics I start feeling stressed or anxious	d	Positive
Q 5	I enjoy teaching mathematics	c	Neutral
Q 7	I would prefer to be evaluated on a mathematics lesson by a lecturer	e	Strongly positive
Q 9	I have had only good experiences when teaching mathematics	d	Positive
Q 10	I am not motivated to improve my mathematics skills	a	Strongly negative
Q 11	If I could choose, I would never become a mathematics teacher	a	Strongly negative
Q 14	When a learner does better than usual in mathematics, it is often because the teacher exerted a little extra effort	d	Positive
Q 15	I will continually find better ways to teach mathematics	e	Strongly positive
Q 16	Even if I try very hard, I will not teach mathematics as well as I will most subjects	a	Strongly negative
Q 17	When the mathematic grades of learners improve, it is often due to their teacher having found a more effective teaching approach	e	Strongly positive
Q 19	I will generally teach mathematics ineffectively	b	Negative
Q 21	Increased effort in mathematics teaching produces little change in learners' mathematics achievement	e	Strongly positive

Q 22	The teacher is generally responsible for the achievement of learners in mathematics	e	Strongly positive
Q 23	When a low-achieving learner progresses in mathematics, it is usually due to extra attention given by the teacher	e	Strongly positive
Q 26	Given the choice, I will not invite the principal to evaluate my mathematics teaching	c	Neutral
Q 31	The inadequacy of a learner's mathematics background can be overcome by good teaching	c	Neutral
Q 30	I do not know what to do to make learners like mathematics	e	Strongly positive

Table 4.3 clearly indicates that most of the participants chose a response coded a (strongly negative) for *Question 11: If I could choose, I would never become a mathematics teacher*. This negative response indicates that they have low self-efficacy beliefs towards their mathematics teaching ability. This supports McGuire's (2016) argument that student teachers who have low self-efficacy beliefs are more likely to be dissatisfied with being a mathematics teacher.

Most of the participants are unsure if they enjoy teaching mathematics as they chose a response coded c for *Question 5*. According to McGuire (2016), a teacher's enjoyment in mathematics may influence their self-efficacy beliefs towards teaching it. Thus, the student teachers' uncertainty in their enjoyment in teaching mathematics negatively influences their self-efficacy beliefs towards teaching it.

The participants showed that they are not confident in their ability to teach mathematics as they chose a response coded a (strongly negative) for *Question 16: Even if I try very hard, I will not teach mathematics as well as I will most subjects.* It can be said that their uncertainty in their enjoyment of teaching mathematics negatively influences their ability to teach mathematics (McGuire, 2016). The participants' negative response to *Question 16* indicates that they have low self-efficacy beliefs towards their mathematics teaching ability (McGuire, 2016).

The results reveal that the student teachers feel that they are unable to teach mathematics effectively. This can be seen by the participants' response where they chose a response coded b (negative) was selected for *Question 19: I will generally teach mathematics ineffectively*. This negative response also shows that they have low self-efficacy beliefs towards their mathematics teaching ability. This supports McGuire's (2016) argument that teachers who doubt their ability to teach mathematics effectively may have low self-efficacy beliefs.

According to Pendergast et al. (2011), a teacher's content knowledge of a subject may have a major influence on their self-efficacy beliefs towards teaching it. The more confident teachers are in their mathematics content knowledge, the higher their self-efficacy beliefs would be towards teaching it (Pendergast et al., 2011). The participants' low self-efficacy beliefs towards their mathematics content knowledge could be a contributing factor to their low self-efficacy beliefs towards their mathematics teaching ability. This is further discussed in the next phase of data analysis in Section 4.3.

Even though the participants are not confident in their mathematics teaching skills, they did not feel the need to improve them. This is evident when most of the participants chose a response coded a (strongly negative) for *Question 10: I am not motivated to improve my mathematic teaching skills*. As previously stressed in Section 2.2.2, motivation is not self-efficacy, but it does play an influential role in affecting individuals' self-efficacy beliefs (Bandura, 1989b). In other words, for their further professional development, student teachers' self-efficacy beliefs may influence their motivation to improve their teaching skills (Komarraju & Nadler, 2013). The participants' response reveals that they have low self-efficacy beliefs towards their mathematics teaching ability. This supports Komarraju and Nadler's (2013) claim that teachers who have low self-efficacy beliefs are generally not motivated to work harder and do not use self-regulation processes such as setting goals to improve their teaching skills.

On the other hand, the participants chose a response coded e (strongly positive) for *Question 15: I will continually find better ways to teach mathematics*. The participants' positive response shows that they are willing to find better ways to teach mathematics which indicates high self-efficacy beliefs. However, this indecisiveness between not wanting to improve their mathematics teaching skills and their determination to find better ways to teach mathematics, is a sign that they have low self-efficacy beliefs towards their mathematics teaching ability (Pendergast et al., 2011).

The participants chose a response coded d (positive) for *Question 2: When I get asked to teach mathematics I start feeling stressed or anxious.* This suggests that while they are conscious of their lack of confidence in their mathematics teaching ability, they experience it is as controllable. With regards to their mathematics teaching experience, most of the participants chose a response coded d (positive) for *Question 9: I have had only good experiences when teaching mathematics*. It can be concluded again that these student teachers' low self-efficacy

beliefs towards their mathematics teaching ability does not affect their emotions or feelings towards teaching it and this is probably because they have had good mathematics teaching experiences.

Even though the participants are not confident in their ability to teach mathematics, most of them are willing to be critiqued by their lecturers. This is evident as most of them chose a response coded e (strongly positive) for *Question 7: I would prefer to be evaluated on a mathematics lesson by a lecturer*. On the contrary, they are unsure if they would invite the principal to evaluate their mathematics lesson. This can be seen as the majority of the participants chose scale item 3 (neutral) for *Question 26: Given the choice, I will not invite the principal to evaluate my mathematics teaching*. This indicates that their confidence in their mathematics teaching ability affects the way they feel about teaching in front of their learners' principal. This suggests that the confidence they feel about teaching mathematics in front of others, is relative to their relationship with that person. For this reason, these student teachers have low self-efficacy beliefs towards their mathematics teaching ability (Giles et al., 2016).

Many of them are aware that their mathematics teaching ability affects their learner's mathematics achievement, as most of the participants chose a response coded e (strongly positive) for the following questions:

Question 23: When a low-achieving learner progresses in mathematics, it is usually due to extra attention given by the teacher

Question 17: When the mathematic grades of learners improve, it is often due to their teacher having found a more effective teaching approach

Question 22: The teacher is generally responsible for the achievement of learners in mathematics

In addition, they chose a response coded d (positive) for *Question 14: When a learner does better than usual in mathematics, it is often because the teacher exerted a little extra effort*. The participants also chose a response coded e (strongly positive) for *Question 21: Increased effort in mathematics teaching produces little change in learner's mathematics achievement* and scale item 3 (neutral) for *Question 31: The inadequacy of a learner's mathematics background can be overcome by good teaching*. Teachers with a high self-efficacy beliefs recognise the influence they have over learners' achievement and motivation (Aðalsteinsson et

al., 2014). Even though the participants are aware of the impact their teaching has on the learners' mathematics achievement, they did previously reveal that they are unable to assist learners with mathematical difficulties. This again indicates that they have low self-efficacy beliefs towards their mathematics teaching ability (Aðalsteinsson et al., 2014; Giles et al., 2016).

Most of the participants chose a response coded e (strongly positive) for *Question 30: I do not know what to do to make learners like mathematics*. This shows that they have low self-efficacy beliefs towards their mathematics teaching ability. This is supported by Aðalsteinsson et al.'s (2014) argument that student teachers with low self-efficacy beliefs are usually unable to encourage learners to like mathematics. S

4.2.3 Likert questionnaire summary

The following summary answers the main research question: *What is the BEd foundation phase fourth year student teachers' self-efficacy beliefs towards teaching mathematics?* This is done by summarising the analysis of the two sub questions: *What are the BEd foundation phase fourth year student teachers' self-efficacy beliefs towards their mathematics content knowledge?* and *What are the BEd foundation phase fourth year student teachers' self-efficacy beliefs towards their mathematics teaching ability?*

4.2.3.1 Research Question 1: What are the BEd student teachers' self-efficacy beliefs towards teaching mathematics?

As seen in *Question 8*, the participants feel that their mathematics ability affects their mathematics teaching ability. This supports Bandura's claim that student teachers' self-efficacy beliefs mediate between their content knowledge and their teaching skills (1997). Due to the fact that a teacher's content knowledge influences their mathematics teaching ability and vice versa, these two sub questions provide an answer to the main research question: *What is the BEd foundation phase fourth year student teachers' self-efficacy beliefs towards teaching mathematics?*

The results from the Likert questionnaire indicate that the BEd foundation phase fourth year student teachers have low self-efficacy beliefs towards teaching mathematics.

In the following section I discuss the analysis and findings of the open-ended questionnaire and interview results.

4.3 Open-Ended Questionnaire and Focus Group Interview Results and Data Analysis

This section will firstly discuss the process of analysing the open-ended questionnaires and focus group interviews. Secondly, the results and various themes identified in the open-ended questionnaire and focus group interviews will be described. Lastly, these themes will be analysed and discussed by referring to the literature provided in Chapter Two and illustrated by selected quotes identified in the findings in the open-ended questionnaire and focus group interviews.

4.3.1 The process of analysing the open-ended questionnaires and focus group interview results

The open-ended questionnaires and focus group interviews both answer the second main research question: *What are the self-reporting factors that influence the BEd foundation phase fourth year student teachers' self-efficacy beliefs?*

The open-ended questionnaires and interviews underwent thematic analysis separately. As mentioned in Section 3.8, this research adopted the Braun and Clarke method of thematic analysis. This method consists of six stages: familiarising yourself with your data, generating initial codes, searching for themes, reviewing the themes, defining and naming themes and producing the report (Nowell et al., 2017). The following section discusses the process in more detail of how the open-ended questionnaires and interviews were analysed using these six stages.

Stage 1: Familiarising yourself with your data

As described in Section 3.5, the open-ended questionnaires were conducted first. Following Braun and Clarke's recommendation that researchers read through all the data sets before beginning coding (Nowell et al., 2017), I read through all their responses in order to immerse myself in the data and get a sense of its texture. By reading through all the questionnaires, I was able to familiarise myself with possible themes and patterns. I was also able to identify the

general sense of why the student teachers have low self-efficacy beliefs towards teaching mathematics.

Once all the interviews were completed, I began transcribing the interviews myself in order to ensure reliability. During the transcription, I began writing down possible themes and patterns that emerged from the data.

Stage 2: Generating initial codes

Once I had familiarised myself with the data, I began the initial production of preliminary codes. I also coded the data sets myself instead of electronically, as I wanted the analysis to be reliable and accurate. During coding I identified important sections of text/quotes which could be used to support the analysis of each theme, as attaching sections of the text strengthens the analysis (Nowell et al., 2017).

I coded the interviews and open-ended questionnaire separately as discussed in Section 3.8.3. After coding both data sets, I arrived at the first broad finding: the open-ended questionnaires and the interviews had very similar code words. This indicates consistency in the participants' responses throughout the data collection process. The similarity in the coded words also strengthens the data analysis, as well as ensuring reliability and validity.

Stage 3: Searching for themes

Once all the code words were identified across both data sets, I started interpreting and analysing them. The codes identified in the open-ended questionnaires and the interviews were analysed together. The code words presented a definite pattern that could easily be grouped into respective main themes as well as sub themes.

Stage 4: Reviewing themes

Four main themes emerged from the data coding set. The validity of each individual theme was considered by referring back to the research question mentioned above. This ensured that the analysis reflected the purpose and meaning of this research. Once the themes were relevant, clear and meaningful to this research, I then created a 'thematic' map/content mind map. This mind map included the four main themes, their respective codes, selected texts/quotes as

evidence from the data, as well as relevant literature addressed in Chapter Two. The thematic map created a bigger picture of the analysis and enabled me to find relationships between codes and themes which in turn created subthemes.

Stage 5: Defining and naming themes

This stage entailed refining and defining the themes and sub themes. It was important to ensure that the names of the themes were clear working definitions that captured the essence of each theme in a concise manner. In order to strengthen the themes, many of the subthemes were named after text/quotes found in the data set. As previously mentioned, these subthemes that were named after texts or quotes are in quotation marks. The themes and subthemes that emerged from the data are presented in Table 4.4 below.

Table 4.4: Indicating the themes and subthemes

Theme 1: Knowledge effects on teaching confidence	*Sub theme 1*	*"I'm not very confident in every maths concept"*
	Sub theme 2	*"I would only teach a concept I feel comfortable in"*
	Sub theme 3	*"Mathematic courses affected the way I feel about teaching it".*
Theme 2: Teaching experience vs schooling experience	*Sub theme 1*	*"Through experience I gained confidence"*
	Sub theme 2	*Learning from teaching*
	Sub theme 3	*Teaching environment*
	Sub theme 4	*"The challenge is language"*
	Sub theme 5	*Learning from their learning*
Theme 3: The role of support	*Sub theme 1*	*"I don't seek support from colleagues"*
	Sub theme 2	*"I got support from my mentor teacher"*
Theme 4: The role of emotion		

Stage 6: Producing the report

This stage entailed the analysis of the themes in relation to the literature discussed in Chapter Two and is addressed in Section 4.3.2 below.

This section makes reference to the texts/quotes identified in the open-ended questionnaire and focus group interview. As mentioned in Section 3.9.2, the participants were given the option to write a pseudonym of their choice on the open-ended questionnaire. In order to ensure

anonymity, the participants' pseudonyms that they provided are used in the discussion below. The participants who were selected to take part in the focus group interview and those who did not provide a pseudonym on the open-ended questionnaire are named using alphabetic letters. The texts/quotes identified in the open-ended questionnaire and focus group interviews are presented using italics and quotation marks. I decided to choose the direct quotes/text provided by the participants identified in these two data sets. The direct quotes/text make the analysis more reliable and for this reason I did not grammatically correct any of the participants' responses.

4.3.2 Discussion of findings

As identified in the Likert questionnaire, the student teachers have low self-efficacy beliefs towards teaching mathematics. This section provides more nuances to this finding and discusses the reasons why the participants have low self-efficacy beliefs towards teaching mathematics. As mentioned in the beginning of this section, it answers the research question: *What are the self-reporting factors that influence the BEd foundation phase fourth year student teachers' self-efficacy beliefs?*

4.3.3 Theme 1: Knowledge effects on teaching confidence

The Likert questionnaire results indicate that the majority of the participants are uncertain whether they are able to teach mathematical concepts effectively, as well as the extent to which they can assist learners with mathematical difficulties. This broad theme is divided into three subthemes namely: "*I'm not very confident in every maths concept"; "I would only teach a concept I feel comfortable in";* and "*Mathematic courses affected the way I feel about teaching it".*

4.3.3.1 Sub theme 1: "I'm not very confident in every maths concept"

In the open-ended questionnaire and focus group interviews, the participants discussed their uncertainty of their ability to teach mathematical concepts.

When the participants were asked about their feelings towards mathematics, they stressed that they are not confident in all mathematical concepts. They made use of bold statements to express their feelings towards certain mathematical concepts, for example: *A: "I'm not very*

confident in every maths concept" and *B:* "*In some of the concepts, I don't really feel confident".* These bold responses indicate that they are aware and certain of their feelings towards their mathematics content knowledge. These student teachers' lack of confidence in their mathematics content knowledge, is a contributing factor to their low self-efficacy beliefs towards teaching mathematics. This is supported by Bekkdemir (2010) who argues that intellectual factors such as mathematics content knowledge, affects individuals' self-efficacy beliefs.

The participants then explained their feelings towards certain mathematical concepts in more detail, by describing the reasons for not being confident. It was revealed that they doubt their cognitive ability to do mathematics as seen in this statement: *Mama: "I feel less confident about teaching it because I am not a genius in it".* This indicates that these student teachers believe that they are not experts in mathematics. They also implied that a mathematical mind is needed in order to do mathematics as they made use of phrases such as: "*I am not a genius in it".* According to Swars et al. (2006), mathematics anxious individuals believe they are 'no good' at mathematics. From their responses, I concluded that the student teachers are mathematically anxious as they believe that they are not good at mathematics. Kinnenun (2012) further supports this and states that confident teachers perceive themselves as 'good' teachers. The participants' doubtful claims in their ability to do mathematics, negatively influences their confidence in teaching mathematics. Swars et al. (2006) also explains that mathematics anxiety is not a dislike for mathematics, but a feeling of discomfort which impacts a teacher's confidence and the participants suggest that this is the case for them when they used the phrase *– less confident in teaching it.*

4.3.3.2 Sub theme 2: "I would only teach a concept I feel comfortable in"

The participants also discussed their feelings towards teaching these challenging mathematical concepts. They revealed that they do not only lack confidence in certain mathematical concepts, but they also strongly object to teaching these challenging concepts. This can be seen in participant *A's* response: *"I cannot just go and teach a concept I don't feel comfortable in, no".* This straightforward response also shows that they find it impossible to teach a concept that they are not confident in. Many of the participants used the strong negative *'no'* in order to justify their feelings towards teaching challenging mathematical concepts. Kinnenun (2012) stresses that student teachers' self-efficacy beliefs may affect how well they cope during their

teaching practical. Their reluctance to teach certain mathematical concepts affects their teaching practice experience and therefore contributes to their low self-efficacy beliefs towards teaching mathematics. This supports Jojo's (2019) argument that poor content knowledge is a factor influencing student teachers' motivation to teach mathematics in South Africa, as previously mentioned in Section 1.2.3.3.

Many of the participants also made use of the word *avoid* when describing their feelings towards teaching challenging mathematical concepts. For example, participant *C* said: *"I avoid by all means, I'd rather get help"*. The student teachers' eagerness to avoid teaching certain mathematical concepts also reveals that they have mathematics anxiety. Further to this, Sloan (2010) states that mathematics anxious teachers believe that there is more leeway in avoiding certain concepts in the foundation phase. This avoidance also indicates that the participants are not motivated to teach challenging concepts. Bandura (1997) clarifies this by stating that teachers with low self-efficacy beliefs will not teach a concept they are not confident in.

Some of them argued that they would only introduce the challenging mathematical concept and leave the rest of the teaching responsibility to other teachers. Participant *D*, for example, said: "*I just make the introduction for them so when they go to the upper grade, they can at least understand, they can get to know it"*. This does not only prevent them from gaining experience but also hinders them from learning the skills of teaching these challenging concepts. Bandura (1997) states that teachers with low self-efficacy beliefs will most likely avoid putting in effort to improve their knowledge on mathematical concepts and may have little motivation to understand these concepts (Remirez et al., 2018). The student teachers not being motivated or determined to teach challenging mathematical concepts, is another contributing factor to their low self-efficacy beliefs towards teaching mathematics.

The participants stressed that there are two reasons why they choose to avoid teaching mathematical concepts that they are not confident in. Firstly, they are concerned that their feelings towards challenging mathematical concepts will affect the learners in the classroom, as seen in this quote: *Nopinki:* "*If the teacher is negative or positive about the subject, the learners will catch it"*. According to Cantrell (2003), a teacher's self-efficacy beliefs are influenced by their ability to help learners learn (as cited in Olson, 2014). Therefore, the student teachers concern regarding the impact their negative feelings might have on their learners, is

another contributing factor towards their low self-efficacy beliefs towards teaching mathematics.

Secondly, the student teachers also choose to rather teach concepts they are confident in because they are worried about the impact their limited mathematics content knowledge will have on the learners. Participant *A'*s statement indicated this: "*I don't want to go and fill their minds with, with something that is not correct*. *Sometimes we confuse ourselves, then we tend to confuse the learners that we teaching and then they don't grasp the concept".* This response further supports the notion that the participants do not have confidence in their ability to teach these challenging mathematical concepts.

This last concern is bound up with student teachers' sense of responsibility for their learner's mathematical achievement. This can be seen in this participant's response: *A: "If learners don't understand, you feel like you have failed".* Aðalsteinsson et al. (2014) argue that motivation and performance are important reinforces of student teachers' behaviour. The participants' lack of confidence causes them to doubt their mathematical teaching performance (Aðalsteinsson et al., 2014). It can be concluded that their lack of confidence and their concern of negatively influencing their learners' achievement, while showing an appropriate professional concern, are all contributing factors to their low self-efficacy beliefs towards teaching mathematics.

The Likert questionnaire indicated conflicting results as to whether the participants are able to assist learners with difficulties and help them understand certain mathematical concepts. The above analysis concluded that student teachers are not confident in assisting learners with difficulties, as they are concerned about the implications their low self-efficacy beliefs towards mathematics will have on the learners they teach.

4.3.3.3 Sub theme 3: "Mathematics courses affected the way I feel about teaching it"

The student teachers also felt that the mathematics courses at university influenced their lack of confidence towards teaching challenging mathematical concepts. As previously mentioned in Section 1.2.3.2, student teachers may blame their teacher training programmes and their lecturers for their unsuccessful transitioning into the school working environment (Sayed & McDonald, 2017).

The participants stressed that they are unable to apply what they have learned in the mathematics courses at university. They characterised the transition from university to the teaching world in a very negative way by using words such as, *bombarded*. This indicates that the mathematics courses at university make them feel overwhelmed. Evidence of this can be seen in the following quotes: *B: "Although we get taught a lot in class, it's so difficult to put into practical use"*; *A: "You are bombarded with theory … then you have to apply* w*hat you are taught in university, like it's totally different from when you get into the schooling experience".* The student teachers reveal that they feel unprepared when entering the teaching practical which contributes to their low self-efficacy beliefs towards teaching mathematics. They stressed that adequate teaching methods and techniques need to be taught in the university mathematics courses.

The participants explained that their confidence in mathematics changes depending on the environment. They stressed that they feel more confident in the mathematics lecture venue at university than in the classroom during teaching practice. It can be said that the student teachers did not feel secure in their ability to teach mathematical concepts outside the university setting. For example: *D: "I am more confident in university, less confident when I have to teach".* According to Bekkdemir (2010), environmental aspects such as a lecture venue influences a teachers' confidence and self-efficacy beliefs. Student teachers seem to view the lecture room as a safety net and this contributes to their low self-efficacy beliefs towards teaching mathematics when in the classroom.

The participants also reflected that they lack confidence in mathematics because certain mathematical concepts are not covered in sufficient depth in the mathematics courses at university, as shown by participant *D*'s concern: "*I'm not confident in teaching maths, the lecturers have not covered enough in order for us to be confident".* Thus, the student teachers depend on these mathematics courses to improve their content knowledge, especially with regards to those concepts they find challenging. This indicates the importance of the teaching programme and the mathematic courses at university. Therefore, they have low self-efficacy beliefs because they are not properly equipped with all the mathematics content knowledge that is needed to teach mathematics.

The participants also explicitly stressed that the constant change of mathematics lecturers at university has caused an amount of instability and confusion. They mentioned how this impacts

their confidence towards teaching mathematics. Participant *C* provided a detailed statement: "*Different lecturers each and every term, I feel like there's a lot of confusion, there's no consistency. I feel like if there was consistency, I would've felt confidence in what I was teaching and the quality of it".* Thus, the disruption of mathematics lectures is a contributing factor to their inability to learn mathematical concepts effectively.

4.3.4 Theme 2: Teaching experience vs schooling experience

The participants went in-depth about their teaching experience and their background schooling experience. They stressed that both these experiences influenced their confidence and self-efficacy beliefs towards teaching mathematics. This broad theme is divided into five sub themes namely: *"Through experience I gained confidence"*; *learning from teaching; the teaching environment; "the challenge is language"; and learning from their learning.*

4.3.4.1 Sub theme 1: "Through experience I gained confidence"

In the Likert questionnaire, interviews and open-ended questionnaires, the participants showed that they have had good teaching practical experiences. They also felt that the teaching practical enabled them to experience what it was like to be a teacher and referred to their experience as an eye-opener, for example: *A: "Planning a lesson* and *going to the schools and having that opportunity to teach maths. … It was eye-opening"* and *Zenno: "My experiences with teaching maths have been eye-opening".*

The participants also described their initial feelings about teaching mathematics before entering the teaching practical. They revealed that they had low confidence as well as doubt in their ability to teach mathematics. The student teachers' statements revealed this: *D: "Before my maths lesson on TP, I was not so confident about the lesson … when I first started I doubted myself"*. These doubtful feelings towards teaching mathematics before entering the teaching practical, indicates that they had low self-efficacy beliefs towards teaching mathematics. This supports Usher and Pajares (2009) argument, that student teachers may have a low sense of self-efficacy beliefs towards teaching mathematics before entering the field.

They also discussed how the teaching practical influenced their confidence towards teaching mathematics. The following quote revealed that the student teachers gained more confidence towards the end of the teaching practical: *B: "Towards the end of my TP I was more confident*

in maths". Thus, the teaching practical experience had a positive impact on their self-efficacy beliefs towards teaching mathematics. Usher and Pajares (2009) confirm that successful teaching experiences are vital in building a teacher's self-efficacy beliefs. The participants' appreciation for the teaching practical highlights the importance of such experiences.

4.3.4.2 Sub theme 2: Learning from teaching

The participants later explained why they gained confidence towards the end of the teaching practical. They stressed that the teaching practical provided them with the opportunity to carry out important tasks such as planning and implementing lesson plans and helped them learn new strategies and teaching methods, as seen in *Ella's* response: *"During my teaching experience I learned a lot of new strategies".* This highlights the importance of the teaching practical in building skills to become effective teachers. Bandura (1997) upholds this notion that through experience, one develops skills and self-regulating techniques. The participants stated that through learning new strategies and teaching techniques, their confidence in teaching mathematics increased: *D: "Through TP I learned new knowledge and gained confidence as to how to apply certain mathematical concepts".* Redmon (2007) argues that field experience may build teachers' self-efficacy beliefs along with skills and knowledge and this is confirmed in the current research. By gaining confidence through learning teaching strategies and techniques, the student teachers' self-efficacy beliefs towards teaching mathematics increased.

As previously mentioned, the participants conveyed their appreciation towards the teaching practical as it helped them gain confidence through learning new teaching skills and knowledge. However, the participants later confessed that their good teaching practical experiences only relate to the teaching of mathematical concepts that they are confident in. This is evident in this quote: *B: "Teaching experience depends on the concept and confidence in the content being taught"*. The participant's argument coincides with Olson's (2014) claim that teacher self-efficacy is context-specific. In other words, a teacher's self-efficacy is subject to the specific content and concept that is being taught (Olson, 2014). As identified in the previous theme, they do not teach mathematical concepts that they are not confident in, therefore their increased self-efficacy beliefs are only related to those mathematical concepts that they prefer teaching. In conclusion then, they only learn new teaching strategies and techniques from mathematical concepts that they teach.

4.3.4.3 Sub theme 3: Teaching environment

The participants asserted strongly that their teaching experience also depends on the classroom environment in which they teach mathematics. The following section therefore discusses how the teaching environment contributes to their self-efficacy beliefs towards teaching mathematics.

The participants explained that the classroom environment in which they teach mathematics affects the way they feel about teaching it. As mentioned above, the student teachers would rather avoid teaching a mathematical concept that they are not confident in. They stressed that it is vital for them to be in an environment where they have control over what mathematical concepts they want to teach. If they were in an environment where this option was not provided, they would view the experience as negative. Participant *A* stressed that: "*If I wasn't in a class where I had the freedom to choose … I would've DIED"*. Bandura (1997) argues that environmental factors strongly influence a teacher's psychological arousal and in turn influences a teacher's self-efficacy beliefs. The use of the word *died*, suggests that they would not be able to cope in such an environment. Strong psychological arousal of feelings of uneasiness, distress or in this case dying, shows that features of the environment are powerful contributing factors to their low self-efficacy beliefs towards teaching mathematics (Bandura, 1997).

On rare occasions, some of the BEd fourth year student teachers are not given the option to avoid teaching mathematical concepts that they are not confident in. In such situations, these participants described their teaching experiences in a negative way by using words such as *awful* and *terrible,* as seen in this example: *E: "There were experiences that was awful when I was teaching time and fractions"*. The participants spoke about these negative experiences by referring to certain mathematical concepts. In addition, 23 participants revealed that they are not confident in teaching fractions and time. Bandura (1997) argues that mastery of experiences raises a teacher's self-efficacy beliefs. However, there is a conundrum here: participants who taught challenging mathematical concepts did not have successful experiences and those who avoided teaching them, did not gain any experience. This lack of successful experiences is a contributing factor to the student teachers' low self-efficacy beliefs towards teaching mathematics (Bandura, 1997).

The participants also revealed that the behaviour of the learners in the classroom affects the way they feel about teaching mathematics. They explained that misbehaving learners in the classroom negatively affects their teaching practical experience. This was another indication that the teaching environment impacts their teaching experience and in turn their self-efficacy beliefs. Participant *G* described the experience of teaching learners who behave poorly as difficult: "*My experience was difficult because I had a noisy class … that was difficult to manage".* The student teachers' negative feelings towards teaching learners who behave poorly also show that they have mathematics anxiety (Bekkdemir, 2010). Thus, they have low self-efficacy beliefs towards teaching mathematics because many of them had misbehaving learners in their classrooms.

Another teaching environmental factor that impacts the student teachers' self-efficacy beliefs towards teaching mathematics, are their mentor teachers. They stressed that their mentor teacher's teaching style and techniques impact the way they feel about teaching mathematics. This supports Petersen's (2017) argument that student teachers may find it challenging to adjust to their mentor teachers' teaching style, as previously discussed in Section 1.2.3.2. Participant *B* revealed that they are not able to make the lessons their own: "*My mentor teacher had her own teaching style and this made teaching maths difficult".* Being told how to teach certain mathematical concepts prevents them from gaining successful experiences in teaching mathematics. Classroom environments where the mentor teachers are insensitive and unsupportive contribute to the participants' mathematics anxiety (Bekkdemir, 2010). Therefore, the mentor teachers have an influential impact on the student teachers' experiences.

4.3.4.4 Sub theme 4: "The challenge is language"

Language played an important role in impacting the participants' teaching practical experience. In particular, many taught in classrooms where their learner's mother tongue was isiXhosa, which impacted the way they taught mathematics.

They asserted strongly that teaching a mathematical concept in isiXhosa is challenging. Many of the participants described this experience as a *problem*, for example: *Thandwazintombi: "One of the huge problems that most of us face is teaching maths in isiXhosa".* The student teachers also mentioned that teaching in isiXhosa negatively impacts their confidence in teaching mathematics. This indicates that language is a prime contributing factor to their low

self-efficacy beliefs towards teaching mathematics. This supports Petersen's (2017) argument that many student teachers in South Africa may find it challenging to teach learners in an unfamiliar language, as previously discussed in Section 1.2.3.2. The participants also elaborated on their emotions towards teaching mathematics in isiXhosa, which is addressed in the theme below in Section 4.3.6.

On the other hand, language concerns did not only apply to the participants who were not isiXhosa speakers. Mother tongue isiXhosa student teachers were frustrated as they were unable to teach certain mathematical concepts in their home language. This is because they are uncertain of the isiXhosa terminology used to explain mathematical concepts. Nana's and Cherry's responses indicated this: *Nana: "As a Xhosa home language speaker, it has not been easy to teach maths because my vocabulary is limited for foundation phase"* and *Cherry: "I was struggling with isiXhosa vocabulary for maths".*

As mentioned before, a meaningful teaching experience is important as it builds a student teacher's self-efficacy beliefs (Oh, 2010). As discussed in this theme, the participants encountered many obstacles in the teaching environment during the teaching practical. In the open-ended questionnaires and interviews, the participants mainly focused on the negative experiences that occurred during the teaching practical. Bandura (1997) explicitly states that individuals who only focus on negative experiences generally have low self-efficacy beliefs. In conclusion, the student teachers' teaching practical experiences negatively impacted their self-efficacy beliefs towards teaching mathematics.

4.3.4.5 Sub theme 5: Learning from their learning

The participants explained that their background schooling experience impacted their confidence in mathematics and the teaching of it. This is evident in this participant's comment: *C: "I wasn't keen for maths and I think it's from my schooling experiences that I am also less confident in teaching maths. I never got the confidence to do maths".*

The participants then revealed that their background schooling experience had a profound impact on the way they feel about teaching mathematics. This is shown in participant *C*'s statement: "*My foundation phase contributed a lot on how I see maths and perceive it, how I understand it and how I respond to maths"*. Their inability to properly understand mathematical concepts explains why they lacked confidence in teaching mathematics to

foundation phase learners. Thus, their background schooling experience is another contributing factor to their low self-efficacy beliefs towards teaching mathematics. The participants also blamed their background schooling on their inability to teach mathematical concepts in isiXhosa, as seen in this participant's remark: *B: "The language was scary cause I come from a not so government background"*, meaning that she went to a private school and was not taught in isiXhosa.

The participants then went into detail about why their background schooling experiences affected the way they feel about teaching mathematics. They stressed that their foundation phase teachers are to blame for their negative feelings towards mathematics. They felt that their teachers did not teach them effectively, which is evident in the following quotes: *B: "I never had that one teacher who made maths exciting and doable … they would teach us to memorise it instead of understanding it and applying it to our daily lives". Grace: "In my primary school years I didn't acquire enough mathematical knowledge and I think I can blame my foundation phase teachers for that".* This also indicates the importance of proper teaching techniques and methods in foundation phase schooling. The participants explained that their negative feelings towards mathematics caused them to give up on learning mathematics as a subject: *A: "For me it was the most difficult thing, I ended up doing maths lit".*

4.3.5 Theme 3: The role of support

Bandura (1977) stresses that student teachers rely on the vicarious experiences of others and social support to improve their self-efficacy beliefs. In the open-ended questionnaire and interview, the participants expressed strong feelings about who they seek support from during the teaching practical. This theme is divided into two sub themes namely: "*I don't seek support from colleagues"* and "*I got support from my mentor teacher"*.

4.3.5.1 Sub theme 1: "I don't seek support from colleagues"

Many of the participants mentioned that they do not seek support from their colleagues. Kinnenun (2012) argues that the effectiveness of social encouragement depends on the relationship that the persuader has as well as the situation. The student teachers did not seek social support from their colleagues, as they saw them as being at the same level or struggling with the same problems. The participant *Bren* emphasised this: "*Comments from peers I don't*

find to have such an impact as they are all still new to this too". They prefer seeking advice from someone who has more experience in teaching mathematics.

The student teachers felt that the support they would receive from their colleagues would not be effective or have a major influence on their feelings towards teaching mathematics. This is evident in the following quote: *Bren*: *"They are all still new to this too so are not always going to provide constructive help"*. Bandura (1994) argues that when people with similar experiences succeed in a task, such as teaching mathematics, it gives others the belief that they too can succeed. This indicates that the participants doubt their colleagues' ability to teach mathematics effectively.

The participants argued that their peers are unable to give them encouragement and support towards teaching mathematics, as they all lack confidence in mathematics. This can be seen in these participants' statements: *Mic: "Many of the students feel the same way, many of them are uneasy about teaching maths, there is a large number of students who are not comfortable or confident in teaching maths"* and *G: "Most of my fellow students were also not confident in teaching maths therefore our feelings were mutual".* Tschannen-Moran and McMaster (2009) stress that student teacher's interpretation of their colleagues' experiences impacts their reason for seeking their support. They are aware that their colleagues may have had negative experiences in teaching mathematics because they lack confidence. Thus, they find it fitting to seek support from individuals who have had positive mathematics teaching experiences.

The participants lastly mentioned how the attitude of their colleagues influences the way they feel about teaching mathematics. As revealed in *Nana*'s comment: "*Their attitude or responses affect me in a way"*. Not only are the student teachers aware of their colleagues' low confidence in mathematics, but they are also aware that they may have a negative attitude towards mathematics. Hendricks (2016) discusses the role of modelling and argues that the attitude of the person that you model can affect your own persistence. Therefore, a student teacher observing someone who is optimistic is more likely to persist in the completion of a task (Hendricks, 2016). In this case, the student teachers did not want to seek support from someone who may potentially affect their performance negatively.

4.3.5.2 Sub theme 2: "I got support from my mentor teacher"

The participants maintained that they would rather seek support from their mentor teachers. They stressed that they received support from their mentor teachers during the teaching practical. The participants generally mentioned that the support they received from their mentor teachers was vital in order to survive teaching practice. As emphasised by *D: "I got support from my mentor teacher, she really supported me a lot during teaching practice".* During the teaching practical, two or more student teachers are frequently placed in the same school. Those who were alone in a school turned more to their mentor teachers for support, as explained by participant *D: "I was the only one on my TP in my school, so the support I got was from my mentor teacher".* This indicated that they relied on their mentor teachers for guidance and help during the teaching practical.

The participants then explained that their mentor teachers helped increase their general confidence in teaching. This can be seen in the following statement: *C: "Sometimes I don't feel confident when a lesson didn't go well, then I always bounced back because my mentor teacher was always supportive".* Bandura (1997) says that modelled behaviour with clear outcomes are more likely to increase an individual's behaviour. The phrase *bounced back* indicates that the support the student teachers received from their mentor teachers increased their resilience after failed lessons. This links to Bandura's (1997) argument that the more resilient one is after failure, the higher one's self-efficacy beliefs will become. They were aware that they would receive positive support from their mentor teachers, as their role and declared intention is to support them.

The participants discussed how observing their mentor teachers increased their confidence and in turn their self-efficacy beliefs towards teaching mathematics. This can be seen in participant's *B's* explanation: "*Two weeks into my TP I felt more confidence after having watched how she does things".* This highlights the importance of observation during the teaching practical. Bandura (1997) claims that modelling someone who is successful increases one's self-efficacy beliefs. The student teachers observed teachers who had been identified as mentors because they were successful in teaching mathematics.

Many of the student teachers had good relationships with their mentor teachers. As shown in this participant's response: *A: "I had a very good relationship with the teacher"*. As mentioned

above, the effectiveness of social encouragement depends on the relationship and the situation (Kinnenun, 2012). As previously stated, the participants received support from their mentor teachers and were therefore exposed to many teaching strategies. As explained by participant *D: "The support that the teacher gives you at school, for me is brilliant and it's much more exposure and the support that I got from my mentor teachers, I learnt a lot from her".* It is argued that through exposure, teachers gain more confidence in their ability to manage classrooms and master experiences (Hoy & Spero, 2005). This highlights the importance of the teaching practical and the type of support received from mentor teachers.

As identified above, the student teachers were concerned about their ability to assist learners with difficulties. They mentioned that the social support they received from their mentor teachers helped them gain more knowledge on how to teach learners with barriers, for example: *D: "Mentor teacher support showed how to accommodate specific learners and how to include specific learners".* Such support is vital in building self-efficacy beliefs towards teaching mathematics. The participants also said that by observing their mentor teachers, they were able to learn new teaching techniques, styles and strategies. Participant *D* mentioned that: *"I observed a lot and I asked the teacher to teach challenging concepts so that I can know what techniques and styles to use"* and *C: "Mentor teacher supported me like very good because she gave me learning strategies to teach nicely".* It is argued that observing a teacher is beneficial as they transfer knowledge, skills and strategies (Tschannen-Moran & McMaster, 2009). On the other hand, observing is simply not enough, one must model and gain experience through teaching.

The participants seemed to rely heavily on the support of their mentor teachers. As mentioned before, they prefer observing instead of teaching mathematics lessons in which they do not feel confident, which is evident in this participant's statement: *C: "My teacher gave me a lot of time to observe things I didn't understand, such as fractions".* In certain situations, it is considered beneficial if student teachers observe lessons before attempting to teach them. However, there is a thin line between observing to build teaching skills and observing to avoid teaching. Tschannen-Moran and McMaster (2009) argues that when a student teacher observes a successful mathematics lesson, they are likely to view the teaching practical as manageable. The participants felt as though their mentor teachers were relieving them from teaching mathematical concepts that they are not comfortable in: *D: "When it comes to specific topic,*

such as time, she said if you are not comfortable in teaching it, I will do it". This avoidance allowed them to view the teaching practical as manageable ,as seen in the following quote: *D: "My mentor teacher gave me a free pass … just like teach what you want to do".* The student teachers were therefore, not gaining confidence in teaching challenging mathematical concepts. According to Oh (2010), teachers who rely a lot on the support from others have low self-efficacy beliefs. Their dependence on their mentor teachers to teach challenging mathematical concepts is a contributing factor to their low self-efficacy beliefs.

Individuals who are persuaded that they can succeed are more likely to take part in challenging tasks (Bandura, 1997). The student teachers were not persuaded that they could succeed in teaching challenging mathematical concepts and in turn were not motivated to try, as explained by participant *D: "My mentor teacher would take … the topics that I was not comfortable in and I take the ones that I am".* Redmon (2007) stresses that without social support, student teachers believe that they do not have the ability to teach, and that their efforts are insufficient. The participants did not receive feedback regarding the teaching of challenging mathematics concepts and therefore still believe that they are unable to teach them effectively. Tschannen - Moran and McMaster (2009) argue that social encouragement is aimed at strengthening student teachers' teaching skills. Thus, the student teachers have not yet developed the necessary skills to teach these challenging mathematical concepts.

The participants said that they received feedback on some of the mathematics lessons that they taught. They explained how feedback influences the way they feel about teaching mathematics. The student teachers argued that they can visually picture how a mathematics lesson will go according to the comments that they receive, as seen in *Nana*'s explanation: "*Comments can portray a picture in your head and see maths as difficult or easy to teach".* Tschannen-Moran and Hoy (2007) mention that encouragement can motive student teachers to achieve more goals and make them feel confident. The participants also discussed how positive and negative comments influence their motivation:

> *When given positive comments, I feel as though I am capable but when given negative comments are made, it demotivates me and positive comments show that something good is happening, negative comments bring me down and I feel as though I'm not giving my best. (G)*

This highlights the importance of verbal persuasion and its impact on student teacher motivation, as suggested by Hendricks (2016).

4.3.6 Theme 4: The role of emotion

In the Likert questionnaire, the participants revealed that they get nervous when tested on their mathematics knowledge. More than half of the participants further expressed negative emotions when asked in the open-ended questionnaire and focus group interviews about their feelings towards teaching mathematics. This theme further indicates that the majority of the participants explained their teaching experiences by referring to their emotions.

The participants revealed that their emotions towards mathematics influences the way they feel about teaching it, as identified in *Nana's* comment: "*My emotions affect the way I feel about maths and teaching it".* This highlights the importance and impact emotions have on performance and supports Pajares and Bandura's (1978) argument that high emotional arousal can negatively affect performance.

While any stressful situation may stimulate emotional arousal (Bandura, 1977), the participants mentioned that when asked to teach mathematics during the teaching practical, their negative feelings towards mathematics increased. This showed that the student teachers view teaching mathematics as something that is severely stressful. These elevated fear provoking thoughts can lead to elevated levels of distress and affect their self-efficacy beliefs (Bandura, 1978; Pajares, 1997). These increased negative feelings that they experienced when teaching mathematics is a contributing factor to their low self-efficacy beliefs towards teaching it.

Many of the participants used the word *dreadful* to describe their feelings towards teaching mathematics, as seen in this participant's quotes: *A: "I really don't like maths, it is one of the subjects that I dread … if I have to do a maths lesson then its dreadful".* The use of the word *dreadful* is another indication that the student teachers are mathematics anxious, as it is associated with words such as fear, unhappiness, suffering and unpleasantness. They also felt overwhelmed and defeated when they have to teach mathematics as seen in the quote: *C: "I feel defeated when I teach maths".*

Individuals judge their physiological state as a sign of vulnerability (Bandura, 1977). The student teachers' negative feelings towards teaching mathematics affects their ability to teach

it. This can be seen in the following quote where the participant was concerned that their feelings towards teaching mathematics may affect the learners that they teach.

> *If I am not happy or comfortable with teaching maths then I won't do any justice to learners. Instead I make them hate maths and if I have negative emotions towards maths then my learners will also feel the same way. (Mama)*

As discussed earlier, the student teachers are concerned that the learners may inherit their negative emotions towards mathematics. This indicated that they are aware of the impact their negative emotions towards mathematics has on the learners that they teach. Kinnenun (2012) argues that a strong physiological arousal may be a contributing factor to predicting failure. As identified, their negative emotions causes them to predict their failure in teaching mathematics.

Many of the participants also used the words *nervous* or *nerve-racking* when describing their feelings towards teaching mathematics. This was evident in the following quote: *G: "My experience in teaching maths has been nervous because there are a lot of maths components that I am not comfortable to teach"*. The participants' lack of content knowledge, as mentioned in the first theme, is a factor contributing to their negative emotions towards teaching mathematics. Pajares (1997) adds, that avoidance of stressful situations may prohibit the development of coping skills which results in a lack of competency and creates negative emotions such as nervousness, as indicated in the following quote: *Mic: "My feelings about maths make me avoid teaching it because I have little understanding of it".* This avoidance prevents them from learning coping strategies in order to deal with feelings of being nervous. Their inability to cope with negative emotions is another contributing factor to their low self-efficacy beliefs towards teaching mathematics. Hoy and Spero (2005) assert that feelings such as anxiety, stress and nervousness impact a teacher's self-efficacy beliefs and in turn create a belief that they are incapable of teaching effectively. Individuals interpret their mood or negative emotions as a sign that they will perform poorly (Bandura, 1994). This indicated another reason why the student teachers avoid teaching mathematics; they are concerned that they will teach it incorrectly.

Some of the participants discussed how they felt before the teaching practical. They mentioned that their feelings of being nervous began before entering the classroom environment, for example: *E* "*I felt nervous to teach it as I had not taught maths before".* The student teachers were nervous because they lacked experience in teaching mathematics. This indicated that they

had perceived ideas and feelings about teaching mathematics before being given the opportunity to do so. Poulou (2007) argues that these negative feelings towards mathematics may have an effect on their self-efficacy beliefs.

The participants also explained that language is another reason why they have high physiological arousal towards teaching mathematics. As mentioned in the previous theme, the student teachers are unable to teach certain mathematical concepts in isiXhosa. Their inability to perform this task causes them to feel nervous, as shown in participant *C*'s explanation*: "It's nerve-racking because there is a language issue".* Many of the participants also described their feelings towards such experiences as *scary*, as seen in *A* and *B*'s response: *"The challenge is language"* and *B: "When it comes to teaching for me, it was also scary because of the language".* This indicated that teaching mathematical concepts in isiXhosa has a negative impact on the way they feel about teaching mathematics. Such negative physiological arousal further supports the fact that language is a contributing factor to the student teachers' low self-efficacy beliefs towards teaching mathematics.

The participants also feel nervous because they are unaware of their learners' prior knowledge, as emphasised by participant *John Snow: "My experience in teaching mathematics was always nerve-racking because the assumed knowledge of the learners is not always there"*. This concern further indicated that the student teachers doubt their ability to teach mathematics effectively, especially when they need to depart from their prepared lesson plan.

As discussed in the previous theme, the participants compared their teaching methods to that of their mentor teachers: "*My teaching methods always differs to that of the host teacher"*. The differences between their teaching methods causes nervousness. This was another indication that the classroom environment affects the way the student teachers feel about teaching mathematics. It can be argued that the mathematics teaching style that they learn at university is different from their mentor teachers' methods.

The participants explained that their background schooling has impacted on their attitude towards mathematics, as identified in this quote: *C:* "*I did not have a pleasant experience when learning maths in FP and this did affect my attitude".* Negative attitudes towards teaching mathematics showed that the student teachers have mathematics anxiety (Kinnenun, 2012). As mentioned in the previous theme, many of the student teachers have had negative mathematics

learning experiences at school and this has impacted on the way they feel about teaching it. The participants stressed that their background schooling experience has influenced their feelings towards mathematics. They described their background schooling experience in learning mathematics in a negative way, by using words such as *scary*, *hate* and *fear*. This can be seen in the following quotes: *Dorry: "I grew up being scared of the subject, where at school we were made to fear maths as a subject"* and *A "I was one of those kids who hated maths … I hated maths like so much".* This revealed that their dislike towards mathematics began when they were younger. Using words such as *scary* and *fear* to describe their schooling experience is another indication that the student teachers are mathematically anxious (Kinnenun, 2012). This links to Bekkdemir's (2010) argument that a teacher's background schooling experience is often to blame for their mathematics anxiety. As previously mentioned in Section 1.2.3.1, student teachers' background schooling experience in learning mathematics may influence their feelings towards teaching it (Moodley at al., 2015). Tschannen-Moran and McMaster (2009) explain that mood plays an important role in an individual's physiological arousal. The student teachers had negative feelings and moods towards mathematics when they were younger, and it seems as though their feelings towards mathematics have not changed. This highlights the importance of a student teacher's own foundation phase schooling experience.

4.4 Open-Ended Questionnaire and Focus Group Summary

The analysis of the open-ended questionnaire and the focus group interviews supported the Likert questionnaire results, that the BEd foundation phase fourth year student teachers have low self-efficacy beliefs towards teaching mathematics.

This section answers the research question: *What are the self-reporting factors that influence the BEd foundation phase fourth year student teachers' self-efficacy beliefs?*

In summary, the factors that give rise to their low self-efficacy beliefs towards teaching mathematics are as follows:

- Their lack of confidence of certain mathematical concepts is a contributing factor to their low self-efficacy beliefs towards teaching mathematics. This influences their decision to not teach complicated mathematical concepts in the classroom which in turn fuels their low self-efficacy beliefs towards teaching it. The university mathematics

courses are another contributing factor to their low self-efficacy beliefs towards teaching mathematics.

- The skills and teaching techniques that they learned during teaching practice did increase their self-efficacy beliefs. On the other hand, because they avoided teaching challenging mathematical concepts, their self-efficacy beliefs towards teaching mathematics remain generally low. The challenging teaching environment and the issue of teaching mathematical concepts in isiXhosa is another contributing factor to their low self-efficacy beliefs towards teaching mathematics. The student teachers also had negative mathematics schooling experience which still affects their feelings towards mathematics and teaching of it which is reported to be a contributing factor to their low self-efficacy beliefs towards teaching mathematics.
- The student teachers relied heavily on their mentor teacher support. Their mentor teachers would teach all the mathematical concepts that they were not confident in. This in turn prevented them from gaining any experience. They also did not receive proper social support or constructive feedback. These are all contributing factors to their low self-efficacy beliefs towards teaching mathematics.
- They experienced a lot of negative emotions and feelings towards mathematics and the thought of teaching it. These feelings have affected their confidence in teaching mathematics. Their negative feelings and emotions are a contributing factor to their low self-efficacy beliefs towards teaching mathematics.

The next section discusses the results and analysis of the final focus group interview that was conducted after their final teaching practice. This analysis identifies any similarities or differences in the themes which explains the contributing factors to their low self-efficacy beliefs towards teaching mathematics. The final focus group interview adds reliability and validity to the participants' responses.

4.5 Final Focus Group Interview Results and Analysis

As previously discussed in Section 1.3, the main goal of this research is to bring awareness of BEd foundation phase fourth year student teachers feelings, thoughts and opinions towards teaching mathematics to foundation phase learners. As mentioned in Chapter Three, the data collection process commenced before their final teaching practice. The data collected and analysed before their teaching practice was sufficient and true to this research. However,

according to Bandura (1997), student teachers' self-efficacy beliefs are likely to change depending on their experiences during their teaching practice. Thus, in order to fulfil the research goal and purpose, I felt it was necessary to conduct one more phase of data collection in order to identify if their final teaching practice changed their self-reported factors influencing their low self-efficacy beliefs towards teaching mathematics. This last phase of data collection was comprised of a focus group interview that took place after their final teaching practice.

This section will firstly discuss the process of analysing the focus group interview data. The findings are then discussed by comparing the various themes identified in Section 4.3.1. A summary will then be provided to highlight the main points revealed in this analysis.

4.5.1 Process of analysing the focus group interview

After I transcribed the interview myself, I started analysing the results. As mentioned in Section 4.3.1, this research adopted the Braun and Clarke method of thematic analysis. Because this analysis aimed to identify any similarities and differences from the participants' responses, the themes and subthemes remained the same. In order to ensure that the analysis was reliable and valid, I decided to analyse the data using the six stages of thematic analysis discussed in Section 4.3.1. This was also to identify any additional themes that needed to be included in the discussion. After the thematic analysis, no additional themes or subthemes needed to be included. The themes and subthemes that emerged from the data are presented in Table 4.5 below.

Table 4.5: Indicating the theme and subthemes

Theme 1: Knowledge effects on teaching confidence	*Sub theme 1*	*"I'm not very confident in every maths concept"*
	Sub theme 2	*"I would only teach a concept I feel comfortable in"*
	Sub theme 3	*"Mathematic courses affected the way I feel about teaching it".*
Theme 2: Teaching experience vs schooling experience	*Sub theme 1*	Teaching environment
	Sub theme 2	Learning from teaching
	Sub theme 3	"The challenge is language"
Theme 3: The role of support	*Sub theme 1*	"I don't seek support from colleagues"
	Sub theme 2	"I got support from my mentor teacher"
Theme 4: The role of emotion		

4.5.2 Discussion of findings

This section aims to identify similarities and differences among the self-reporting factors contributing to student teachers' low self-efficacy beliefs towards teaching mathematics.

4.5.3 Theme 1: Knowledge effects on teaching confidence

In this section, three sub themes will be discussed: "*I'm not very confident in every maths concept";* "*I would only teach a concept I feel comfortable in";* and "*Mathematics courses affected the way I feel about teaching it"*.

4.5.3.1 Sub theme 1: "I'm not very confident in every maths concept"

The analysis of the open-ended questionnaire and interview responses revealed that the student teachers are not confident in teaching certain mathematical concepts which contributes to their low self-efficacy beliefs towards teaching mathematics. After their final teaching practice, it was identified that nothing much has changed regarding their confidence towards certain mathematical concepts. This can be seen where participant *A* compared her confidence towards her mathematics content knowledge: "*For me there is not much change".* Thus, the participants' discussion after their final teaching practice indicated that they are still not confident in certain mathematical concepts, for example, *B: "There are concepts that I still find difficult".* This showed that their confidence towards their mathematics content knowledge has not improved since their last teaching practice. It can be concluded that student teachers do not have confidence towards mathematics which remains a contributing factor to their low self-efficacy beliefs towards teaching mathematics.

It was also discovered in the open-ended questionnaire and interview results that the student teachers had mathematics anxiety as they expressed themselves as not being 'good' at mathematics (Swars et al., 2006). During the interview after their final teaching practice, they did not express themselves in the same way but it was identified that they still experience mathematics anxiety. This can be seen when participant *B* indicated that they are still not confident in their mathematics ability: "*I am not confident enough to do it"*. This indicated that they still feel the same way about teaching mathematics after their final teaching practice (Kinnenun, 2012). This further showed that mathematics anxiety remains a contributing factor towards the student teachers' low self-efficacy beliefs towards mathematics.

4.5.3.2 Sub theme 2: "I would only teach a concept I feel comfortable in"

The open-ended questionnaire and interview analysis identified that the student teachers would not teach mathematical concepts that they were not confident in. Bandura (1997) argues that through experience, one may gain confidence in one's ability to teach effectively. With Bandura's argument in mind, their confidence should have increased towards teaching mathematical concepts after their final teaching practice. This increased confidence would in turn improve their self-efficacy beliefs towards teaching mathematics (Bandura, 1977).

After their final teaching practice, they found some progress with regards to their confidence in teaching mathematics. This can be seen in *B*'s response*: "I have seen some progress, so I am a bit more confident in teaching it"*. Their progress only refers to teaching mathematics in general. This increased confidence in teaching mathematics in general, indicated that their final teaching experience did help improve their self-efficacy beliefs towards teaching mathematics. However, there were still some mathematical concepts that they are not confident in teaching: *A: "I am not fully confident in teaching fractions"* and *C: "I am still not confident in teaching time"*. This indicated a pattern with regards to specific mathematical concepts. The participants previously stressed that fractions and time are concepts that they find difficult to understand and teach. The above quotes showed that after their final teaching practice, they still found fractions and time to be challenging mathematical concepts. With regards to Bandura's (1977) argument, their final teaching practice did not increase their confidence towards teaching those specific mathematical concepts and therefore their self-efficacy beliefs towards teaching mathematics remained low.

In the analysis of the open-ended questionnaire and focus group interview, the student teachers argued that they do not only lack confidence in teaching certain mathematical concepts, but they would also avoid teaching it. After their final teaching practice, they showed that they would at least try and attempt to teach them, as seen in *A*'s response: *"I myself am going to try"*. This indicated an improvement in the student teachers' determination to gain more experience in teaching challenging mathematical concepts. They also indicated that they would feel more confident in attempting to teach a challenging mathematical concept if they could observe a lesson first. For example, *A* observed*: "I am going to get other teachers to teach it in my class so that I can see how to teach it"*. This indicated that the student teachers' motivation to teach challenging concepts had increased, but only on the basis that they observe

the lessons first. Even though their motivation had increased, they were still not entirely confident in their ability to teach challenging mathematical concepts without guidance and assistance. Thus, their need for assistance and guidance are contributing factors to their low self-efficacy beliefs towards teaching mathematics.

4.5.3.3 Sub theme 3: "Mathematic courses affected the way I feel about teaching it"

The participants previously revealed in the open-ended questionnaire and focus group interviews that their university mathematics courses negatively influenced their confidence towards teaching certain mathematical concepts. After their final teaching practice, they mentioned that they still hold the university responsible for not introducing them to successful mathematics teaching methods. This can be seen where participant *C* explained how their third year course still impacts their teaching confidence in fourth year: *"In university we did 2D and 3D shapes in third year but we never actually got taught how to teach it".* The student teacher's argument indicates that university courses still play a role in their lack of confidence towards teaching mathematical concepts and even a year later is still a contributing factor to their low self-efficacy beliefs towards teaching mathematics.

4.5.4 Theme 2: Teaching experience vs schooling experience

In this section three related sub themes are discussed: *Learning from teaching; Teaching environment and " The challenge is language".*

4.5.4.1 Sub theme 1: Teaching environment

The student teachers' teaching environment during their final teaching practice was slightly different compared to their other teaching practices, particularly in that many of them were sometimes left alone in the classroom. They described this situation as challenging, as can be seen when participant *C* mentioned: "*If I don't plan then no teaching will take place, it was challenging".* The participants also stressed how such an experience had a negative impact on their wellbeing. For example, *C* comments*: "I reached exhaustion by the 5th week because of the amount of work".* Such experiences contribute to their low self-efficacy beliefs towards teaching mathematics.

The participants previously revealed in the open-ended questionnaire and focus group interview that their mentor teacher's teaching style and techniques negatively impacts the way

they feel about teaching mathematics. After their final teaching practice, they again found that their mentor teacher's teaching style challenged their notions of mathematics teaching, as seen in this quote: *C: "Mentor's teaching was the real problem".* This was another indication that they still have mathematics anxiety as their teaching experience was negatively influenced by the classroom environment (Bekkdemir, 2010). Participant *A* went into detail and discussed the reasons why this was problematic: "*The problem I found with mathematics was teaching out of the DBE book because the teacher would just pick it up and explain the instructions".* Their responses showed that they do not have control over the classroom when their mentor teachers are present. Thus, their frustration with their mentor teacher's teaching style and techniques are still contributing factors towards their low self-efficacy beliefs towards teaching mathematics.

In the open-ended questionnaire and focus group interview, the participants stressed that their classroom environment has a significant impact on their teaching experiences and teaching confidence. After their final teaching practice, they discussed their concern about their potential classroom next year. As shown in these participants' explanations: *B: "Confidence depends on what class you have next year"* and *C: "It is the environment you get put into next year".* This revealed that the student teachers were still aware of the impact their classroom environment has on their confidence and therefore it remains an important contributing factor to their low self-efficacy beliefs towards teaching mathematics.

4.5.4.2 Sub theme 2: Learning from teaching

As indicated in the open-ended questionnaire and interview analysis, the participants learned various teaching strategies and skills. They also suggested that their good teaching experiences depended on the mathematical concepts that they taught and the level of confidence towards teaching those mathematical concepts. After the participants final teaching practical, they again revealed that they had learned new skills and techniques. This further supports the claim that teaching experience is valuable to the student teachers in developing knowledge, skills and teaching techniques (Bandura, 1997), as seen when *A* emphasised that: "*I had to manage time, I learned a lot on how to manage the class".* Hoy and Spero (2005) stress that through exposure, individuals gain more confidence in their ability to manage classrooms successfully and to master their teaching practice experience. This was evident during student teachers' final teaching practice as they gained more confidence in their ability to teach and manage a class.

After their final teaching practice, the participants also described their experience as beneficial as they had learned how to implement strategies and techniques that they had acquired during previous teaching experiences. This can be seen in this response: *C: "Being left alone in the classroom I could see if there was growth taking place. Being left in the deep end does wonders because I could implement strategies and approaches that you would want to see taking place"*. This supported their previous discussion in the open-ended questionnaire and focus group interview, that they would prefer to be in an environment where they have control over their teaching techniques and methods.

4.5.4.3 Sub theme 3: "The challenge is language"

The participants previously discussed in the open-ended questionnaire and focus group interview that language influenced their teaching practical experience. They stressed that teaching learners certain mathematical concepts in isiXhosa was challenging and affected their confidence towards teaching mathematics.

After the student teachers final teaching practice, they again expressed their concern towards teaching mathematics in isiXhosa or Afrikaans. This can be seen in *B*'s comment about teaching mathematics in isiXhosa: *"I find it difficult to teach maths in isiXhosa because I do not have the vocab, it is limited"*. This indicated that language was still a contributing factor to their mathematics anxiety and low self-efficacy beliefs towards teaching mathematics.

4.5.5 Theme 3: The role of support

In this section I will discuss two sub themes: "*I don't seek support from colleagues"* and "*I got support from my mentor teacher".*

4.5.5.1 Sub theme 1: "I don't seek support from colleagues"

In the open-ended questionnaire and focus group interview, the participants spoke of not seeking support from their colleagues as most of them were not confident in mathematics. They stressed that they would rather seek support from someone who is more experienced in teaching mathematics. During the student teachers final teaching practice, they still preferred to seek support from someone other than their colleagues. This showed that they still found their colleagues support towards mathematics to be insufficient.

4.5.5.2 Sub theme 2: "I got support from my mentor teacher"

The student teachers revealed in the opened-ended questionnaire and focus group interview that they received support from their mentor teachers. They discussed that through observation, they felt confident and learned teaching techniques and skills. As mentioned above, many of them were often left alone in the classroom during their final teaching practice. For example: *A*: *"My mentor teacher left the class for me"* and *B: "My mentor teachers was sometimes not in the class and sometimes there".* The participant's *A* and *C* then explained that their mentor teachers were sometimes busy with other school responsibilities, and put them in charge of the classroom: *A: "My mentor teacher was too busy, so I had to take the ropes"* and *C: "She was constantly busy with school things, I had to do everything".* Kinnenun (2012) argues the importance of observation and feedback in gaining new skills and techniques. The participants previously mentioned in the open-ended questionnaire and focus group interview, that they had received some feedback during their teaching practice. However, this was not the case during their final teaching practice. Being left alone in the classroom indicated that they did not receive the support and feedback that they needed. It is arguable that this impacts their ability to gain more confidence and in turn contributes to their low self-efficacy beliefs towards teaching mathematics (Redmon, 2007; Tschannen-Moran & McMaster, 2009).

The participants then elaborated more on the support that they received during their final teaching practice. Participant *C* explained the importance of support: *"To some extent you need some guidance and assistance from the mentor teacher. There needs to be some support".* Even though their mentor teachers were not always present in the classroom, they did seek their support by organising meetings after school, as seen in this quote: *C: "I would seek advice from my mentor teacher after school".* They also discussed how their mentor teachers helped them plan lessons: *C: "We would discuss the lessons for the next day"* and *A: "My mentor teacher would give advice on lessons and the resources that I would need"*. This revealed that the student teachers took initiative to find their mentor teachers and receive guidance and advice. This highlights the participants' need for support.

As revealed in the analysis of the open-ended questionnaire and focus group interview, the student teachers relied on their mentor teachers to teach challenging mathematical concepts which was detrimental to their self-efficacy beliefs towards teaching mathematics. During their final teaching practice, they still asked their mentor teachers to teach the challenging concepts

that they were not confident in. This can be seen in the following quotes: *C: "I wanted them to know when I did not want to teach something"* and *B: "My mentor teacher had to teach a concept that I didn't like; she didn't mind".* Even though they had a lot of experience in teaching on their own, they were still not confident in their ability to teach mathematics effectively. Thus, their limited experience in teaching challenging mathematical concepts is still a contributing factor to their low self-efficacy beliefs towards teaching mathematics.

4.5.6 Theme 4: The role of emotion

The participants previously described their mathematics teaching experience in the open-ended questionnaire and focus group interview as *dreadful* and *nerve-racking*. After their final teaching practice, they mentioned that they still feel anxious and nervous. Participant *A* discussed that taking over the responsibilities in the classroom made them feel anxious: *"All the responsibility made me feel anxious"*. They also discussed that they are still nervous with regards to teaching mathematics as seen in this quote: *A: "There are only some aspects of mathematics that I am a bit nervous in teaching".* This indicated that they still experienced mathematics anxiety and their negative feelings towards teaching mathematics is still a contributing factor to their low self-efficacy beliefs.

4.5.7 Final focus group summary

The student teachers' final teaching practice presented some of its own obstacles and new challenges. One of the biggest challenges that they faced during their final teaching practice was the teaching environment, in particular being left alone in the classroom with too much responsibility and not enough feedback. According to Bandura's (1989b) argument, these student teachers should have increased self-efficacy beliefs towards teaching mathematics after their final teaching practice. The mastery of successful teaching experiences should elevate their confidence. However, this was not the case for them, as after their final teaching practice, the student teachers' self-reporting factors contributing to their low self-efficacy beliefs were similar to those identified in the analysis of the open-ended questionnaire and focus group interviews. In other words, their final teaching practice did not influence their self-efficacy beliefs towards teaching mathematics. This indicates that additional experience does not necessarily give a sense of mastery.

In Chapter Five below, I explain the significance of this research and the importance of self-efficacy theory. I then answer the main research question again by discussing the key findings gathered in all three phases of data analysis identified in Chapter Four.

CHAPTER FIVE: CONCLUSION

5.1 Introduction

This research was guided by the question:

What is the BEd foundation phase fourth year student teachers' self-efficacy beliefs towards teaching mathematics and what are the self-reporting factors that give rise to these self-efficacy beliefs?

The research question enabled me to uncover the participants' feelings, thoughts and opinions towards their mathematics content knowledge, as well as their mathematics teaching ability.

This chapter begins by highlighting the significance of this research and the importance of the self-efficacy theory. It will then discuss the key findings and the insights that emerged from this research. This is followed by the research limitations and recommendations for future research. This thesis is then concluded with some final words, where I discuss my personal experience in conducting this research.

5.2 Significance of this Research and Self-Efficacy Theory

In South Africa, foundation phase student teachers are underperforming in teaching mathematics and research relating to foundation phase teaching suggests that motivation is one of the main reasons for this (Jojo, 2019). Improving the education system may take a considerable amount of time and effort, but improving student teachers' motivation and self-efficacy beliefs is feasible. Considerable effort has been put into improving the quality of foundation phase teaching across the country, in order to improve retention and quality across the system (Armstrong, 2014). In light of this, the focus of this research is on foundation phase student teachers. It has been identified that motivation among student teachers provides the resilience which encourages them to remain in the teaching profession. Statistics have revealed that these student teachers are leaving the teaching profession within the first few years of teaching, indicating their demotivation (Armstrong, 2014). Studies have shown that intrinsic and extrinsic factors that motivate student teachers are opportunity costs, job satisfaction, background schooling experience, teaching environment, transition period, language, classroom size and insufficient support and inadequate mathematics content knowledge

(Wolhuter et al., 2012; Armstrong, 2014; Moodley et al., 2015; Petersen, 2017; Sayed & McDonald, 2017). Previous studies have explicitly stated that motivation is not self-efficacy, but that these two concepts influence each other (Bandura, 1977). Self-efficacy is the fundamental basis for creating an individual's persistence, motivation and determination.

The main goal of this research was to raise awareness among researchers, teacher training programmes and student teachers of the BEd foundation phase fourth year student teachers about their self-efficacy beliefs towards teaching mathematics. This research also aimed to provide further insights into student teachers' self-efficacy beliefs towards teaching mathematics.

This provides a platform from which further research can develop intervention strategies to improve student teachers' self-efficacy beliefs. Teacher training programmes are responsible for preparing and equipping student teachers with the necessary skills, techniques and knowledge. Awareness of their student teachers' self-efficacy beliefs towards teaching mathematics will enable them to reflect and make the necessary changes to the university mathematics courses.

Self-efficacy theory is a psychological theory which was established by Bandura in the 1980s. The self-efficacy theory is still used today to investigate and identify "how individuals feel, motivate and behave" (Bandura, 1994, p. 1). It is a fairly new theory in the educational field and has been used to investigate teachers' self-efficacy beliefs. However, hardly any research has been done on foundation phase teachers' self-efficacy beliefs in South Africa (Jackson, 2008). This indicates the uniqueness and importance of this research as it hopes to contribute to the developing field of educational psychology.

Self-efficacy stems from Bandura's social cognitive theory. Self-efficacy beliefs are defined as "people's judgments of their capabilities to organize and execute courses of action required to attain designated types of performances" (Pajares 1997, p. 39). The self-efficacy theory is one of the most influential theories used in psychology to investigate and identify individuals' feelings and opinions. Thus, self-efficacy theory is the most suitable theory for this research, as it enabled me to identify and analyse the student teachers' self-efficacy beliefs towards teaching mathematics.

5.3 Key Findings

I was drawn to this topic of research because, through my experience of being a PGCE student teacher and as a teaching practical examiner, I noticed many student teachers were not confident in teaching mathematics during their teaching practice. The analysis of the findings confirmed that this was indeed the case for many participants.

In the Likert questionnaire analysis, it was established that the participants are unsure of their confidence towards their mathematics teaching ability. They later clarified in the open-ended questionnaire and focus group interviews that they are not confident in teaching certain mathematical concepts. The findings revealed a pattern, indicating that many of these student teachers find the mathematical concepts, such as time and fractions, to be challenging. A number of factors were identified to be responsible for their lack of confidence in teaching certain mathematical concepts. They blame their university's mathematics courses for the challenging transition into the teaching profession and they doubt their mathematics ability. They also reflected that their schooling experiences caused them to dislike and fear mathematics. All of the above shows that the student teachers have low self-efficacy beliefs towards teaching mathematics, because through experience, they have not gained confidence and in turn have not successfully mastered their teaching experience.

The participants further mentioned that they are unable to teach mathematics effectively. They later stated that they would rather avoid teaching challenging mathematical concepts. These student teachers further asserted that they would rather leave that responsibility to other teachers with more experience in teaching mathematics. The self-reporting factors that gave rise to the avoidance of teaching challenging mathematical concepts are similar in that they doubt their mathematics content knowledge and they believe the university mathematics courses did not enable them to apply theory to practice. They further identified the disruption and confusion as a result of the constant change of lecturers in the university mathematics courses as a significant contributing factor. In addition, they were concerned about negatively influencing the learners' feelings towards mathematics and their content knowledge. Likewise, their avoidance of teaching all mathematical concepts contributes to their low self-efficacy beliefs towards teaching mathematics. They are not mastering the teaching practical experience and avoidance does not improve their confidence in teaching challenging concepts. It is

important to note that through avoidance, participants do not learn coping strategies and skills in times of failure or stress.

The participants showed in the Likert questionnaire that they had good teaching experiences, and they mentioned before and after their teaching practice that, through experience, they gained new teaching skills, strategies and knowledge. In the open-ended questionnaire and focus group interviews, it was revealed that their good teaching experiences only referred to teaching mathematical concepts that they felt confident in. These student teachers reported that the classroom environment negatively impacted their teaching experience as they stressed that they had difficulty in teaching mathematics in isiXhosa. They indicated that they were uncertain of the learner's prior knowledge and they had discipline issues in the classroom. The participants mentioned that they disagreed with their mentor teachers' teaching style, which further impacted their teaching experience. Some of the participants, in their final teaching practice, were also left alone in the classroom with too much responsibility and not enough support. These factors all contributed to their low self-efficacy beliefs towards teaching mathematics. The reason is that disruptive classrooms and negative feelings towards their teaching practice increased their mathematics anxiety, as well as impacted their overall teaching confidence. These findings indicate the importance of the teaching environment and the impact it may have on a student teacher's self-efficacy beliefs.

The participants also revealed that they had good teaching experiences based on the support they received during their previous teaching practice. They openly discussed that they turned to their mentor teachers for support instead of their colleagues. They explained that their mentor teachers provided them with ample support to the extent where they were allowed to observe challenging mathematics lessons instead of teaching them. After their final teaching practice, these student teachers indicated that they hardly received any support from their mentor teachers. The analysis showed that they would still prefer to observe rather than teach the challenging mathematics concepts. These student teachers' responses indicated that they rely on social support, because similarly, they are not confident in their ability to teach mathematics effectively; they are not confident in their mathematics content knowledge and they are uncertain of their ability to assist learners with difficulties. It was made apparent that their reliance on social support and the vicarious support of others contributed to their low self-efficacy beliefs. The reason is that avoidance does not improve a student teachers' confidence

in teaching challenging concepts and too much observation with little practical experience hinders confidence. As mentioned before, they do not learn coping strategies and skills in times of failure.

The Likert questionnaire indicated that the participants do not feel stressed or anxious when asked to teach mathematics. However, they again mentioned that this is only referring to teaching mathematical concepts that they feel confident in. These student teachers explained that their negative feelings towards teaching mathematics increased, when asked to teach it. They made use of words such as *nerve-racking, dreadful, dead, fear, hate* and *scary*, when explaining their feelings towards teaching mathematics. Such negative feelings indicate that they have low self-efficacy beliefs towards teaching mathematics. Similarly, the analysis showed that they have these feelings towards teaching mathematics because they lack content knowledge. They again stated that their schooling experience and their inability to teach mathematics in isiXhosa are also to blame. As previously discussed, the student teachers showed that they have different teaching methods to their mentor teachers and that they are unaware of their learners' prior knowledge, which also caused them to experience negative feelings. In addition, the findings further indicated that their limited mathematics teaching experience and the responsibilities associated with being a teacher, contribute to their negative feelings towards teaching mathematics.

5.3.1 Summary of the key findings

The following Table 5.1 provides a summary of how the findings answered the research question mentioned above in Section 5.1.

Table 5.1: Summary of the key findings

Participants' self-efficacy beliefs	The self-reporting factors that give rise to these self-efficacy beliefs	The reason why they have low self-efficacy beliefs towards teaching mathematics
Lack of confidence in their mathematics teaching ability	• They doubt their mathematics ability. • Their schooling experiences caused them to dislike and fear mathematics. • They blame the university's mathematics courses for the challenging transition into the teaching profession.	• Through experience, they did not gain confidence and did not successfully master their teaching experience.
Avoidance of teaching challenging mathematical concepts	• They doubt their mathematics content knowledge. • They are concerned about negatively influencing learners' feelings towards mathematics and their content knowledge. • They identified the disruption and confusion of the constant change of lecturers in the university mathematic courses as a significant factor. • They believe the university mathematics courses did not enable them to apply theory to practice.	• They avoid teaching challenging mathematical concepts which, in turn, does not improve their confidence in teaching challenging concepts. • They do not learn coping strategies and skills in times of failure or stress. • They are not mastering the practical teaching experience.
Negative teaching environment/ experience	• They were uncertain of the learners' prior knowledge. • They had discipline issues in the classroom. • They disagreed with the mentor teacher's teaching style. • They had difficulty in teaching mathematics in isiXhosa. • They were left alone in the classroom with too much responsibility and not enough support.	• They experience negative feelings towards the teaching practice which causes mathematics anxiety. • They are expected to teach disruptive classrooms which increase mathematics anxiety and impacts teaching confidence.

Reliance on social support and vicarious experience of others	• They do not have confidence in their ability to teach mathematics effectively. • They do not have confidence in their mathematics content knowledge. • They are uncertain about their ability to assist learners with difficulties.	• Avoidance does not improve their confidence in teaching challenging concepts. • They do not learn coping strategies and skills in times of failure. • They are not mastering the practical teaching experience. • Too much observation with little practical experience hinders their confidence.
Negative feelings towards teaching mathematics	• *Nerve-racking,* • *Dreadful,* • *Dead,* • *Fear,* • *Hate,* and • *Scary*	• They fear that their feelings may negatively impact the learners feelings about mathematics. • They have limited mathematics content knowledge. • They have limited mathematics teaching experience. • They are expected to teach in isiXhosa. • They are unaware of their learners' prior knowledge. • They have different teaching styles compared to their mentor teachers. • They have negative background schooling experiences. • Responsibilities associated with being a teacher.

5.4 Insights Emerging from This Research

This research revealed the importance of identifying student teachers' self-efficacy beliefs towards teaching mathematics, before and after their teaching practice. It provided a more detailed understanding of the participants' self-efficacy beliefs towards their mathematics content knowledge and mathematics teaching ability. The teacher training programmes need to consider these student teachers' self-efficacy beliefs towards teaching mathematics before they enter the teaching practice, with the intention of supporting their confidence in teaching. Furthermore, the teacher training programmes need to design mathematics courses that cover both theory and practice of all the mathematical concepts, especially mathematical concepts such as fractions and time. It is also important that student teachers gain experience in teaching

challenging mathematical concepts. The support they receive during the teaching practice, as well as the teaching environment, needs to be monitored carefully in terms of their motivation and confidence.

5.5 Research Limitations

This research provided substantial and rich findings regarding the participants' self-efficacy beliefs towards teaching mathematics. However, using a different theory besides Bandura's self-efficacy theory, may be beneficial in identifying additional information regarding the student teachers' self-efficacy beliefs.

The data collection process took place during the student teachers' mathematics lectures. Thus, the focus group interviews, Likert questionnaire and open-ended questionnaires were conducted under a time limit. Even though the time was sufficient, I do think having an unlimited time frame would have created a more relaxed environment during the data collection process.

I decided to add a third phase of focus group interviews at the end of their teaching practice. This was to ensure the reliability and validity of the participants' responses. Due to the time constraints, I was only able to conduct one focus group interview. It would have been beneficial to this research if I was able to conduct all three focus group interviews after their final teaching practice.

During the final phase of data collection, not many student teachers attended the mathematics lecture, resulting in the focus group interview having fewer participants. I do understand that attendance is not something that the researcher can predict or control. I do believe that it would be beneficial to this research if more participants had been in the final focus group interview. However, the student teachers who participated provided sufficient responses.

5.6 Recommendations for Future Research

The overarching aim of this research was to bring awareness of student teachers' low self-efficacy beliefs towards teaching mathematics to the student teachers, as well as the teacher training programmes. Findings from this particular research have shown that university courses (teacher training programmes) influence student teachers' self-efficacy beliefs towards

teaching mathematics in many ways. The following are some suggestions that teacher training programmes should consider:

I recommend that teacher training programmes should spend more time informing student teachers of mathematics teaching methods and mathematics teaching strategies. This may improve their confidence in teaching mathematics, particularly of those concepts which they find challenging. The student teachers may also find the transition from university courses to the school working environment more manageable. This may in turn, increase their self-efficacy beliefs towards teaching mathematics.

The analysis of the findings obtained in this research revealed that many participants find fractions and time to be challenging mathematical concepts. I suggest that teacher training programmes should focus on providing their student teachers with adequate mathematics content knowledge, specifically those two concepts. The analysis indicated the need for teacher training programmes to investigate their student teachers' self-efficacy beliefs towards teaching mathematics and the factors that influence it. The hope is that it may provide them with insight into which mathematical concepts the student teachers find challenging. Once identified, the teacher training programmes can then focus on improving the student teachers' content knowledge in these challenging areas.

Teacher training programmes should take into consideration the possibility that their student teachers may experience mathematics anxiety. This could assist in preventing mathematics anxiety from influencing their self-efficacy beliefs towards teaching mathematics.

As discussed in Section 1.2, student teachers in South Africa are generally experiencing feelings of demotivation towards teaching mathematics. The findings indicated that student teachers' self-efficacy beliefs towards mathematics should be an ongoing topic of research. In light of this, I highly recommend that future research investigates possible intervention strategies to improve the student teachers' low self-efficacy beliefs.

As discussed above, in order to identify extra information regarding student teachers' self-efficacy beliefs, I suggest future research use a more general approach.

After the participants' final teaching practice, it was identified that teaching experiences do not always improve a student teachers' self-efficacy beliefs. Further studies focusing on third year

student teachers may reveal more information regarding their self-efficacy beliefs throughout the teacher training programme.

I suggest that this research be conducted across multiple universities in order to identify the overall foundation phase student teachers' self-efficacy beliefs towards mathematics in South Africa.

5.7 Final Word

This research has benefited me in more ways than one. I have developed skills in all facets of the research process. This research has made me more aware of the pressing matters surrounding South Africa's mathematics teaching and learning. As an educator, this research process has made me more aware of the importance of being a competent teacher. As a teacher, I will approach mathematics and the teaching of mathematics with a different outlook. The findings have provided me with insight into the learner's vulnerability towards learning mathematics and the impact a teacher's confidence, feelings, thoughts and teaching techniques have on the learner's development of mathematics skills. Self-efficacy theory became an interest of mine while completing my psychology honours degree. It has been a rewarding process for me to be able to combine my two passions – psychology and education. As a future researcher, I would like to further my studies in the psychological educational field and expand on self-efficacy theory.

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APPENDICES

Appendix 1 – Permission letter to the Director of Student Affairs at Rhodes University

The Director of Student Affairs
Rhodes University
P.O Box 94
Grahamstown
6140

REQUEST FOR PERMISSION TO CONDUCT RESEARCH ON STUDENTS AT RHODES UNIVERSITY

To whom it may concern

My name is Chloe Harrison, and I am a Masters student at Rhodes University (RU) in Grahamstown, South Africa. The research I wish to conduct for my Master in Education requires me to collect data from the BEd fourth year students. This research will be conducted under the supervision of Dr. Caroline van der Mescht and Dr. Pamela Vale, of the Rhodes Education Department, who are happy to answer any questions that may arise concerning this research.

All students participating in this research are above the age of 18 years. Ethical clearance for this research has been obtained through the Education Department Higher Degrees Committee and the ethical clearance reference number is 2018.6.04.02. This research will identify students' thoughts and feelings towards teaching mathematics and I undertake to uphold the reputation of Rhodes University throughout the research process.

Upon completion of the study, I undertake to provide you with access to the research findings. If you require any further information, please do not hesitate to contact me on 0723757672 (phone number) and chloeharrison62@gmail.com (email).

Thank you for your time and consideration in this matter.

Yours sincerely,
Chloe Harrison
G12h6550
Rhodes University

Appendix 2 – Permission letter to the Head of the Education Department at Rhodes University

The Head of the Education Department
Rhodes University
P.O Box 94
Grahamstown
6140

REQUEST FOR PERMISSION TO CONDUCT RESEARCH AT RHODES UNIVERSITY EDUCATION DEPARTMENT

To whom it may concern

My name is Chloe Harrison, and I am a Masters student at Rhodes University (RU) in Grahamstown, South Africa. The research I wish to conduct for my Master in Education requires me to collect data from the BEd fourth year students. This research will be conducted under the supervision of Dr. Caroline van der Mescht and Dr. Pamela Vale, of the Rhodes Education Department, who are happy to answer any questions that may arise concerning this research.

All students participating in this research are above the age of 18 years. Ethical clearance for this research has been obtained through the Education Department Higher Degrees Committee and the ethical clearance reference number is 2018.6.04.02. This research will identify students' thoughts and feelings towards teaching mathematics and I undertake to uphold the reputation of Rhodes University throughout the research process.

Upon completion of the study, I undertake to provide you with access to the research findings. If you require any further information, please do not hesitate to contact me on 0723757672 (phone number) and chloeharrison62@gmail.com (email).

Thank you for your time and consideration in this matter.

Yours sincerely,
Chloe Harrison
G12h6550
Rhodes University

Appendix 3 – Permission letter to the Registrar at Rhodes University

The Registrar at Rhodes University
Rhodes University
P.O Box 94
Grahamstown
6140

REQUEST FOR PERMISSION TO CONDUCT RESEARCH ON STUDENTS AT RHODES UNIVERSITY

To whom it may concern

My name is Chloe Harrison, and I am a Masters student at Rhodes University (RU) in Grahamstown, South Africa. The research I wish to conduct for my Master in Education requires me to collect data from the BEd fourth year students. This research will be conducted under the supervision of Dr. Caroline van der Mescht and Dr. Pamela Vale, of the Rhodes Education Department, who are happy to answer any questions that may arise concerning this research.

All students participating in this research are above the age of 18 years. Ethical clearance for this research has been obtained through the Education Department Higher Degrees Committee and the ethical clearance reference number is 2018.6.04.02. This research will identify students' thoughts and feelings towards teaching mathematics and I undertake to uphold the reputation of Rhodes University throughout the research process.

Upon completion of the study, I undertake to provide you with access to the research findings. If you require any further information, please do not hesitate to contact me on 0723757672 (phone number) and chloeharrison62@gmail.com (email).

Thank you for your time and consideration in this matter.

Yours sincerely,
Chloe Harrison
G12h6550
Rhodes University

Appendix 4 – Participants informed consent form for the Likert questionnaire and open-ended questionnaire

Participants informed consent form

Research Project Title:	BEd foundation phase fourth year student teachers' self-efficacy beliefs towards teaching mathematics and the self-reported factors that influence these self-efficacy beliefs.
Researcher:	Chloe Harrison

Participation Information
• I understand the purpose of the research study and my involvement in it • I understand the risks and benefits of participating in this research study • I understand that participation in this research study is done on a voluntary basis • I understand that I may withdraw from the research study at any stage without any penalty • I understand that while information gained during the study may be published, I will remain anonymous and no reference will be made to me by name or student number. Only the name I choose will be used in this study • I understand that personal information may be used • I understand that I will be given the opportunity to read and comment on the transcribed survey and questionnaire notes • I confirm that I am not participating in this study for financial gain • I understand that no information given in the survey or questionnaire will affect my position in this faculty or any future endeavours at Rhodes University
Information Explanation
The above information was explained to me by: (XXX Researcher)
The above information was explained to me in English and I am in command of this language:

Voluntary Consent	
I, hereby voluntarily consent to participate in the above-mentioned research. **I would like to receive results from this study at the following email address:**	
Signature:	***Date:*** / /

Investigator Declaration	
I, _____ declare that I have explained all the participant information to the participant and have truthfully answered all questions asked of me by the participant.	
Signature:	***Date:*** / /

Appendix 5 – Participants informed consent form for the focus group interviews

Participants informed consent form

Research Project Title:	BEd foundation phase fourth year student teachers' self-efficacy beliefs towards teaching mathematics and the self-reported factors that influence these self-efficacy beliefs.
Researcher:	Chloe Harrison

Participation Information
• I understand the purpose of the research study and my involvement in it • I understand the risks and benefits of participating in this research study • I understand that participation in this research study is done on a voluntary basis • I understand that I may withdraw from the research study at any stage without any penalty • I understand that while information gained during the study may be published, I will remain anonymous and no reference will be made to me by name or student number. Only the name I choose will be used in this study • I understand that personal information may be used • I understand that I will be given the opportunity to read and comment on the transcribed survey and questionnaire notes • I confirm that I am not participating in this study for financial gain • I understand that no information given in the survey or questionnaire will affect my position in this faculty or any future endeavours at Rhodes University • I give permission to be recorded during this interview and I understand this recording will remain confidential
Information Explanation
The above information was explained to me by: (XXX Researcher)
The above information was explained to me in English and I am in command of this language:

Voluntary Consent	
I, hereby voluntarily consent to participate in the above-mentioned research.	
Signature:	***Date:*** / /

Investigator Declaration	
I, _____ declare that I have explained all the participant information to the participant and have truthfully answered all questions asked of me by the participant.	
Signature:	***Date:*** / /

Appendix 6 – Likert questionnaire

Student number (Please note this is optional): _____

Name I choose for this study (Optional): _____

Email address for sharing study results in 2019: _____

Instructions:

Please indicate the degree to which you agree or disagree with each statement below by marking the appropriate circle to the right of each statement

1	2	3	4	5
Strongly agree	Agree	Uncertain	Disagree	Strongly Disagree

	1	2	3	4	5
I feel confident in my mathematics ability	◯	◯	◯	◯	◯
When I get asked to teach mathematics I start feeling stressed and anxious	◯	◯	◯	◯	◯
I feel that my mathematics knowledge does not need to be improved	◯	◯	◯	◯	◯
I get nervous when tested on my mathematics knowledge	◯	◯	◯	◯	◯
I enjoy teaching mathematics	◯	◯	◯	◯	◯
I am able to assist learners with mathematical difficulties	◯	◯	◯	◯	◯
I would prefer to be evaluated on a	◯	◯	◯	◯	◯

mathematics lesson by a lecturer					
My mathematics ability does not affect my teaching ability	◯	◯	◯	◯	◯
I have had only good experiences when teaching mathematics	◯	◯	◯	◯	◯
I am not motivated to improve my mathematics skills	◯	◯	◯	◯	◯
If I could choose, I would never become a mathematics teacher	◯	◯	◯	◯	◯
To what extent will you be able to help your learners with mathematical concepts	◯	◯	◯	◯	◯
When a learner does better than usual in mathematics, it is often because the teacher exerted a little extra effort	◯	◯	◯	◯	◯
I will continually find better ways to teach mathematics	◯	◯	◯	◯	◯
Even if I try very hard, I will not teach mathematics as well as I will most subjects	◯	◯	◯	◯	◯
When the mathematics grades of learners improve, it is often due to their teacher having found a	◯	◯	◯	◯	◯

more effective teaching approach					
I know how to teach mathematical concepts effectively	◯	◯	◯	◯	◯
I will generally teach mathematics ineffectively	◯	◯	◯	◯	◯
I understand mathematical concepts well enough to be effective in teaching foundation phase mathematics	◯	◯	◯	◯	◯
Increased effort in mathematics teaching produces little change in learners mathematics achievement	◯	◯	◯	◯	◯
The teacher is generally responsible for the achievement of learners in mathematics	◯	◯	◯	◯	◯
When a low-achieving learner progresses in mathematics, it is usually due to extra attention given by the teacher	◯	◯	◯	◯	◯
I will find it difficult to explain to learners why a particular equation is right	◯	◯	◯	◯	◯
I am unsure if I have the necessary skills to teach mathematics	◯	◯	◯	◯	◯
Given the choice, I will not invite the principle to	◯	◯	◯	◯	◯

evaluate my mathematics teaching					
When I teach mathematics, I will usually welcome learner's questions	◯	◯	◯	◯	◯
When a learner has difficulty understanding a mathematical concept, I will usually be at a loss as to how to help the learner understand it better	◯	◯	◯	◯	◯
I will typically be able to answer learners' mathematics questions	◯	◯	◯	◯	◯
I do not know what to do to make learners like mathematics	◯	◯	◯	◯	◯
The inadequacy of a learner's mathematics background can be overcome by good teaching	◯	◯	◯	◯	◯

Appendix 7 – Open-ended questionnaire

Student number (please note this is optional): _____

Name I choose for this study (optional):_____

Email address for sharing study results in 2019: _____

Question 1

How have your experiences been when teaching mathematics and how did they make you feel about your teaching mathematics ability? Please provide an example of any experience or an explanation for your answer.

Question 2

Do you think your fellow students experiences in mathematic courses or teaching mathematics during their TP affect the way you feel about teaching it? Please provide an example or an explanation to justify your answer.

Question 3

Do comments (positive/negative) from fellow students/ mentor teachers/ families / lectures about mathematics or teaching mathematics affect the way you feel about teaching mathematics? Please provide an example of such an experience or an explanation for your answer.

Question 4

Do you think your emotions about mathematics affect the way you feel about teaching it? Please explain why and provide an example if possible to justify your answer.

Appendix 8 – Focus group Interview

Question 1

How would you describe your feelings towards mathematics when you were teaching it during your teaching practical?

Question 2

Do you feel confident that you can teach any mathematical concept to a foundation phase class?

Question 3

What has your experience been like teaching mathematics during your TP and explain?

Question 4

What support did you receive from colleagues, lecturers and mentor teachers with regard to teaching mathematics? Did this influence how you felt about teaching mathematics?

Question 5

Given the fact that teaching is your chosen career, if you could choose any other career would it still be teaching or would you chose to do something else and why?

Appendix 9 – Final Focus Group Interview

Question 1

How would you describe your feelings towards mathematics when you were teaching it during your final teaching practical?

Question 2

After your final teaching practice, do you feel confident that you can teach any mathematical concept to a foundation phase class?

Question 3

What has your experience been like teaching mathematics during your final TP and explain?

Question 4

What support did you receive from colleagues, lecturers and mentor teachers with regard to teaching mathematics during your final teaching practice? Did this influence how you felt about teaching mathematics?